THE

ENGLISH MECHANIC

ENGLISH MECHANIC

AND

WORLD OF SCIENCE.

WITH WHICH ARE INCORPORATED

"THE MECHANIC," "SCIENTIFIC OPINION," AND "THE BRITISH & FOREIGN MECHANIC."

ILLUSTRATED WITH NUMEROUS PRACTICAL ENGRAVINGS.

VOLUME LXX.

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ILLUSTRATIONS.

THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

MOTOR CYCLES.—XIII.

FIG. 80 shows a vertical section of the bottom bracket, with the spindle, chain-wheel, and the roller-clutch. Referring to the figure, A is the bracket-shell, B the barrel and eccentrics, C the spindle, D D the bearing cups, E the lock-nut which locks the left-hand cup after adjustment, F is the chain-wheel, G G two of the clutch rollers, H H is the clutch-disc screwed to the crank-boss, K K the steel clutch-ring fastened to the chain-wheel, L L is a brass cover for the clutch mechanism, fastened to the chain-wheel by eight small set-screws. The bottom bracket-shell (Fig. 81), as well as the eccentric barrel (Fig. 82), is to be cast in malleable iron, and both patterns and core-boxes will be needed for each. The two lugs, marked A A in Fig. 81, are for clamping screws to hold the eccentric barrel in position by slightly closing the ends of the shell casting. These lugs must be left loose on the pattern, being secured by a wire skewer which the moulder can withdraw. Allowance must be made for machining the barrel on the inside, and for truing-up the ends, and for boring the lugs out to fit the tubes. When making the pattern for the eccentric (Fig. 82), allow for boring right through the barrel and turning the outside faces and edges of the eccentrics. When the castings have been obtained, take the bracket-shell in hand first; grip it in a jaw-chuck, and bore out inside to 2⅝in. diameter, facing the end off at the same setting. The casting will have to be rechucked to face the opposite end. To bore out the sockets for the tubes, the casting can either be bolted to the saddle of the lathe, being packed up to get the sockets concentric with the lathe centres, and then bored with a rose bit held in a chuck; or the casting may be bolted on an angle-bracket on the face-plate, and be bored out with a boring-tool held in the tool-post of slide-rest. The angles must be as shown in Fig. 81: otherwise the frame will not come together correctly. Drill and tap the two lugs, and fit a ¼in. set-screw with a collar and square head. Next put a saw-cut through each lug, making each cut about ⅝in. long. This is to allow the set-screws to pinch the barrel on to the eccentric. To machine the eccentric, Fig. 82, will require care. Commence by boring through the barrel, making the bore the correct diameter for screwing to take the cups. The cups can be bought for 1s. 6d. per pair finished, and, with a pair of thread calipers, the diameter at the bottom of the thread easily obtained, and the eccentric bored accordingly. The bore is next chambered out to 1¾in. diameter, as shown. During these operations the casting is gripped in a jaw-chuck. A mandrel is now to be prepared with *two* centres at each end. One pair of centres must be ⁵⁄₁₆in. out of centre, which is the amount of eccentricity to be given to gripped in a jaw-chuck, centring it by the bore, and the inside at one end screwed to suit the cup. At the same setting turn and screw the projecting rim. This rim is screwed

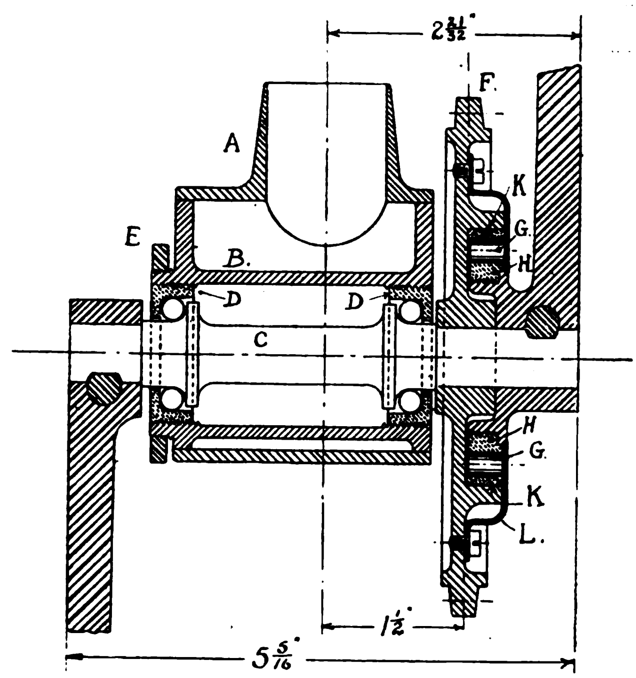


FIG. 80.

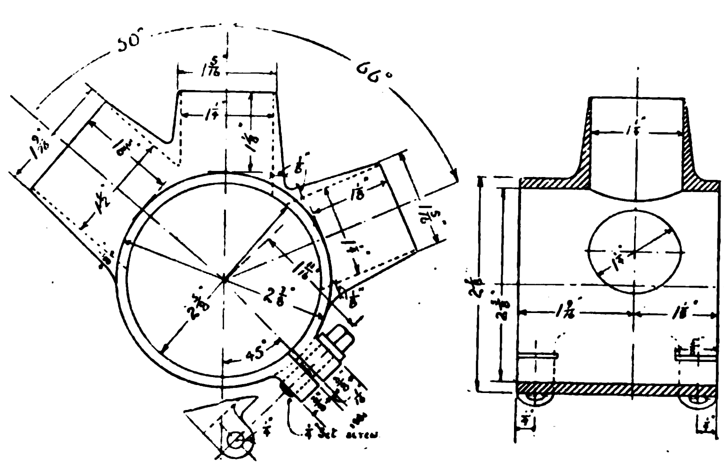


FIG. 81.

the bracket. The casting is to be driven on to this mandrel, and the edges of the eccentrics turned to 2⅜in. diameter, after which the mandrel is removed and the casting again taper, and has four saw-cuts, so that when the lock-nut, also with a taper thread, is screwed up it will grip the cup firmly. A short piece of iron is now gripped in a

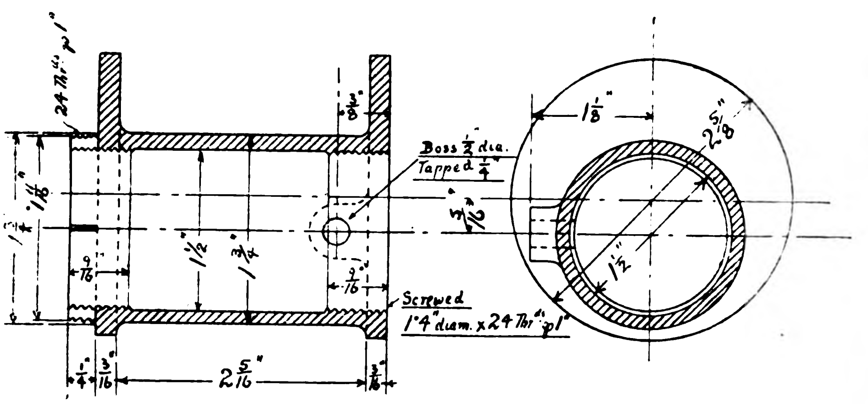


FIG. 82.

chuck and turned and screwed the same as the cups. On to this the casting is screwed by the thread cut in one end of the bore, and the opposite end then threaded. The cup at this end is prevented from slacking by a ¼in. set-screw being fitted into the boss shown behind the eccentric, a small piece of brass being interposed between the end of the screw and the cup to prevent the thread on the latter from being damaged.

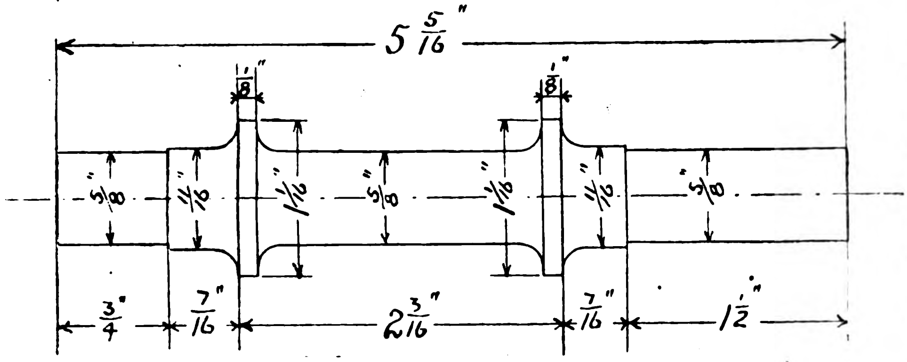


FIG. 83.

Fig. 83 is the bottom-bracket spindle. Much diversity of opinion exists as to the relative merits of cast or mild steel for this purpose. Personally, I prefer good cast steel with the ball-races hardened, the rest of the spindle being left soft. It should be turned nearly to size, and then annealed and left to cool in the ashes or buried in lime. This will minimise the risk of warping when hardening the ball-races. I recommend a gas blowpipe for heating the races, as besides being cleaner in use it is easier to localise the heat. The cranks are fitted to the spindle in the usual manner with cotter-pins, and it requires considerable care to insure the cranks being truly opposite each other. The flats on the ends of the spindle for the cotter-pins should be quite flat: if at all rounding the flats on the cotters will not bear properly, and consequently the cranks will be loose. The bottom bracket lock-nut (Fig. 84) is made of steel, and should be slightly hardened. Make it a good fit on the taper-thread on eccentric. The slots around the edge are to receive a key, formed as a fork with two projecting pins, for tightening. It will be noticed that the crank on the right hand (or chain-wheel side) of bracket has a boss to receive the clutch-disc. This is seen in detail in Fig. 85. A rough stamping of a crank should be procured, and after drilling the ⅝in. hole for the spindle, drive it on a mandrel, and turn to the dimensions given in Fig. 85. The cross-hole for cotter-pin is ⅜in. diameter, and a

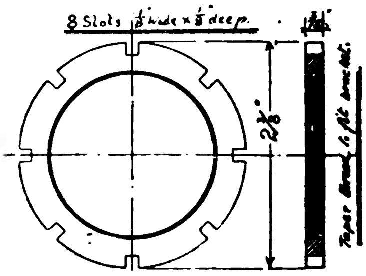


FIG. 84.

piece of ⅝in. wrought iron is to be pushed into the hole in crank-boss while drilling the cotter-hole. In all other respects this crank will be the same as its fellow, which should be bought finished.

For the chain-wheel (Fig. 86) we shall require a pattern, which must be carefully made, due allowances being made for machining the boss on both sides, turning the clutch recess, and cutting the teeth. The hole in centre and the clutch recess are lined with hardened steel, to prevent wear. The wheel, being made of malleable cast iron, would be too soft to withstand the pressure of the clutch-rollers. The steel clutch-ring is held in place by three or four small set-screws put through the malleable iron, and tapped into the steel. The inside diameter of this clutch-ring is to be exactly 2⅛in., and turned quite smooth, and must be concentric with the ⅝in. hole in chain-wheel boss. The chain-wheel teeth had better be

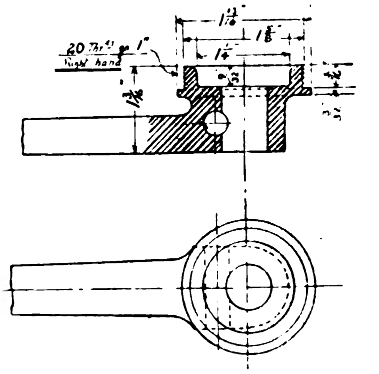


FIG. 85.

machine-cut. Any one of the chain-making firms—such as Hans Renold, Manchester—will undertake this work.

There are to be 16 teeth for a 1in. pitch block chain, ⁵⁄₁₆in. wide between side plates. It will be noticed in the section of chain wheel that the centre line of the teeth coincides with one face of the web of the wheel. The eight holes tapped ⅛in. are for the screws, with which the cover of the clutch gear is held in place. The clutch-disc, Fig. 87, is made of steel, and must be hardened and tempered a medium straw colour. There are one or two points requiring attention. The inclined faces on which the rollers cam when in use are

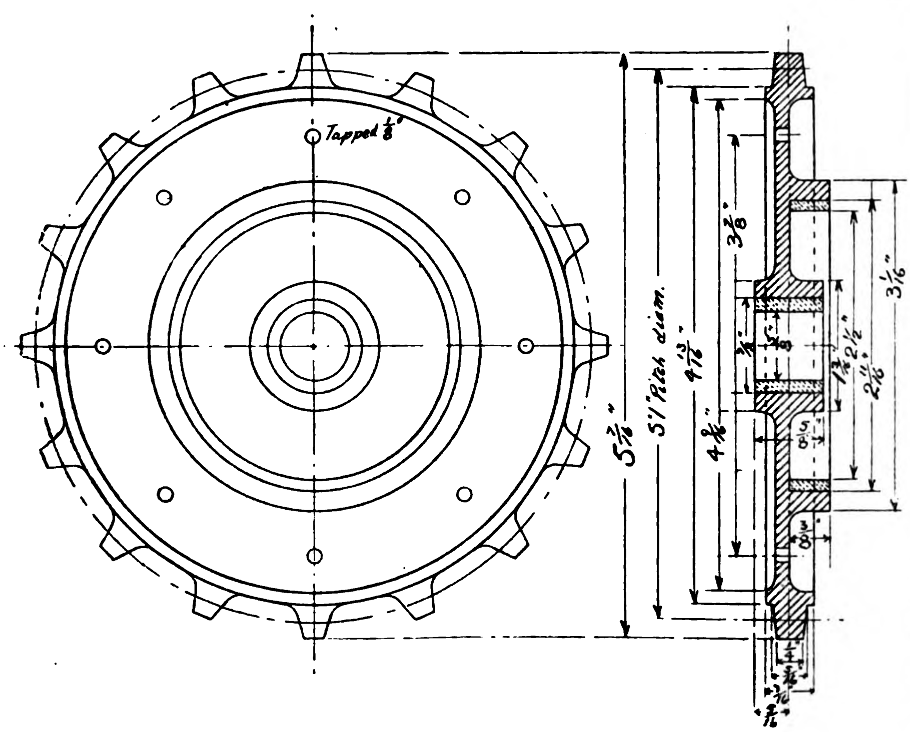


FIG. 86.

struck with a radius of $1^1/_{16}$in. from a centre which is $\frac{1}{8}$in. eccentric to the bore, and the recess is on the side facing you in Fig. 87. The exact shape of the teeth is of small moment, as they only serve to retain the rollers in place and do no work. One of the rollers is shown dotted in position. The disc is bored and screwed to fit the thread on the crank-boss, and the recess fits over the projecting collar on the same. (See Fig. 80.) The rollers are of hardened steel, $\frac{1}{4}$in. diameter by $\frac{3}{8}$in. long. Eight of them will be required, all of the same diameter. If the clutch-disc is not accurately made, and the rollers all the same diameter, there will

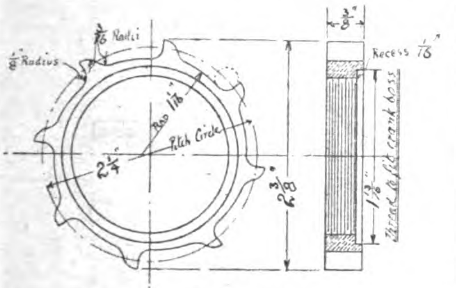


FIG. 87.

be a danger of one roller doing all the work, and probably giving way under the strain. The clutch-gear cover is seen in position in Fig. 80, being shown as a thick black line. It should be spun up out of sheet brass, No. 18 or 20 B.W.G. and nickel-plated. It is fastened to place with eight iron set-screws $\frac{1}{8}$in diameter.

ORNAMENTAL TURNING.—XXV.

By J. H. EVANS.

THE dome or spherical chuck will now claim our attention as the next in importance as belonging to this section of the ornamental turning apparatus. The value of such an addition to the lathe will be fully appreciated when it is explained that it, to some extent, aids in the production of curves and their decoration—similar to those emanating from the more costly and complex instrument (the spherical slide-rest), which will be fully treated in due course.

A short outline of its capabilities will be useful before detailing its manufacture, as it will lead up to the various points that require careful consideration.

Domes and kindred curves are obtained on solid forms by the partial rotation of the chuck when placed upon the mandrel nose. When the chuck is thus employed, in conjunction with the slide-rest only, it will be seen that we have two right-line movements. By the adjustment of the slide of the chuck by its main screw, the work is raised or depressed to or from the axis of the mandrel, in order that the desired curve may be brought to the necessary position to agree with curves to be cut. The second right-line movement is formed in the slide-rest, which places the tool or cutter also in position, with regard to the distance to or from the axis of the mandrel horizontally.

The variety of curved formations is largely increased by the interposition of the eccentric, ellipse, or rectilinear chucks—either singly or in conjunction one with the other, the semi-rotation being arrested by aid of the segment stops under the guidance of the worm-wheel and tangent screw.

We will now proceed to study the manufacture of the chuck itself, which will be found anything but a difficult undertaking. The following details of its construction will, I hope, greatly reduce what few difficulties might otherwise stand in the way of a satisfactory result in the end. By reference to Fig. 7, we see the dome chuck in its position on the lathe head, and the illustration shows the chuck in its latest and most approved form, having, as will be seen, a second worm-wheel and tangent screw at the base of the right-angle arm This improvement has many advantages, which will receive full explanation as we proceed. The chuck, then, in its primary form is composed of a strong, oblong, metal body, with a projecting boss at one end (Fig. 1). The latter is screwed to fit the mandrel-nose, and when doing this, the best way is to surface the front faces, then place it on a true surface chuck and bolt it thereto. When adjusted to the correct position—viz., the centre of the boss—the front of the boss must be turned off so that when it is screwed well home

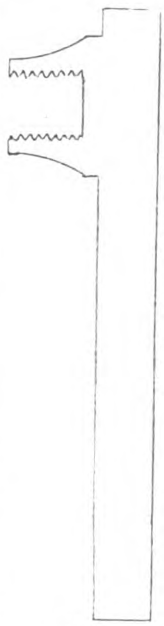


FIG. 1.

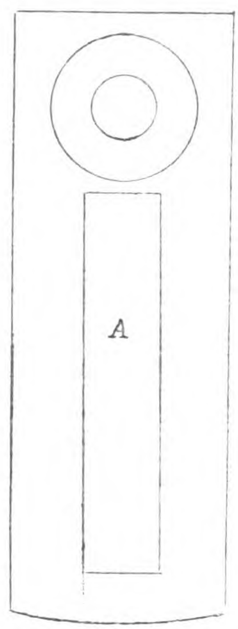


FIG. 2.

to the face of the mandrel, and the index in one of the zeros, the body will assume the vertical position. It must be then carefully turned on the front face. This done, we have the foundation from which to work, in order that all may be retained square, one part to the other.

The sides must now be filed up perfectly parallel, and from these the oblong mortise, A, Fig. 2, is got out perfectly true, and, of course, square in every way. It is necessary that great care is bestowed on this interval, as it is on this that the tenon of the right-angle arm has to work, and if unduly free in any part of the fitting it is likely to cause vibration during the progress of any cutting that may be of a severe character.

Before giving the details of the compound of material importance, but about the size mentioned is suitable in proportion.

With the right angle arm thus fitted, we have, so to speak, the foundation of the whole chuck substantially finished. I may mention that when tapping the thread in the arm we always use a steel tap, the plane part of which fits the hole in the body of the chuck, thus insuring both being in the parallel line, as the fitting guides the cutting part of the tap in the true course. On the top of body a metal end-plate is fitted by two steel screws, and countersunk out to receive the

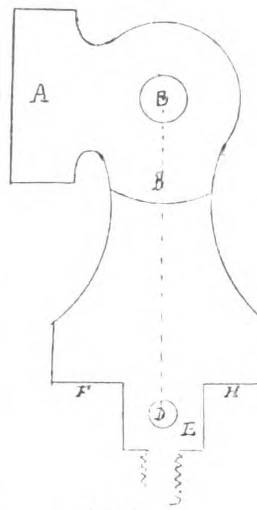


FIG. 3.

FIG. 4.

collar on the screw A, Fig. 5, the end of the screw passing through to receive the milled head by which it is actuated. When the collar is fitted to the recess, a very small portion of the face of the end-plate should be removed, so that the same may be adjusted to prevent any end-play or loss of time in the screw when in action. This is an important feature in this, as in all other chucks containing a similar movement.

The next proceeding will be to first obtain the precise centre and position of the filling to be turned in the upper part of the right-angle arm, Fig. 3, to receive the worm-wheel very. A great deal, I may say, depends upon this one feature: therefore, I must impress upon my readers not only the necessity for care in laying-out the centre, but the caution required to maintain these points when once certified. In the first instance, the centre must be in a direct line with the centre of the main screw, which passes through the tool

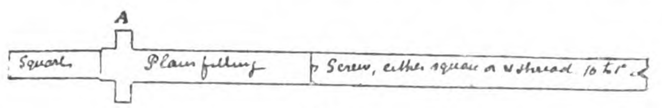


FIG. 5.

chuck—that is, the one illustrated—it will be well to just give the outline of the right-angle arm in its plan form. This is seen in Fig. 3, and thus shaped, it is fitted at E to slide in the parallel mortise A, Fig. 2. Great care must be exercised to keep the two faces F, H, Fig. 3, perfectly in agreement, so that when the nut is tightened on the screw the arm will draw up square and rigid.

We must now see that the body of the chuck and the arms are correctly bored for the reception of the screw. A $\frac{3}{8}$in. hole is accurately bored through the top part of the body, the truth retained by the opposite centre being marked on the other extremity. It is not necessary to bore a hole in this end at all, as the tendency to vibration in the screw is avoided by the arm moving along it; also the depth of the plain part being longer than is usual, it is sufficient to obviate any irregularities. The diameter of the hole bored in the body will be, of course, just in excess in diameter of that exterior of the screw; the arm is now secured in its fitting, and tightened there by its nut, a cylinder drill, fitting the long hole in body, is then used, being reduced at the cutting part which passes through the arm at D, Fig. 3, to suit the size of the tap which is to produce the thread in the same, which must be of corresponding value to all screws for similar purposes—viz., 10 threads to the inch. The diameter is not D, Fig. 3; the dotted line shows the manner in which this should be set out. It is not well to rely upon simply drilling this out: the correct way is to place the arm on a true surface chuck, and accurately centre it thereon, then either solder or bolt it securely to the chuck. The front of the arm is then turned out at the same time to fit the periphery of the worm-wheel. Fig. 4, a side view of the arm, shows how it is turned at this part. When finished on both sides, the arm should be about $\frac{3}{4}$in. wide, and the depth of the recess E, Fig. 4, $\frac{5}{16}$in., which is the width of the wheel; this will leave a filling of $\frac{5}{16}$in. in depth, sufficient to form a guide to retain the accuracy. The wheel is then fitted to move between the two faces by a screw having a large head and loose steel washer under it.

We now come to the worm-wheel, which must be made from a casting, as shown by Fig. 6, and when finished it has 96 teeth cut in the periphery. This casting is first well hardened by repeated blows from a hammer, the scale and sand being first entirely removed. It is then held by the front part A, Fig. 6, in a jaw chuck, while the other parts are reduced to truth and the sizes required. The exact size of the pin for the centre fitting is not material; but, of course, it must be made to accurately fit the hole B, Fig. 3. The necessary diameter of the wheel will be $2\frac{1}{4}$in., to

contain 96 teeth, and at this part it must fit the recess turned in the arm to accommodate it.

With this part fitted, the end of the pin B, Fig. 6, on wheel must be filed to a square, and a steel washer fitted to it, the external diameter of which should not be less than 1¼in., in order that the facial bearing at this part may correspond somewhat with that on the face of the wheel. When it bears on the opposite side of the arm, the screw-head, which holds the wheel in its place, must also have a correspondingly large head (these are both fully illustrated by Figs. 7 and 8 in the engraving of the chuck) in its place.

Our next proceeding will be the tangent screw and frame. Referring to Fig. 3 it will be seen that a projection is left on the arm at A. This is to admit of an improvement that I introduced in the action of this part. As originally made, the frame which holds the tangent screw was fixed in the position that held the screw tangential to the wheel, regardless of any desire to move it from this point. This I found in practice most inconvenient. As an instance of the advantages derived from its being fitted as described and illustrated, we will suppose that it is desired to cut a square base. This being the case, it is necessary to divide the wheel into four equal portions. Therefore, when the primary facet has been cut with the wheel fixed at 96, it will

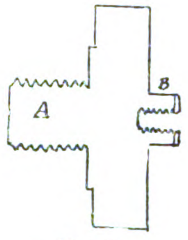


Fig. 6.

require to be moved through 24 divisions for each consecutive side—viz., 24, 48, and 72. In the absence of the power to throw the screw out of gear, it necessitates 24 revolutions of the screw for each adjustment.

It was this inconvenience that led me to make it as now shown, and all that is required to be done is to release the screw. Move the wheel round to the required point and again fix the screw in gear. Surely this must be appreciated, as the continual rotation of the winch handle for the like result can but be deemed a monotonous proceeding.

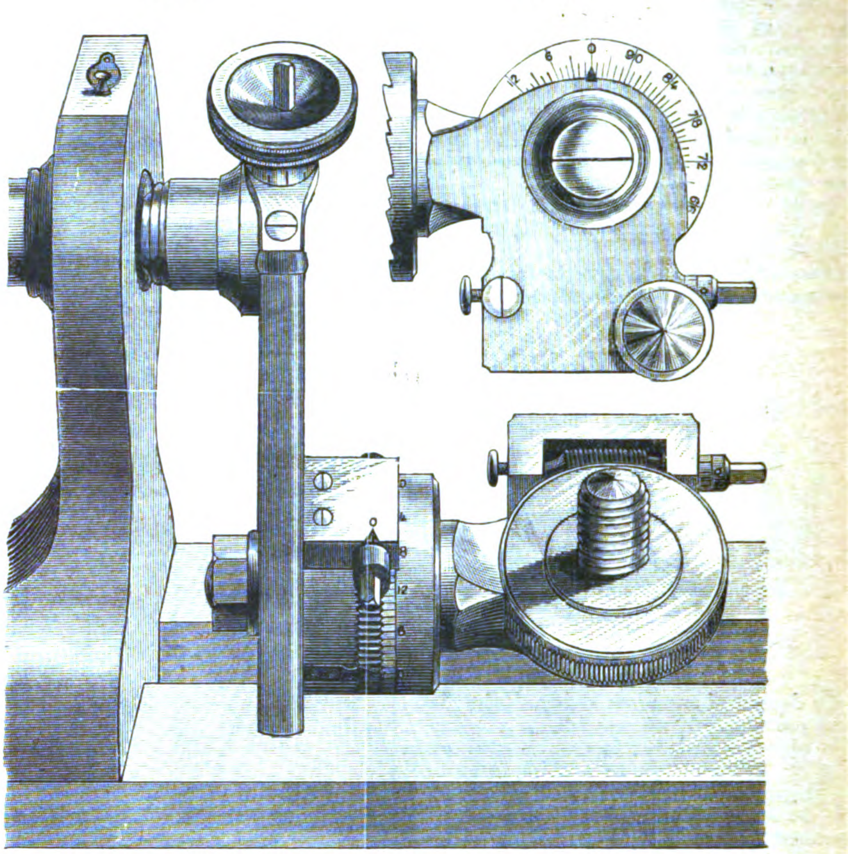
Thus, then, we have an improvement which, beyond any idea that I may have of its advantages, has been fully certified by very many of our scientific amateurs, who have adopted it to a very large extent. It will, however, be perhaps more distinctly visible as the various uses and specimens of work executed by it are approached.

We have now before us the details of what I will call the plain, or simple dome, chuck. Another improvement has been made in the shape of a second worm-wheel at the base of the right-angle arm. This is clearly illustrated by Fig. 7 and Fig. 8. The latter will also give a clear and distinct idea of the manner in which it is added. This worm-wheel forms a very important improvement to the chuck, as it enables the work to be moved to an oblique position, by which various compound shapes are formed, that cannot be obtained by any other means. It is the introduction of such novelties that renders the different instruments of a vastly more interesting character.

When making the dome-chuck on this, the latest improved plan, a circular disc with a tenon attached to it, is first fitted to the elongated slot or mortise, the lower end projecting beyond the body of the chuck in the same manner as the plain right-angle arm; at the base of the remaining portion forming the arm is another worm-wheel of 96 teeth. This is made to attach to the lower disc by a screw countersunk into the wheel, and fixing into the disc. The worm-wheel is actuated by a tangent screw, working in a metal frame, fixed also to the lower disc by two screws; on the top of the wheel the arm is attached, having a circular disc at the base by which it is fixed to the worm-wheel.

This would appear at first rather a complicated arrangement, but in reality it is perfectly simple, and is the only way the action can be obtained. The upper part is fitted up in precisely the same way as described for the plain arm, and by

Fig. 7. Fig. 8.



reference to the engraving, Figs. 7 and 8, it will become perfectly clear to all interested in it, and I should strongly recommend, when undertaking to make the chuck, to let it be in its most complete form.

A milled head is fitted to the square on the upper end of the screw. This is for the purpose of adjusting the arm to the necessary position to suit the curve or dome to be decorated. The front of this is divided into ten equal parts, and figured at every other line, 0, 2, 4, 6, and 8. This division, it may be mentioned, is seldom of much real use in adjusting hemispherical objects, the work being generally reduced approximately to form while revolving on the mandrel nose, and when transferred to the dome-chuck, it is adjusted to suit the sphere without reference to any particular starting-point or division of the micrometer in the screw. With the above remarks, I conclude what will, I think, contain every instruction for the manufacture of the dome or spherical chuck, and the continuation of the subject will have reference to the manipulation of it, accompanied by illustrations of the work effected by it.

SHORT-DISTANCE ELECTRIC POWER DISTRIBUTION.*

Long-distance transmission, especially in connection with water-power and high pressures, has attracted the attention of the electrical engineer so strongly that he has not given as much thought to the apparently smaller and less important matter of local distribution of power as the subject perhaps deserves. This is to some extent because the equipment of workshops makes little noise. In such cases electric driving is generally carried out quietly by the engineers who have charge of the works, and the consulting engineer is not called in, and there is no institution paper read anywhere, and nothing exciting happens—the machinery is merely put in and set to work. This is a great drawback; not because institution papers are specially good things, or because consulting engineers ought specially to be encouraged, though, personally, of course, I think they ought, but because it allows the subject to fall into the background in a way which is not warranted by its importance. The result is that most workshop engineers—I very nearly said millwrights, forgetting that the race is extinct now—know nothing about electrical motors, and never think of them in designing a shop. It is not that electric driving is not good enough; it is that it is never considered at all in many cases.

The most obvious places for electric-motors are those in which there is a difficulty with any other method of transmission. Mining, especially coal-mining, occurs at once as a good example. Higher efficiency, cheapness, safety, and practicability of the electric-motor put it in the front rank at once.

The next case is where scattered steam-engines are employed. Take the case of the average chemical works, for instance, or iron yard. You find a pipe supported on infrequent poles, giving a sort of cross-country excursion, every day. You know it is meant to be a steam-pipe because there is warm water leaking from all the joints, and that it is not lagged because it was considered that enough internal warmth would get along the inside to prevent freezing. If you trace this pipe out, you will find it goes to a punching-bear or shears, which are rattled around by a steam and warm water engine, which leaks too much for the water to blow its cylinder-ends off. The amount of money wasted in this way is something terrible.

In connection with docks, yards, wharves, and so on, where there are many cranes, hydraulic power distribution is generally employed. Hydraulic distribution has a great advantage when the work to to be done consists of moving something a short distance against a great force, as in the case of pressing, riveting, and pressing and drawing; but in the case of lifting, the electrical system is generally more convenient. The majority of cranes in Great Britain are probably worked by local steam-engines of the worst and most inefficient kind. Of course, where there are no facilities for anything like a central generating station, the electrical system is infinitely better than this; but compared with hydraulics the advantages are not so marked. One great drawback of the hydraulic system is the inefficiency. The ram has always enough pressure behind it to do the maximum work it will ever be called upon to do, and it uses a corresponding amount of energy every stroke, whether it really has any work to do or not. This extra energy goes into the water, and the inefficiency of the hydraulic system is easily gathered from the temperature of its water. As already remarked, the hydraulic system is best for slow thrusts; but when the mechanism involves gearing-up, the electric-motor naturally comes in, even if it has to gear down. It is more efficient to gear down than up. A hydraulic capstan, for instance, is a monstrosity.

So far we have dealt with cases in which neglect of electrical transmission is a crime. We will now pass to a larger class, in which it is merely a prevalent vice. The electrical system may be compared with its competitors in order.

The motor may replace the local steam-engine and boiler. That means generating on a larger, and therefore more economical, scale, with smaller coal

* By James Swinburne, extracted from the *Engineering Magazine*.

and oil bills, and less labour. If the local engines to be replaced have varying loads, great economy may result, because the larger engine, by averaging the load, may work at an economical load always, and its maximum power may be very much less than the aggregate power of the smaller engines. The motor has a very much higher efficiency under varying loads than the engine, so there is a fair source of economy. Unless the local engines are very large, motors can replace them with great advantage in nearly all cases. As a special instance, we may take the average ironworks. Here there are large engines, generally with local boilers dotted about, each engine working one rolling-mill. In the case of an ordinary engineering works, each shop has generally its own engine and boiler, involving access for coal, special labour, and low economy. Going back to the iron or steel works, there is general need for some local generating plant, such as the blowing-engines, which work on steady, and therefore economical, load; and there is no reason why a power-house should not be arranged at that spot for the supply of the whole system.

The next arrangement is the common vice of having a boiler which supplies one engine close to it, and feeds a distribution system of steam-piping, generally very badly lagged, which supplies small engines dotted about for running saws, cranes, or large machine tools. In such cases the motor saves an enormous waste in the steam-pipes, and attention is very much more economical as regards power.

The gas-engine is a lively competitor of the motor when the power is supplied by a central station. If gas costs, say, two shillings per thousand cubic feet, and electric energy fourpence, the cost of electrical energy comes out about six times that of gas. The difference is so great that in many cases the gas-engine is better than the electric-motor, though it has a varying load, and takes nearly the full amount of gas always, and though it needs more attention and costs more to begin with. The real reason is that the price paid for electrical energy from the central station is enormously high, on account of the capital sunk in mains, motors, and expensive sites, and on account of the expense of running and collection. In cases where the power is supplied by the consumer himself, it comes out so much cheaper that gas power cannot compete with it at all.

The great development of the electrical motor will be in taking the place of the ordinary belt and shafting transmission in all kinds of factories. In such cases, for instance, as flour-milling, where the machines run at constant speed, and approximately constant load, the opening for electric transmission is perhaps smallest; but even in that case it will probably pay. This example is taken as perhaps the worst of its kind for electrical transmission, and even here the motor has some great advantages which may make it worth while to put in electric transmission in case of new mills, even if it does not pay to change existing plant. In the first place, all the shafting and belting is taken away, and lighter buildings are necessary. Smooth working and silent running is obtained, and the efficiency is certainly increased, that is to say, smaller engine-power is needed.

In the case of cotton-spinning the same reasoning applies. The electric-motor has here a very special advantage. A properly-designed shunt machine runs at constant speed, not only with varying load, but also under varying pressure, so that the machinery can run at constant speed, even though the driving-engine varies considerably.

The driving of machine tools by motors has perhaps received more attention than all the other applications of small motors put together. As a rule, engineers arrange their own shops in a way which they would be ashamed to adopt in filling an order. There is no doubt that all tools can be best driven by motors, the only question that is open is, whether each tool should have its own motor, or whether several small tools, such as lathes, should have a shaft and one motor for the lot. The only other question of difficulty is to choose between direct current and the polyphase system. The absence of all noise from a shop is in itself by no means a particularly sentimental consideration; the disappearance of all overhead shafting has thus an advantage apart from the fitness for overhead cranes, and even small overhead runners. The small motor is, however, much less efficient than frequently supposed. There is a common idea that all dynamos and motors run up to high efficiencies, say 95 per cent. or so; but small motors are much more likely to be of the order of 59 per cent. The initial expense of small motors is their chief attribute, however, and in addition to this, machine tools are not designed for motors to begin with, but the maker sticks it on where he can, under protest, and treats it as an architect does a church organ, as an unavoidable evil, which has to be tolerated, but must not be considered. A great part of the cost of the small motor is the framework and bearings, and if the machine tool were properly designed, and the motor made by the tool-maker, this cost would be saved, for the motor and frame would take the place of the bearings and framework of other motion or reduction gear employed in connection with belt driving. At present the motor is bought as a complete mechanism from some electrical works.

Next as to varying speeds. As automatic tools come into more general use, the need for wide variations of speed become unnecessary. But in most cases variations of speed are required, and the old pulleys are kept in the machine. Probably the simplest method of getting various speeds in direct-current systems is by having several mains. Thus, a four-wire system, having 30, 60, and 120 volts, gives speed ratios of 1, 2, 3, 4, 6, and 7, which is much more than most speed pulleys. The field-magnets are always fully excited by the 210 volts across the outers, and the armature takes the various pressures. This system gives good economy, and is simple, and it costs little extra to run four wires instead of two. The question of speed is not so easily dealt with in the case of polyphase machines, as it is necessary there to have several sets of mains with different frequencies as well as different pressures, or to have more or less complicated methods of coupling the inducing element.

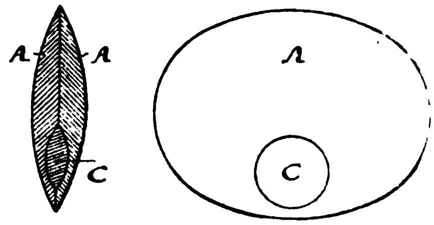
One of the greatest, and perhaps the least recognised, advantages of electrical driving without shafting is that as each machine is self-contained, the ordinary foundations can be left out. A lathe or any other tool, if decently designed, does not depend on the foundations for rigidity; the only thing the foundations do is to take up the shake communicated from outside by the belts. A self-contained machine runs better the less it is fastened down, or, to take Mr. Beaumont's motto, "If the mechanism wants to wobble, let it wobble." The stresses on all the parts, for instance, of a badly-balanced mechanism are less if the framework is not fixed to any foundations. The saving of foundations and belting as well as shafting should be credited to the motor, and the saving in wear and tear of the belting, as well as in mere coal and oil, should also be credited to the motor's running account.

In all sorts of portable tools, such as drilling, riveting, power chipping, power caulking, countersinking, and tapping, the motor is far away ahead of compressed air, steam, rotating spirals, or any other systems; and there is no reason why portable riveters and punches should not be driven electrically too.

On board ship there is a large opportunity for the introduction of electric control of steering-gear, capstans, winches, pumps, and all sorts of discharging gear. In men-of-war electricity is also applicable for working the guns, turrets, loading-gear, and similar mechanism. One obvious advantage is that the transmission system—namely, the mains, can be very easily arranged in duplicate, so that a shot is not so likely to cause disablement.

THE BIFOCAL LENS FOR EYEGLASSES.

THE bifocal lens for eyeglasses and spectacles is said to have been originated by Benjamin Franklin. For persons whose vision is of such a character that a lens that enables them to see distant objects does not enable them to see print or objects at close range, a bifocal lens is a decided convenience over the old practice of wearing two pair of spectacles, as one sees portrayed in the portraits of Patrick Henry, one pair resting on his



nose and the other pushed high upon his forehead. Those who need one lens for near vision and another for far vision will be pleased with the recent invention of Mr. Borsch.

Hitherto the bifocal lens has been made of two pieces of glass of different curvatures cemented together or confined within a frame. The line of junction of the two lenses is annoying to the sight; dirt collects in it, and it is an obstruction to the convenient wiping of the glass. The figure shows the new bifocal lens, which is said to have attracted the attention of the Franklin Society. It consists of a minor short-focus lens C C for viewing near objects, inclosed wholly within the interior of a longer focus, or less powerful lens, A, for viewing objects at a distance. The difference in magnifying power of the two lenses is obtained wholly by the difference in refractive index of the different kinds of glass of which they are made. A bifocal lens made as described is an extremely neat article, and inspection hardly discloses any difference in appearance from a simple lens.—*Popular Science*, N.Y.

THE MOST PERFECT STEAM-ENGINE.

IN the course of an article on a Forgotten Steam-Engine, the *Engineer* says:—There is, however, one invention of James Watt which has never been exploited—a fact the more remarkable in that it has given us a steam-engine which works under the most perfect thermodynamic conditions under which it is possible to employ steam to produce motive power. The fact that Watt invented the engine and patented it appears to have been quite forgotten; and although one or two inventors have patented modifications of it since, they seem to have done so in blissful ignorance of Watt's work; and the inventions have not been pushed to commercial success, so far, at least, as we know.

Those who have studied James Watt's life and works know that he left very little to be learned as to the principles on which a steam-engine should be made. In his day the science of thermodynamics did not exist as we understand it. But for all practical purposes it may, for the steam-engine, be summed up in a sentence—"Keep the cylinder hot." All the science in the world cannot tell us more than that. Watt perfectly understood, moreover, what was to be had from expansion. It is difficult, indeed, to mention any factor likely to promote the economy of the steam-engine whose existence Watt did not recognise, and whose value he did not appraise. He invented and patented the steam jacket, and he did more than this. A defect of the jacket is that while the surface to be kept hot is of almost infinitesimal thickness, the heat derived from the steam in the jacket has to pass through the metal of the cylinder liner, and the result is that the incoming and expanding steam as a rule comes in contact with metal colder than itself, and so condensation takes place. To prevent this it is necessary that the steam in the jacket should be at temperature considerably higher than that of the steam in the cylinder, a condition which can only be secured by superheating the jacket steam, or using steam of a much greater pressure than that in the cylinder. It is not, we think, necessary to pursue this subject in detail. There is a tolerably extensive literature of it in existence. The ebb and flow of heat in the walls of a cylinder have been carefully marked out by Donkin and others. Indeed, Mr. Donkin's researches on the temperature of cylinder walls, and cylinder condensation, have come to be regarded as classical.

Now, James Watt cut the Gordian knot and disposed of the whole difficulty by inventing an engine in which the cylinder is jacketed inside instead of out. Very soon after he had invented his first or atmospheric engine, he saw that the cold air following up the piston must cool the cylinder. It was clear that the difficulty could be got over by having the engine-house filled with air at the same temperature as the steam—say 215° Fahr. or so. But this was impracticable, and consequently he took the great step in advance of all former inventors of excluding the air altogether and substituting an atmosphere of steam for it. He shut up the cylinder in a little house of its own, which he kept filled with steam of high pressure, and he patented this steam-engine in 1769—that is to say, 130 years ago—and, as we hope to show in a few minutes, he then gave the world the most perfect steam-engine which, from the thermal efficiency point of view, it is possible to construct.

If our readers can refer to Bourne's "Treatise on the Steam-Engine," they will find, on p. 13, a very good drawing of Watt's 1769 engine; but its construction is so simple in all the essentials that we can make it clear, we think, without a drawing. A single-acting, open-topped vertical cylinder stands inside another. If we stand a small tumbler on a table, and turn a large tumbler upside down over it, we have the whole arrangement. The inner cylinder is fitted with a piston, the rod of which passes through a stuffing-box in the top of the outer cylinder. A couple of valves put the inner cylinder alternately in communication with the space between the two cylinders and with a jet condenser. In working, the outer cylinder is always filled with boiler steam. It is, indeed, an extension of the boiler in the same sense that the condenser is an extension of the inner cylinder. The piston-rod is coupled by a chain and arc head to the working beam; at the other end of the beam are the spear rods and pumps. When at work let us suppose the piston to be indoors, that is to say, at the bottom of the cylinder, the steam-valve opens, steam passes under the piston, balancing the pressure above, and the engine goes out-of-doors by the weight of the spears, and the forcing stroke takes place. Then the steam-valve is shut and the exhaust-valve opened, and a vacuum is made under the piston, which comes indoors, and so on. The steam under the piston could be cut off at any point which would give suitable expansion. The range was fixed by the usual limits obtaining in the case of a Cornish engine. It depends on the mass put in motion, its velocity, and resulting momentum. We need not trouble ourselves about this detail now. Because the piston is followed up on its descent by steam of full boiler pressure, the inside as well as the outside

of the cylinder must be of the temperature proper to the pressure. The steam entering the cylinder under the piston will undergo no initial condensation after the steam-valve is shut, and the expanding steam will continually meet with cylinder walls hotter and hotter than itself. The general result will be that condensation of the working steam—as we shall call it, although this distinction is not quite accurate—is out of the question. A certain amount of liquefaction due to the performance of work will take place, but no deposit of moisture on the sides of the cylinder can result. When the piston is descending the boiler steam will probably find the temperature of the cylinder walls reduced, though even this is doubtful. It may be admitted that a certain quantity of water will be produced—although certain experiments which we have carried out go to show that no condensation which can be measured takes place—as the top of the piston always passes above the top edge of the inner cylinder, any water which would otherwise collect on the piston will be pushed over, and will fall down in the space between the two cylinders, from which it can be drained. It must not be forgotten that when expansion is used a certain volume of steam will always be pushed back again into the boiler during the up-stroke of the piston, but this is of no practical importance if the steam pipe is made large.

We have here, then, an engine in which there is no initial condensation. The expanding steam starts dry in a dry, hot vessel, instead of beginning to expand with some 20 or 30 per cent. of water mixed with it. A chapter might be written on the reason why dry steam has a higher thermal efficiency than wet. Our readers who want further information on this point can consult the pages of Zeuner, or Willans, of Dwelshauvers Dery. No conditions more favourable can be found for expanding steam than those provided by Watt. We must seek for sources of waste in the boiler steam. We have repeatedly pointed out that, no matter what the quality of an engine—good, bad, or indifferent—all the steam received from the boiler by the cylinder must leave the cylinder as steam, with the exception of that percentage which is liquefied by the performance of work, and that other portion which is condensed by radiation and conduction from the outside of the engine. This means, of course, that steam condensed initially or otherwise during the stroke must be re-evaporated during the exhaust. To use the words of the veteran Isherwood, whose preface to the second volume of "Experimental Researches in Steam Engineering" is the most masterly treatise on the thermo-dynamics of the real steam-engine—not the ideal affair—ever written, we may say that it is the re-evaporation which is the cause of all the waste, because all the water of condensation, which may amount to 30 per cent. or so, has to be evaporated twice, once in the boiler and once in the cylinder, and no mechanical return is obtained for the second evaporation, which is done by the coal on the grate just as much as though it were done in the boiler. Now in the Watt engine no re-evaporation can possibly take place. We have seen that condensation of the working steam is impossible; and any water resulting from the entrance of the boiler steam into the cylinder cannot re-evaporate, because the pressure at which it was condensed remains always the same throughout the whole cycle. The evaporation takes place in an ordinary cylinder only because of the fall of pressure during the exhaust.

It is not quite clear why Watt did not build engines under his 1769 patent, or, rather, under the particular portion of it dealing with the engine we have described. The probability is that the Cornish engine, working on a totally different cycle, was more convenient. The weight of spears necessary with the earlier engine would be much in excess of that needed with the Cornish engine. A double engine might have been made with a cylinder at each end of the beam; but it would not have been easy to get mine owners to take up such an engine. A Bull engine on the system would only have exchanged one difficulty for another. The pump spears would now have to be as much too light as with a beam engine they must be too heavy. For in the Bull engine their weight would be added to the constant steam pressure forcing the piston down, just as in the beam engine they would have pulled the piston up. Yet it is possible to see how these objections might be got over, as, for instance, in a rotating or flywheel pumping-engine. Indeed, our readers will not, we think, be slow to see that this principle of construction admits of a wider range of application than Watt ever dreamed of; but with this we have nothing to do. Our work begins and ends with directing attention to an old and forgotten invention, whose beauty and excellence should suffice to rescue it from oblivion.

EVERY day the Thames scoops out of its banks 1,500 tons of mud, or half a million tons a year.

IT is reported from Rome that an agreement has been come to between the Governments of Great Britain and Italy, for the construction of a railway from Kassala to Keren and Massowah.

NEW PRIMARY BATTERY: THE HARRISON CELL.*

ALTHOUGH it was in 1793 that Volta discovered that when two discs of metal—one zinc and the other copper—were brought in close contact the zinc became charged with positive and the copper with negative electricity, it was not until 1799 that he constructed his famous primary cell. . . . . Volta's cell furnished the first practical source of electrical energy, and in a form that enabled experiments to be made which culminated in that of Faraday—the base of all our present electrical development.

I now wish to call your attention to the latest form of voltaic cell, which has been brought to perfection during this centennial year, and in which it has been aimed to embody as many as possible of the desirable qualities that the experience of the past 100 years has shown to be necessary in a good voltaic cell. Ever since Volta pointed the way, efforts have been made to devise a perfect form of voltaic cell, but so far unsuccessfully; galvanic polarisation and local action are the principal difficulties that beset the path of the inventor of primary cells.

As I shall have occasion to refer repeatedly to polarisation and local action in describing how these difficulties were overcome in the cell under consideration, I will here give the definition of these two terms as given by Park Benjamin.

"Polarisation is a condition due to the formation of a body, most commonly hydrogen, by electro-chemical decomposition upon the negative electrode, whereby a current in opposite direction to the normal current of a cell is produced, and through which the normal current may be greatly weakened."

"Local action is chemical action occurring within the cell, and is caused by the innumerable small currents which circulate between portions of the same electrode."

A great variety of chemical substances have been used as depolarisers, and even mechanical devices to utilise the oxygen of the atmosphere have been tried. The substances have usually been such as will readily give up oxygen to combine with the hydrogen to form water, and may be either liquids or solids. An objection to liquid depolarisers, besides that of having two liquids in the same cell with the accompanying porous cup or other device to keep them separated, is that but a small percentage of the total depolariser present in the cell is available for useful work, as there is generally a large amount of chemical energy left in the solution after it is too weak for satisfactory work.

Solid depolarisers are preferable to liquid ones, for which solid depolarisers one liquid only is required in the cell, and porous cups can be dispensed with, and the efficiency, or amount available for useful work, is also higher than is the case with liquid depolarisers.

The following table gives the E.M.F. of various cells in which a few of the most commonly used depolarisers—liquid and solid—are used, zinc being the positive element in each case:—

Liquid Depolarisers.	Name of Cell.	Volts.
Copper Sulphate......	Daniel	1·079
Potassium Chlorate ..	Salleron-Renoux..	1·600
Nitric Acid	Bunsen	1·900
Potassium-Bichromate	Poggendorff	2·140
Cupric Oxide	Lalande-Chaperon	0·98
Silver Chloride	De la Rue	1·03
Manganese Peroxide..	Leclanché	1·40
Mercurous Sulphate ..	Marie-Davy	1·412
Lead Peroxide........	Harrison	2·45

It is evident that the cell in which lead peroxide is the depolariser has by far the lightest E.M.F. This new cell, known as the Harrison primary cell, No. 1, is the cell that I propose to describe in this paper. It is an open-circuit primary cell, having a positive element of amalgamated zinc and a negative element of hard lead surrounded by a mass of specially prepared lead oxide (PbO_2). The electrolyte is dilute sulphuric acid, 1 to 6. The E.M.F. of the cell is 2·40—2 50 volts, the average being 2·45. The internal resistance averages ·15 ohm, therefore on short circuit the current is about 16 ampères. The negative element is in the form of a round stick, about 4in. long by 1¼in. in diameter. It is made by compressing in a special machine a mass of lead peroxide around a central conductor of hard lead that has previously been treated in a way that prevents sulphating. This conductor is provided at one end with a copper screw that passes through the cover of the jar, and is held in place by a binding post.

It is not claimed that the use of the lead peroxide for the negative element in this cell is new, for Benjamin says in his book, "The Voltaic Cell," p. 228: "In 1843 Wheatstone observed that by covering the negative electrode of a cell with a body of peroxide of lead or peroxide of manganese the E.M.F. of a cell could be greatly augmented. De la Rue reached the same conclusion at about the same period." Since then numerous inventors have tried to make a practical cell, using lead peroxide surrounding a conductor as a negative element, but the difficulty of making a peroxide that would hold together, and not disintegrate when used, has never been overcome until recently.

This seemingly insurmountable difficulty has been practically overcome in the Harrison cell after several years of experimenting. Every kind of binding material that offered any hope of success was tried, and failed, and even coating the sticks after they were made with different cements was tried, and failed. Several times it was thought that success had been achieved, as occasionally sticks would last for months without cracking or falling to pieces. Success was ultimately attained only after the trouble had been traced to its source, and special means and processes devised to prevent it.

The illustrations show Fig. 1, Harrison cell, No. 1; Fig. 2, negative element of No. 1 cell; Fig. 3, positive element of No. 1 cell.

The process of manufacture is now as follows:—The lead peroxide is prepared electrolytically, and when finished is almost chemically pure PbO^2. Certain precautions have to be observed to insure success. The neglect of any one of them gives us a peroxide that, when made into a stick, will crumble to pieces when put into the electrolyte. The proper amount of finished peroxide is then compressed around the conductor in a very ingenious machine,

* By J. D. DARLING, in the *Journal* of the Franklin Institute.

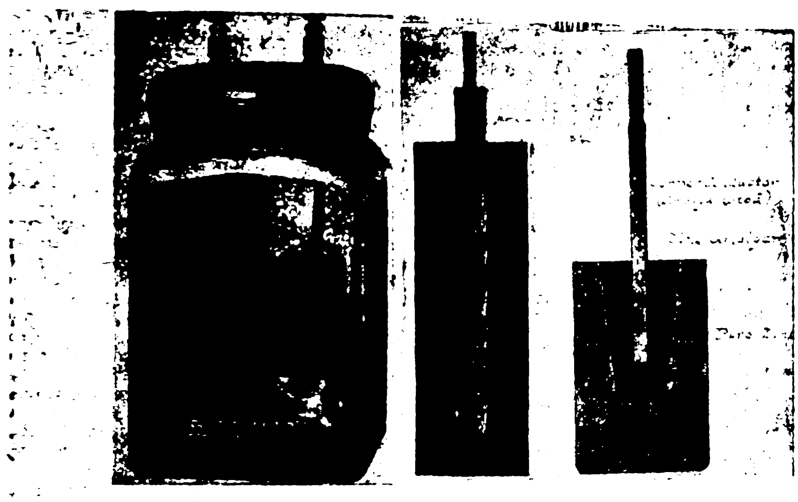


FIG. 1. FIG. 2. FIG. 3.

especially designed for the purpose, and which is worked by compressed air. The finished sticks are allowed to dry for a week or more before being made up; they are then extremely hard, and stand handling and shipment very well.

I will now proceed to describe the positive element of the cell, which also possesses some new features. At first glance it appears to be only a short rod of zinc, 1⅝in. long by 1in. in diameter, with a short conducting copper wire attached to it, but, as dilute sulphuric acid is the electrolyte used in the cell, it is plain that zinc alone would not last long, and a closer examination will show that means have been taken to keep it amalgamated. It is well known that if the zinc element in a primary cell is kept well amalgamated there is little or no local action. Kemp, of Edinburgh, was the first to point this out, in 1828, and although it would appear to be a simple matter to keep the zinc amalgamated, in reality it is not, for on account of the high specific gravity of mercury it has a constant tendency to separate from the zinc, thus leaving the zinc open to attack by the acid. To overcome this tendency the zinc element in the Harrison cell is cast in the form of a cup, and has a stout copper wire, threaded at one end for attaching the binding post imbedded in it. In this zinc cup and around the copper wire enough melted zinc amalgam is poured to completely fill it. This amalgam, when cold, is perfectly solid, and no free mercury is visible. This is a most valuable feature, as there is no mercury to spill and be lost when shipping the cell. Yet it is not necessary to amalgamate the zinc when setting up the cell, as the mercury that is in the element in the form of solid zinc amalgam is almost instantly available when it comes in contact with the exciting fluid.

What occurs when the cell is set up is as follows: Zinc amalgam is electro-positive to pure zinc, the difference in potential being 0·05 volt; therefore, when the zinc element I have described is placed in dilute acid, the first action takes place on the surface of the zinc amalgam. The zinc of the amalgam is dissolved and a minute quantity of the mercury is liberated; this, in a very short time, spreads itself over the surface of the element, and, as there is then nothing but zinc amalgam exposed to the acid, all action ceases.

The zinc element in the Harrison cell is, therefore, self-amalgamating, for it retains this property of liberating just the necessary amount of mercury needed to the end of its life. Tests have shown that the local action is very slight, and that the amount of zinc dissolved bears a close relation to the amount of energy obtained, providing the sulphuric acid used is pure. If impure acid has been used in cutting up the cell, local action will occur on the zinc. The reason for this is that the zinc is highly electro-positive in dilute sulphuric acid, and will precipitate on itself all other metals lower in the electrolytic scale, or less positive, that may happen to be in the acid used in setting up the cell.

If the metals so precipitated readily amalgamate —copper, for instance—no harm will ensue, for they will combine with the amalgamated zinc, and no local pair will be formed. But if, as is usually the case, the metallic impurities present in the end are arsenic, selenium, or iron, local action is certain to be set up, for they will be precipitated on the zinc and, as under the conditions they will not amalgamate, a multitude of local pairs are formed on the surface of the zinc element and it is rapidly consumed.

As sulphuric acid manufactured from iron or copper pyrites always contains more or less arsenic and selenium, such acid should never be used in the Harrison cell except the following precautions are strictly observed. If there is a doubt about the purity of the acid, proceed as follows:—Set up the cell as per directions, and allow it to stand for forty-eight hours. If the acid is not pure, local action will have been set up on the zinc, and gas bubbles will be seen to be rising steadily instead of adhering to the zinc. To stop the action and prevent its return, take the zinc out and scrub it off thoroughly with a stiff brush in running water. This treatment will remove the precipitated impurities from the surface of the zinc that were causing the trouble, and as there are no more left in the solution, the zinc can be replaced again, and there will be no further local action.

But it is much the better plan to use only pure 66° Baumé sulphuric acid in the Harrison cell, and if that is done there is practically no local action.

When there is an objection to the use of liquid sulphuric acid, a substitute for it in the bisulphates of potash or soda in solution can be used with almost equally good effect, providing the bisulphate used is pure.

I will conclude by calling your attention to the mechanical features of the cell and what it will do. As you may see, it is of neat and attractive appearance and of small size, being only 6in. high over all, by 3in. square. Owing to its shape, a large number occupy but a small space. The renewal of the elements is easily performed by unscrewing the binding posts, removing the exhausted elements and inserting new ones. The jar is graduated and properly marked so that no mistake can be made in putting in the right amount of acid and water when setting up the cell, and as dilute sulphuric acid is the electrolyte there are no salts to creep and corrode the connections. Primarily it is intended for open-circuit work, where only one-quarter of an ampère or less of current is required; but it can also be used on light, or what may be called semi-closed circuit work, and any desired current can be obtained by putting cells in multiple.

The cell, on ordinary household work, such as bell-ringing or gas-lighting, will last for at least one year without attention, and then, by changing the acid, it will last for some time longer before it is necessary to change the peroxide stick for a new one. The zinc generally lasts as long as two peroxide sticks; but, of course, the life of the cell depends upon the amount of work it is called upon to do. If, through defective wiring or any other cause, it is short-circuited, or, as it is called, "grounded," its life will be shortened, as would be the case with any other primary cell.

I would now call your attention to another form of cell—what is known as the "Harrison Cell, No. 3." This cell has also lead peroxide and amalgamated zinc for its elements. It has been especially designed for heavy closed-circuit work. Its E.M.F., when new, is 2·7 volts, and its life is 300 ampère-hours on a slow rate of discharge.

In this cell the negative conductor is outside the peroxide of lead, and is in the shape of a perforated basket or grid, divided internally into four equal spaces by lateral walls, and supported by a central rod passing through the cover of the jar and forming the positive terminal of the cell. By this form of construction a large negative surface in close contact with the depolariser is obtained. The entire element is of a very solid and substantial construction that is not easily injured in shipping, and, when exhausted, can be recharged and used over and over again.

The positive element is granulated zinc, lying on a copper grid on the bottom of the jar that has an insulated copper conductor passing up through the cover to form the negative terminal of the cell. To prevent local action, a quantity of mercury is placed in the bottom of the jar, which serves to keep the zinc constantly amalgamated.

Three advantages are secured by using granulated zinc. One is that because of the large surface of zinc exposed in close proximity to the negative element, the cell has a very low internal resistance and a consequently high ampèrage. Another is the ease with which the zinc can be replenished, and, thirdly, the economy obtained in the consumption of zinc. All the zinc put into the cell is used. There are no pieces left to be thrown on the scrap heap, as is the case with cells having vertical plates of zinc. Of course, there is the same need in this cell as in the No. 1 to use pure sulphuric acid, or a solution of pure bisulphate, and the same directions apply for stopping local action caused by using impure acid.

Its high E.M.F., large current, freedom from local action and the ease with which renewals can be made give this new cell distinct advantages over all other forms of what are known as closed-circuit cells. It takes a battery of three copper oxide cells coupled in series to give the voltage of one No. 3 Harrison cell. Manufacturers and users of gas and gasoline engines have long felt the need of a high-voltage primary cell to operate the spark coil attached to their engines, and I believe they will find what they have been looking for in this new cell. Physicians and dentists will also find it well adapted to their needs, and it can be used for operating coils in X-ray work, for telephones and phonographs, as well as for running small motors and fans.

Where small storage batteries are now used, this new cell will be found more convenient, for, besides having a higher E.M.F., there is not the need to send away the whole cell to have it recharged. With an extra negative element and a supply of acid and zinc, the cell can be kept running continuously with but little trouble; or, if desired, and a current is at hand, it can be used as a secondary cell.

CUTTING PRINTS: FOCUSSING SCREENS.

VERY often we find it necessary to trim our prints in all sorts of odd shapes and sizes, sometimes to suit the picture, sometimes to suit some particular unconventional mount that may have taken our fancy. When we get away into these by-paths, it is impossible to get cutting-glasses, and we have to resort to using a straightedge or square. This, however, has many disadvantages. In the first place, we cannot get a full view of the print while trimming; much time is lost in getting the print squared, and if a number have to be turned out, it is difficult to get all the prints uniform in size. Hence the advantage of a cutting-glass in allowing us to work more freely, with greater ease and rapidity.

Many photographers make their own cutting-glasses, and there are many reasons why they should be imitated in this. There is nothing difficult in it. First get a piece of crown glass cut to the required size (crown glass is handier than plate glass for all sizes up to whole plate). Any glazier will supply it at a mere nominal cost. The edges, when cut with a diamond, are left rough; but if you get a box of knife-powder, sprinkle some of it on a smooth-surface stone—old lithographic stone—or glass, moisten it so as to make a thick paste, rub the edge of the cutting-glass in this—a back and forward movement—it will very soon grind down smooth. Great care, however, must be taken to keep it from jumping, as it chips very easily at the corners. To prevent this, hold the glass firmly in both hands, keeping up a sawing movement.

Focussing-screens are ground after the same fashion. Some use fluoric acid to bite down the surface. This is a quick method, but not to be commended for focussing. Get a very fine knife-powder, and keep it moist. It is best to work on a glass surface when grinding a focussing screen. If, when finished, it is too dull, a little vaseline will improve it, and minimise the grain; but if the screen is ground with a circular motion, there should be little or no grain in it.—R. THIRSK, in the *Photographic News*.

VERMOUTH.

THE manufacture of vermouth in France is confined almost exclusively to the city of Marseilles, where all the important manufactories exist. The article is made from ordinary white wine, which is produced extensively in the region of which Marseilles is the principal centre, and which on account of its abundance is very cheap. A pure wholesome white wine may be bought in the south of France at an exceedingly low price. While returns showing the production of wine in France are published every year by the Government, no statistics are kept concerning either the production, consumption, or exportation of vermouth. The two principal points in Europe from which vermouth is exported are Marseilles and Turin. Vermouth, according to the United States Consul at Havre, is simply an infusion of certain plants and bitter aromatic herbs and roots in a quantity of wine, the degree of which has been strengthened by the addition of one-ninth

of its bulk of alcohol, in order to bring the wine, which is usually of not more than 16° alcoholic strength, up to 15°. The alcohol used should be pure, clear, and of about 85° in strength. The following are the ingredients of ordinary French vermouth:—Dry white wine, muscatel wine, wormwood, bitter orange peel, camomile, white germander, Florentine iris root, centaury, Peruvian bark, aloes, cinnamon, nutmeg, alcohol at 85°, and raspberry juice. The herbs and other ingredients are sometimes allowed to remain in the wine for a period of two months, the solution being stirred every fifteen days. After the expiration of two months the wine is drawn off into another barrel, and is allowed to remain therein for two weeks, after which it is drawn off a second time. In the event of the vermouth being cloudy, which is often the case, the manufacturer resorts to the simple process known as *collage*, which consists of stirring in some boiled milk in the proportion of one pint to 26 gallons of vermouth. The white of a single egg, well beaten, for each 26 gallons, or about half a fluid ounce of fish glue, is also used for this purpose. The vermouth should be allowed to remain in the barrel for about five days after the *collage*, after which time it may be drawn off and filtered. If the vermouth thus made is not sufficiently sweet, a little sweet wine or syrup may be added. Its degree of sweetness, however, should not exceed 5° to 7° on the Beaumé scale. Newly-made vermouth has a flavour of herbs, which is occasionally a little too pronounced. Age alone causes the disappearance of this. Certain manufacturers, instead of putting the herbs and other ingredients directly into the barrel, first inclose them in a linen sack, which is then suspended in the barrel of wine. The sack is withdrawn every five or six days, the liquid expressed from it into the wine, and the sack again suspended. It is left in the wine for a month, at the end of which time it is taken out, all the liquid pressed out of it, and the fluid thus expressed returned to the barrel. Other manufacturers first make an alcoholic extract of the ingredients, which extract is afterwards mixed with the wine in the proportions given below. To obtain alcoholic extract referred to, it is but necessary to reduce the dry ingredients mentioned to powder, and to place the same in about 10 to 12 quarts of alcohol of 85° strength. The solution is allowed to remain standing for a week, after which 19 quarts of alcohol, and 7·35 quarts of white wine are added, together with the herbs cut into small pieces. The solution is then warmed in a water bath, which should not be heated above 140° Fahr. After half an hour's warming it is removed from the fire, allowed to cool, and to remain standing for eight or nine days, during which time it should be frequently stirred in order that the sediment may be brought as much as possible in contact with the liquid. The solution, when perfectly clear, is placed in a large glass vessel, and forms an extract of vermouth. To make the article of commerce 1·58 quarts of the extract are mixed with 2·11 quarts of white wine. If, in the simple process of infusion first described, the addition of alcohol to the wine precipitates the tartar contained in the latter, and causes cloudiness, the solution should be allowed to stand a few days until it clears, after which the solid ingredients may be added. The quality of the vermouth manufactured in France depends in a great measure upon the sort of wine used. The wines most employed are those of the valley of the Rhone, certain Spanish wines, and the wines of the extreme South of France. There is a difference between the French and Italian vermouth. A number of French manufacturers make Italian vermouth, however, not for the purpose of deceiving the customer as to its origin, but merely as a type of vermouth, distinct in flavour from the article known as French vermouth. The following are the ingredients which enter into Italian vermouth:—Sweet white wine, wormwood, helenium, calamus odoratus, centaury, holy thistle, water germander, cinnamon, angelica root, gentian, nutmeg, fresh orange sliced, and alcohol at 85°. When the process of infusion, above described, is completed, the manufacturer, or an expert connoisseur identified with his manufactory, samples the vermouth in order to find whether or not it possesses the desired taste. Should the beverage be too bitter, the fault can be remedied by adding a small quantity of wine until, little by little, the proper flavour is reached. If not sufficiently bitter, a small quantity of the solid ingredients may be again infused in the wine. Nor is it necessary that vermouth should possess great alcoholic strength to be good. Some manufacturers make vermouth which contains 17° of alcohol, while others keep their product down to 12°. The average strength is from 14° to 15°.

THE SACRED MOUNTAIN OF ABYSSINIA.

IN an account of an interview with Dr. Reginald Koettlitz, which a representative of Reuter's Agency publishes, the distinguished traveller, who is a medical man, says:—Mount Zuquala, the mysterious sacred mountain of the Abyssinians, is 40 miles from the capital. It is 10,000ft. high, and in the form of a truncated cone. At its summit and in the crater is a remarkable lake, three-quarters of a mile long, which is a veritable Abyssinian Lourdes or Pool of Siloam. It is the belief of the natives that bathing in its waters will cure all diseases. Close by are some springs dedicated to the Virgin Mary. According to the popular idea, barren women need only drink of these fountains to lose their sterility. The waters are regarded with the greatest worship, and must on no account be employed for cooking, or any other useful purpose. I saw quite a number of diseased creatures round the lake shore, crawling about or being carried on litters. The whole mountain—both sides and the the crater—is densely wooded. The place is studded everywhere with hermits' huts, each of which is inhabited by holy men, who live separate lives of extreme austerity. Also hidden away in the forests are a large number of churches. I got into the good graces of the hermits by somewhat curious means. I was being shown over one of the churches, which are plentifully adorned with cheap coloured Biblical pictures "Made in Germany," when a priest with great awe drew my attention to a gaudy representation of St. George and the Dragon. I endeavoured to explain that St. George was the British as well as the Abyssinian patron saint, but the good men were very dubious, until I hit upon the idea of producing a sovereign. This at once convinced them of the truth of my statement, and proved to their complete satisfaction that I was a Christian of a very high order. The whole mountain is curious in the extreme. I was shown one tree with three trunks, united at the base, which is regarded as an emblem of the Trinity, and is hung with human hair and all sorts of trinkets. There are, too, curious crannies between the perpendicular rocks, through which it is an act of devotion to squeeze oneself. The sides of these apertures are highly polished and covered with grease, by reason of the religious activity of diseased pilgrims.

HINTS ON DEVELOPMENT FOR USE OF THE BEGINNER.*

IT may be taken for granted that no one takes up photography only for the purpose of making *negatives*, but that either prints, enlargements, lantern slides, or process blocks are the end; therefore the end, whatever it is, should never be lost sight of. Some people have an idea that the more villainous-looking the negative is the better will be the print; others always express their surprise on seeing good prints from unpromising negatives. Both these are wrong, and are simply acknowledgements that the colour of the negative has not been properly considered. Now, the colour of a negative is of great importance, whether print, enlargement, or slide is the end in view. If the colour was always alike it would not trouble us, but the latest beginner knows that negatives may be either a blue-black, or green, or brown, but it takes him some little time to discover that, while the former give flatter prints—that is, prints with less contrast than he expected—the latter give prints of the opposite character, and he is never certain till he has made a print whether the amount of colour is sufficient to make a perceptible difference in the print. It rests with the photographer whether he makes negatives which are coloured or plain; according to the developer used, so will the negatives be either black, green, or brown. Unfortunately, one of the best developers is the one most given to making brown negatives—we refer to pyro-soda—even when the pyro is kept from oxidising with meta-bisulphate, or with nitric or sulphurous acid. It seems impossible to prevent the developer from drinking oxygen while development is proceeding. To be sure, while religiously abstaining from taking the negative out of the developer to look at it, and by developing for a set time, we can make our negatives of nearly the same colour; but the very fact of abstaining from taking the plates out of the developer prevents us from taking advantage of one useful aid in development, for it is well known that by taking a plate out of the developer, and allowing the development to proceed with the aid of the developer in the film, detail in the shadows is brought up, while the high lights remain almost as they were. When pyro-soda is used, the excess of colour, which results from taking the negative out of the dish, about counterbalances the effect gained when the negative comes to be printed; so the photographer, finding uncertainty in pyro-soda, returns to pyro-ammonia, which is, after all, the best developer for all workers who are not pressed for time, and are able to spend, say, half an hour over the development of each negative. As there are only two kinds of negatives which can be properly developed—those which are the correct and those which are over-exposed—those which are under-exposed always give prints lacking in detail in the shadows. As photographs generally give too much detail, especially when properly exposed, it is advisable always either to under- or over-expose, according to the effect wished for: both under- and over-exposure rid us of the superfluous detail. The beginner should err on the side of over-exposure, then with pyro-ammonia he will be able to master his development, and not let it master him.

The first thing to be done before commencing development is to get a note-book and copy out the numbers of the plates down one side, and rule spaces for particulars of the developer used and time taken to develop opposite the numbers.

Although it is advisable to use the developer which the makers of the plates advise, we are afraid beginners—and those who are not beginners as well—do not always go to the trouble of making up fresh developer according to the formulæ given with the plates; neither can we blame them, for the quantities given by the different makers are so various, the photographer looks upon making up developers as a nuisance. In time platemakers may agree to use a universal formula. Instead of giving a long list of chemicals to be dissolved in two or three solutions, and advising the use of so much of each, it would be simpler to advise the use of so much of a standard solution for each plate.

We will suppose that the beginner has decided to develop, say, a Mawson's "Castle" plate with pyro-ammonia, which plate has had a full exposure. Let him take, instead of equal portions of the developer and the accelerator, only half the quantity of the latter, develop till as much detail and density as appear to be required, and then fix. If the plate, when finished, is wanting in either quantity, it may be taken for granted that more of the accelerator should have been used. By making careful note of the amount of accelerator used for each plate developed, the worker will build up for himself a very useful reference-book, and be able in a short space of time to make his negatives of whatever character he wishes them to be, according to the effect wanted on the particular printing paper used. At present too great contrasts seem to prevail, for the modern printing papers, gelatine, &c., require very delicate negatives. With pyro-ammonia it is much easier to get negatives suitable for gelatine papers than with pyro-soda, on account of its stain, which increases the contrasts; hydroquinone, too, generally gives negatives which are too hard for gelatine papers, though, when thoughtfully used, it is an invaluable developer for the portrait photographer. As the amateur seldom bothers himself with this class of work, we will not bore him with the reasons.

The great thing the beginner should guard against is the use of plates which easily fog in development. Owing to want of care in the manufacture, some plates are dangerously near fog point, and require much care in development. With other plates, such as Mawson's "Castle," the amateur need never fear fog; such a plate may remain in the developer for an hour while detail and density gradually appear, yet show perfectly clear glass at the edges when fixed. As it is difficult to estimate the character of a plate fogged in development, the wise photographer will have nothing to do with them. It is, of course, possible, to fog the best of plates by using an excess of ammonia or soda; but the worker who makes careful notes and measures accurately the amount of accelerator used need never fear it. One good plan is to measure out the amount of pyro, and pour this into the dish; then measure out, after having rinsed out the measure, the full amount of accelerator; and after development to measure accurately the amount of accelerator left in the measure. This deducted from the full amount gives the quantity used, which quantity should be entered, as we said, opposite the plate number in the note-book.

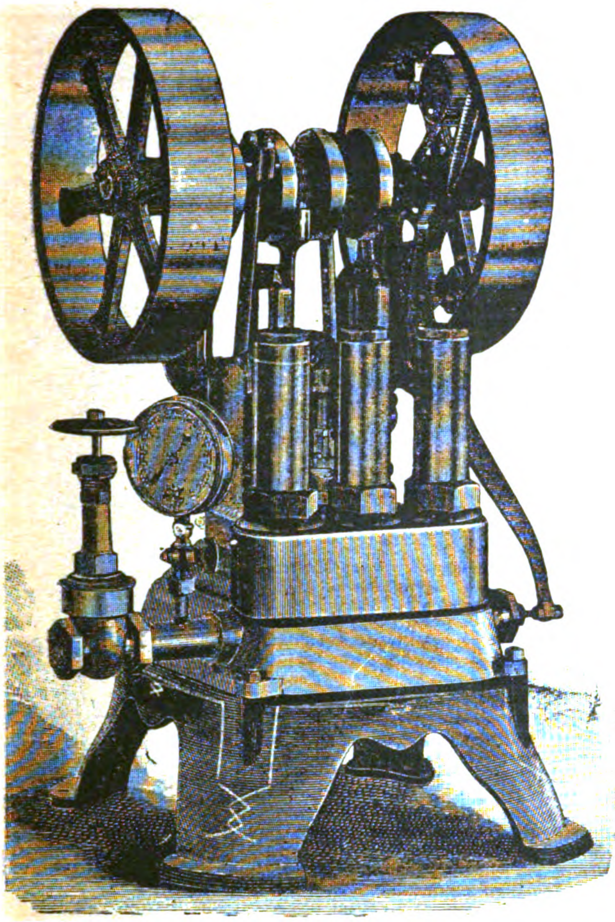
The worker will soon find that some brands of plates will stand a great amount of over-exposure, yet give perfect negatives when carefully developed, while others give hopelessly flat negatives with a generous developer. For that reason we advise the beginner to use a plate such as the "Castle," and give a full exposure.

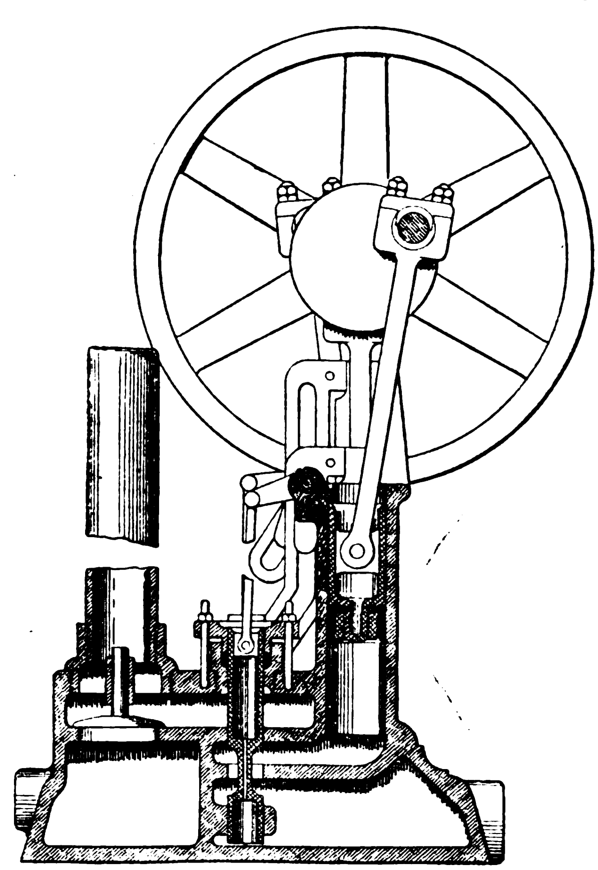
When the student has mastered the development of slow plates, then he may experiment with quick ones; the experience he has gained with slow ones will be of immense benefit, and his failures will be few, because he knows rather than guesses at what he is doing.

We have said nothing about guarding against fogging the plate by foolishly exposing it to the light of the dark-room window, as everyone knows that the safest light fogs any plate, and that all developing dishes should be covered up as much as possible. In our own practice we have a low shelf beneath our window, which keeps all light from the dish, except when we withdraw it from time to time.

There is one defect often seen in amateurs' negatives which practised workers are never troubled with—namely, air-bells, which occur during development, which leave transparent or semi-transparent spots. These are caused by either wetting the plate before development (an unnecessary proceeding), or by adding glycerine to the developer or by using citric acid as a preservative to the pyro.

* By Frank M. Sutcliffe. Extracted from the *Photographic News*.





If air-bells should appear, they can easily be removed by brushing the plate, while in the developer, with a soft camel-hair brush.

THE JOHNS HYDRAULIC ENGINE—A COMBINED WATER AND AIR MOTOR.

ONE of the most ingenious and efficient hydraulic motors which has yet appeared is being made by the Elmira Manufacturing Company, of Elmira, N.Y. The operative principle of the engine is certainly unique, embodying as it does a combination of hydraulic and air pressure. In addition to the power given by direct pressure of any given head of water, the engine employs the pressure produced by suddenly checking the momentum of the water flowing to the cylinder. In other words, the principle of the hydraulic ram is applied to the hydraulic engine without any loss of water.

The motor which forms the subject of our illustrations is a three-cylinder vertical engine, having a three-throw crankshaft, with cranks set at an angle of 120°. The three cylinders have a common supply chamber, from which separate inlets lead to the valves for each cylinder, a check valve being provided to prevent back-flow from the momentum of the water in the supply pipe. Above each inlet is an air chamber. Back of the supply chamber, underneath the cylinders, is an exhaust chamber, and between this chamber and each of the inlets are ports which lead to the bottom of the cylinders and are put successively into communication therewith. An outlet passage is carried down to the exhaust chamber, and is coupled with the exhaust pipe at a point so as to trap the water in the exhaust chamber at the end of the return stroke of each piston, without, however, exerting back pressure.

The inlet and exhaust piston valves controlling the cylinder ports are coupled with rocking levers. Cam-arms reciprocating with the pistons engage these levers so that each piston, when nearing the top of its stroke, by means of its cam-arm, actuates the valve for the next cylinder in order, holding the valve open while it pauses at the top of the stroke, and closing the valve quickly on its descent. Upon the quick closing of each valve the water will be suddenly cut off from the corresponding inlet, but will continue to flow from the supply chamber past the check-valve into the air-chamber, compressing the air until the momentum of the water is checked. The check-valve is then closed so as to maintain the air within the air-chamber in its compressed state. Upon the next opening of the valve the compressed air in the air-chamber will force the water under this increased pressure into the cylinder during the upstroke of the piston, this increased pressure gradually diminishing until the normal pressure of the water supply has been reached. The check-valve will then reopen, and the water will again flow from the supply chamber through the inlet to begin the cycle anew.

The nearness of the air-chambers to the cylinders and pistons gives an elastic action to the flow of the water, with it accumulative extra air-pressure, adds greatly to the efficiency of the motor—an efficiency of about fifty per cent. over the power obtained from the simple pressure and quantity of water alone. The elasticity of the water in following the piston allows the engine to run at a higher speed than the ordinary hydraulic motor. In the hydraulic motors commonly in use the power depends upon the volume and pressure of the water alone; but in the motor described there is the additional power obtained from compressed air. It develops a much greater power with the quantity of water used than in any other form of water motor. The engine is built in all sizes from one-quarter horse-power up, there being no more limit to size than where steam is used for motor-power. The company has its New York office at 159, Greenwich-street, and is glad to give further information to anyone desiring it.—*Scientific American.*

STORAGE BATTERIES AND ELECTRIC TRAMWAYS.

WITHIN the past few years a new field, and one which promises to be one of great magnitude, has been opened for the use of storage batteries. This is the installation of storage batteries of large size to act as regulators in connection with the trolley or third-rail system of propulsion.

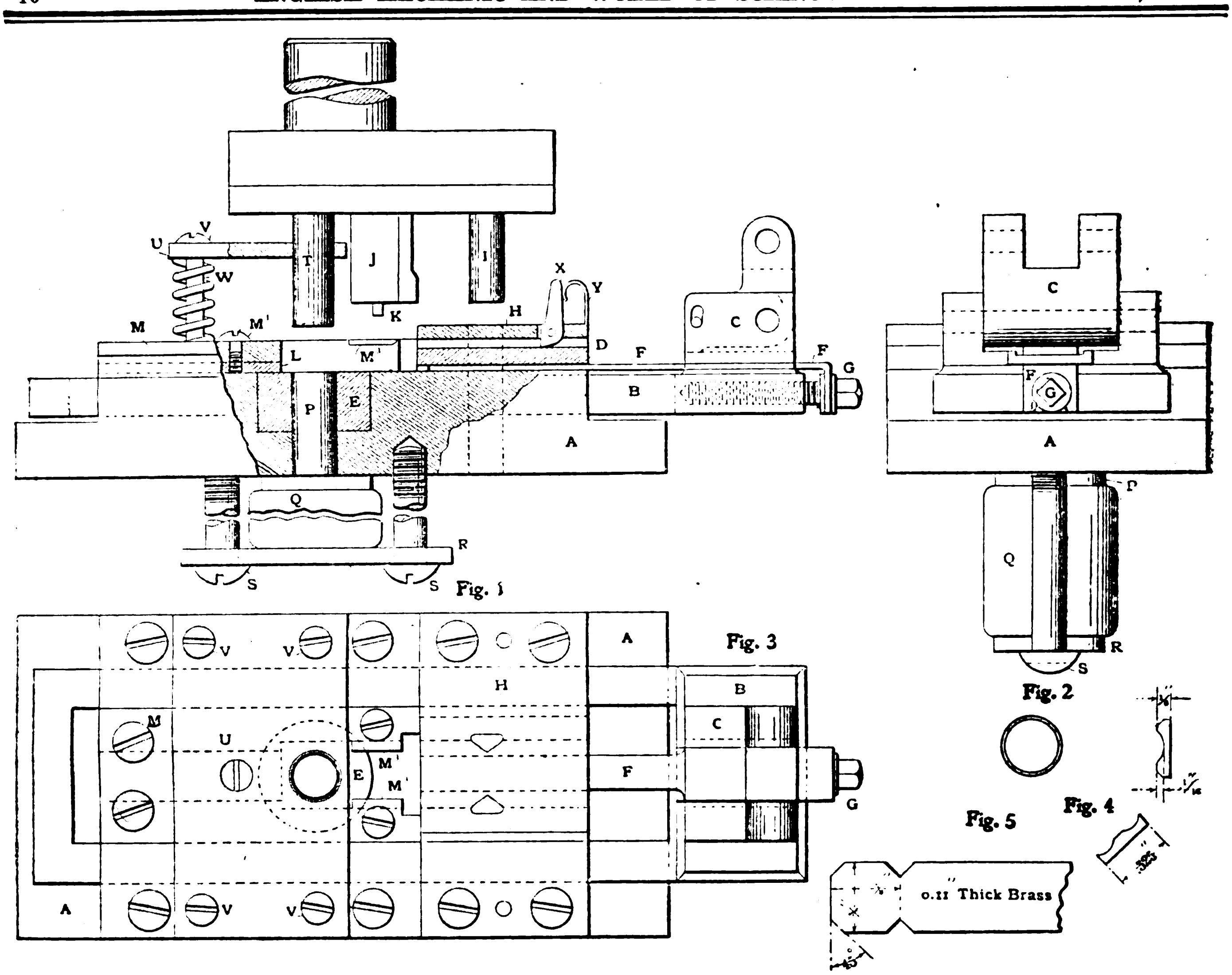
A reliable battery, properly installed will reduce the problem of generation and distribution of electric current by a street railway system to the simple question of handling an even, steady, predetermined load. Installed in the power-house, it will allow the use of a similar number of the most highly-efficient generating units, which, being operated for long periods, fully and steadily loaded, will reduce the cost of power generation to one-half of what is possible with the apparatus best suited to the variable demands made upon most railway power-houses.

A battery will take the place of all that generating machinery which is made necessary by the loads in excess of the average output. It will act absolutely instantaneously in regulating a violently fluctuating load. It is more economical to install for a continuous output of energy than a generating unit that will not have at least a full, steady load for three hours at a time, and it has the great advantage over generating machinery for such loads that, instead of sharing with the rest of the plant a fluctuating load, it is a source of additional output that, in itself, takes care of all such fluctuations and violent changes, leaving the rest of the plant fully and steadily loaded and allowing the use of a class of machinery of much higher economy than is otherwise possible. A battery further reduces the number of times a unit has to be started and stopped to follow the load-line, as with a steadily increasing load coming on the station, the battery, by discharging, can take care of it until it reaches such an extent that an additional machine can be put in service fully loaded, filling the battery again until the output increases to the capacity of the machine.

The battery, whether gaining or losing in the amount of energy stored, will still regulate for the instantaneous load changes. The same reasons apply also to the increase in size and reduction in number of generating units, as a battery, having half the output of a unit, can keep it fully loaded by discharging on first half of the increase of load and charging on the last half, at the beginning of which the machine would be thrown in. The number of running hours of the station can be materially reduced, as the night load is usually so light, for four or five hours, that it can be taken care of entirely by the battery.

A battery is also an admirable protection against flywheel accidents. For instance, in case of a short-circuit on the line the increase in current will be taken by the battery, and when the circuit-breaker goes out, the battery will keep practically the full load on the generators. When the circuit-breaker is thrown in again, the high load for the first few minutes, due to the cars starting up, will be taken care of by the battery, so that the machines will go on undisturbed even under such conditions.—Herbert Lloyd, in the Electric Railway Number of *Cassier's Magazine.*

In an article recently published in the *Zeitschrift für Angewandte Chemie*, Dr. C. O. Weber prophesies an important industrial future for the acetate of cellulose discovered by Messrs. Cross and Bevan, some two or three years ago. In many respects this body resembles the well-known nitro-celluloses, but differs from them in being non-explosive, and is able to stand a high temperature without decomposition. It is not soluble in alcohol, acetone, or ether, but dissolves in chloroform, nitro-benzine, and certain other bodies. It is an excellent insulator, its resistance being greater than that of either guttapercha or indiarubber, and it is suggested, therefore, as a substitute for mica as an electric insulator, whilst in other applications it should replace celluloid.



DIE CONSTRUCTION.*

IN the *American Machinist* of Feb. 23 (see p. 124, March 24) I gave a description of a combination punch and die for piercing, shearing, bending, and forming a piece of sheet metal. The present article illustrates a die for shearing and drawing a piece of sheet metal into the form of a cup with irregular edges. The principle of the two dies is identical as far as the automatic feeding of the strip of metal is concerned. In details of construction and operation they differ. The finished piece, being entirely different from the previous one, calls for a different combination of mechanical movements. The arranging of combinations of mechanical movements, guided by a knowledge of how a piece of metal will act under different conditions, constitutes up-to-date die-making in certain lines of work.

In the drawing, Fig. 1 is a side elevation, and Fig. 2 an end elevation of the die-bed and slide, the punch being left out of this view, as it would not add materially to the description without overcrowding the drawing. Fig. 3 is a plan, Fig. 4 (three views) being the finished article. Fig. 5 shows the strip of metal, ·011in. thick and ⅝in. wide, with two notches cut by the shearing punches I. The metal to the left of the dotted line shows the outline of the blank that forms the piece Fig. 4.

A, Figs. 1, 2, and 2, is designed to show a cast-iron die-bed carrying the slide B. The grip C, its connection to the press and method of operation are identical with that in the reference before given. In this instance it is necessary that the piece of metal that forms the finished article be severed from the strip before any action of forming takes place. The shearing die D is therefore raised above the level of the drawing-die E, and slotted to accommodate an auxiliary slide F made adjustable by means of the shoulder screw G.

The strip of metal passing between the shearing-die D and the stripper gauge H has the notches cut by the shearing punches I. Feeding the length of one blank, the final cut is made by the shearing punch J. This punch is provided with a pin K held out by means of a very sensitive spiral spring; just enough spring being provided to insure the fact that the blank after being severed from the strip, will not draw back, but will lie in front of the slide F.

Upward movement of the ram carries the strip of metal forward for another blank, and the blank already cut is carried over the drawing-die E. The projections M 3, which are part of the gauge M, are bevelled upwardly in front of the cutting-die D, and are to insure the blanks taking their proper position.

The extent of the lateral feed is regulated by means of the screw G in connection with the slide F and the stop I, which is slotted into the gauge M and made adjustable by means of the screw M¹. Side gauging is taken care of entirely without adjustment, as this depends on the width of material which is being worked, and to get good results from dies of this description it is necessary that the width of material be uniform.

The eccentric X is to prevent withdrawal of the strip on the outward stroke of the slide. The arrangement of the pad P actuated by the soft rubber cushion Q was made necessary by the fact that the shell had to be slightly concaved on the bottom. If the shell had been flat, an ordinary push-through drawing die would have answered the purpose. The action of the pad P insures the fact that all of the shells will stick to the drawing punch T. This necessitates the addition of the stripper plate U, which travels on the stud V and is held upward by means of the spiral springs W. The travel of the ram of the press being more than the travel of the stripper-plate, continued upward movement of the punches insures the stripping of the shell from the punch, and the press being set on an incline, gravity causes the shell to fall back of the die.

The lubrication of the drawing die E must be done by a small tube (not shown) leading from left to right on to the drawing punch T, as the perfect working of this die depends upon keeping the shearing punches as dry as possible. A mixture of 9 parts soap-water and 1 part lard oil makes a good lubricant for drawing shell work.

The production of the die illustrated and described is 65,000 pieces per day of ten hours, and perhaps the best thing I could say about its method of construction would be that this particular die has produced, up to date, 9,300,000 pieces, without any perceptible wear, except, of course, to the drawing dies and punches; these parts must be renewed for every two or three hundred thousand pieces. The cutting and feeding parts after this enormous production show no great amount of wear. The question may be raised here, would it not pay to make a gang die and multiply the production at each stroke of the press? I am not in favour of multiple drawing dies, except in special cases, and I shall leave that question to be decided by the man who is responsible for the production.

* By GEO. B. PAINTER, in the *American Machinist.*

THE PREPARATION OF GROUND SECTIONS OF TEETH AND BONE.

FEW preparations for the microscope demand the painstaking attention to manipulative details that is required for the successful preparation of fine sections of teeth and bone. Many short notices have appeared in books and journals on rapid methods of making these sections by hand; rubbing them down on glass, stone, and in other ways. I have tried many of these, and do not find that I can get good results. To those who simply want one or only a few sections, I would say, you can get them from a dealer far cheaper than you can make them. To the student, or those who desire to make many sections, I offer the methods I use, to which I have drifted after large experience in making these preparation.

Apparatus.—A grinding machine, suitable laps of copper, lead, and stone, grinding powders, a chemist's wash-bottle, a small metal table, hardened balsam. My grinding machine is home-made. It is a large Swiss jeweller's lathe, fitted with a screw-chuck to carry laps, so arranged that the laps screw to a seat with great perfection. Above and parallel to lathe-spindle is a shaft in adjustable bearings; from this depends an arm or carrier, the face of which is arranged to receive and clamp with great accuracy cast-iron grinding blocks, about 3in. by 2in. by ¼in. in size. I use lead, copper, and "Scotch Water of Ayr" laps, which are turned true on this lathe. These laps, after turning, are ground one against another to *perfect* truth of surface. The grinding block, which when in the carrier can swing and be withdrawn from the lap, but is held truly parallel to the face of the lap, is now ground perfectly true to the lap. I use carborundum in four grades, from grains to that which requires fifteen minutes to settle. I grind with water from a chemist's wash-bottle. Use the grains on the lead lap, the powders on the copper, finish

with stone lap and water. The process can be divided into four heads: (1) preparation of material; (2) imbedding; (3) grinding; (4) mounting.

1. *Preparation of Material.*—(*a*) Teeth work best that are started "green"—i.e., that have never been allowed to dry out, for drying develops many small cracks, especially in the enamel. If the teeth need cleansing, wash them in dilute lye. Preserve in turpentine. Make rough sections with a ribbon or hack-saw. Make these sections thick, not less than one-sixth the length of the section, if possible. Where the saw cannot be used, grind away half of the tooth and make the section of the remaining one-half. True the surface roughly which is intended for the section. Wash carefully, picking out any grains of carborundum, and removing any soft tissues that it is not specially desirable to leave, as these are very apt to cause trouble. (*b*) Bones: Secure, if possible, fresh bone. Cut into short pieces, and macerate in water till all soft tissues are removed. Bone from the dissecting-hall, where subjects have been injected, is not well suited for this purpose, though, when well cleaned and selected, gives very good results. Saw the bone into rough sections as desired with the hack-saw, being careful that the thickness is never less than one-sixth the greatest dimension.

2. *Imbedding.*—The material, after being washed and cleansed of all grit and dust, is dehydrated in alcohol. For imbedding as well as for cementing the sections to grinding blocks, prepare some hard balsam. Take a commercial grade of balsam and dry it over a gentle heat till, when cold, it will receive the impression of the finger-nail under steady pressure, but flies to piece under shock. The material being dehydrated, pass it into chloroform; after a day add hard balsam from time to time for a week or ten days till the solution is syrupy, then pour off the solution and dry the material for a week or more, so that when cleaned of surplus balsam it shows no stickiness.

3. *Grinding.*—(*a*) Teeth: Clean away from the material all surplus balsam. Coat the surface of a grinding block with hard balsam. Arrange on this, section surface down, as many sections as can be placed on the surface, warm on the metal table, not to boiling, press each section carefully down in its place, cool, put into carrier, grind with coarse powder till a supporting surface is developed, supporting as nearly as possible the whole of each section surface. True this supporting surface accurately. Take a second grinding block, heat on the metal table, coat with balsam, remove to a wooden support, press into this softened balsam quickly and accurately, using only as much pressure as can be given with the hand, the supporting surface of sections. Before the sections can become heated through, plunge the whole into cold water; when thoroughly cold, wipe off and place on hot table with first block down. As soon as the water between the blocks begins to boil, slip block No. 1 quickly off and plunge block No. 2 with sections into cold water. Place the block into the carrier, grind with medium powder till the sections all show a surface suitable for finished sections. Polish the surface with finest powder, then with the stone lap, and finally with dry whiting powder and the hand. After polishing carefully, wash with water, being careful to remove all powder or grit of any kind, dry the surface carefully, and wipe the surface with the finger dipped into gasolene, using only the least possible quantity of gasolene. Clean block No. 1, heat it, and coat with balsam. Transfer the sections to block No. 1, as outlined above, being very careful to exert a uniform pressure in bringing the sections down on block No. 1. Grind first with the grains of carborundum, then, as the sections get thin, use finer and finer powder. If too coarse a grade of powder be used as the sections get thin, the enamel will be broken and the sections will leave the block. When all colour in the enamel begins to disappear, use the stone lap, then grind till all colour is gone from the enamel, the dentine looks transparent, not white, and the block seems to have only a coat of varnish on the surface. Polish with the palm of the hand and whiting, wash in water, dry, wash in gasolene, dry, immerse in benzole till the sections come away. (*b*) Bone is prepared in the same way, save that each section is roughly trued on one side before cementing to the block; they are then cemented with trued surface down, and the section surface is prepared directly, making only one transfer necessary in preparing the sections.

4. *Mounting.*—Tooth and bone sections may be mounted either dry or in balsam. If the cells do not suffer with a deposit of "dew," the dry mounts are the more permanent. The balsam mounts, if carefully made, will last in good condition for many years, and I think are much finer. I prepare cells for dry mounts with gelatine, and seal them with a fine ring of a hot thick solution of gelatine, finishing in black or colours, as desired. It is essential that the sections shall be perfectly dry, the cell dry, and both quite warm when the cell is closed. When made in this way I have lost few slides from "dewing." For balsam mounts I use paper-filtered balsam. Dry this on a slide, in large excess, till when cold it is nearly hard, but not flinty. While hot, coat with this one side of a suitable cover-glass, allow both to cool. Place the section between the two and press the cover down, using as little heat as possible. With a little practice and dexterity all the air bubbles that show up about the section will be washed away. Too much heat fills the section and ruins the mount. Cut away the excess of balsam, and wash, first with gasolene, then with soap and water.

As I have said, success depends upon *attention to details.* One grain of grit out of place at a critical moment will spoil all the sections. I have ground over 100 sections of small teeth on one block at one time. I usually grind 25 longitudinal sections of human teeth at once, and I have made sections of teeth 3in. in length and less than $\frac{1}{1200}$in. thick by this method. The same method can be used for any ground sections, applying, of course, suitable modifications—e.g., spines of Echinus, soft and hard tissues imbedded according to Von Koch or Weil, minerals, &c.—S. P. Cowardin, in the *Journal of Applied Microscopy.*

USEFUL AND SCIENTIFIC NOTES.

There are six new tunnel projects for Greater New York, not including the long-talked-of rapid transit railway tunnel lengthwise of Manhattan Island. Assuming the estimates of the projectors to be correct, the total cost of these six tunnels will reach eight million pounds. The various projects are as follows:—The Hudson River Tunnel Company, for a structure from Fifteenth-street, Jersey City, to near the foot of Moreton-street in Manhattan, the total cost of which will be more than 1¼ million pounds; the Manhattan Tunnel Railway Company, from Chambers-street and West Broadway to some point in Jersey City, to cost 1½ million pounds; the Manhattan and Jersey City Tunnel Company; the New York and Long Island Terminal Company, connected with the Long Island Railroad, for a tunnel from the Flatbush-avenue Station of the Long Island Railroad, in Brooklyn, to some point in Cortlandt-street, Manhattan, between Broadway and West-street, with a capital of £1,800,000; and the New York and Brooklyn Railway Company, which is planned to connect the city halls of the two boroughs, at a cost of not less than 1¼ million pounds. The three tunnels first named are to be under the North River, and the others under the East River.

Returns of Railway Accidents.—The Blue-book containing returns of accidents and casualties as reported to the Board of Trade by the several railway companies in the United Kingdom during the three months ended March 31 last, together with reports of the inspecting officers of the Railway Department of the Board of Trade upon certain accidents which were inquired into, has been issued. It appears that accidents to trains, rolling-stock, permanent way, &c., caused the death of five persons and injury to 157. All the persons killed were railway servants, and of the injured 117 were passengers and 40 were railway servants. The figures for the corresponding period of 1898 were 11 killed (eight passengers and three railway servants) and 87 injured (65 passengers and 22 railway servants). Of the five persons killed and 157 injured, 16 passengers and one servant were injured in collisions between passenger trains or parts of passenger trains; 72 passengers and two servants were injured in collisions between passenger trains and goods or mineral trains, light engines, or other moving vehicles; two servants were killed and 33 injured in collisions between goods trains, light engines, or other moving vehicles; four passengers were injured in collisions between trains and buffer-stops or vehicles at rest, caused by trains running into stations at too high a speed; 12 passengers and one servant were injured by collisons between trains and buffer-stops from causes other than the above; four passengers were injured by passenger trains of parts of passenger trains leaving the rails; three servants were killed by goods trains or parts of goods trains, light engines, &c., leaving the rails; seven passengers and two servants were injured by accidents arising from the failure of rolling-stock (wheels, tires, axles, &c.); one servant was injured by fire in a passenger carriage; and two passengers were injured in other accidents. There were 151 passengers killed and 378 injured in accidents from causes other than accidents to trains, rolling-stock, permanent way, &c., including accidents from their own want of caution or misconduct, accidents to persons passing over level crossings, trespassers, and others. There were also 113 servants of railway companies or contractors reported as having been killed and 1,101 injured, in addition to those already mentioned. Altogether the number of persons killed in the course of public traffic during the three months was 269, and the number injured was 1,635, the figures for the correspondig periods of 1898 being 270 killed and 1,406 injured. In addition to the above, 19 persons were killed and 2,816 injured upon the premises of railway companies in which the movement of vehicles used exclusively upon railways was not concerned.

SCIENTIFIC NEWS.

The "Rapport Annuel sur l'Etat de l'Observatoire de Paris" for the year 1898, by M. Loewy, the director, contains the usual information as to the work of the year, and is supplemented (or frontispieced) with a fine heliogravure of the moon, 20 days 5 hours old on Sept. 19, 1894, from a photograph obtained with the equatorial coudé of the Paris Observatory by MM. Loewy and Puiseux.

The *Bulletin* of the Société Astronomique de France for August contains an article by M. Camille Flammarion on "Le Monde de Jupiter," with several illustrations of the appearance of the planet as seen from Juvisy. It is an interesting paper for those who study Jupiter. Amongst the other articles, "La Rotation de Vénus," by the Abbé Th. Moreux, will be read with attention.

The *Journal* of the British Astronomical Association (Aug. 12) contains the reports of the branches in Australia, and of some of the observing sections. There are several interesting "papers," and a variety of notes which will be read with attention by students of astronomy.

Sir Edward Frankland, K.C.B., F.R.S., Ph.D. D.C.L., LL.D., M.D., &c., Government Analyst of the Metropolitan Water Supply, has died in Norway. He was born on Jan. 18, 1825, at Churchtown, near Lancaster, and was educated at the Grammar School of his native town, whence he proceeded to the Museum of Practical Geology, and completed his education at the Universities of Marburg and Giessen. In 1851 he was appointed Professor of Chemistry in the then recently-founded Owens College, Manchester (now the Victoria University). Six years later he was elected to the professorship of chemistry at Bartholomew's Hospital, and in 1862 he was appointed Professor of Chemistry to the Royal Institution. This post he resigned two years afterwards to accept the Professorship of the Royal College of Chemistry (School of Mines). Of the many publications from the pen of Sir Edward Frankland, the following are some of the most important:—Reports to the Local Government Board on "The Chemical and Bacteriological Condition of the Metropolitan Water Supply," "Lecture Notes for Chemical Students," "Experimental Researches in Pure, Applied, and Physical Chemistry," "The Source of Muscular Power," and "Water Analysis for Sanitary Purposes," and "Contributions to the Knowledge of the Manufacture of Gas." He was a corresponding member of the French and Vienna Academies of Science, Foreign Member of the Royal Academy of Sciences in Bavaria, and of the Academies of Science of Berlin and St. Petersburg; honorary member of the Societies of Natural Sciences of Switzerland and of Göttingen, of the Chemical Societies of Germany, and Lehigh University; and was honorary Foreign Secretary of the Royal Society.

The death is announced of Mr. John Cordeaux, of Great Cotes-house, Lincolnshire. He was born in 1831, and the ordinary occupations of a country life gave him the opportunity to compile a book on the birds of the Humber district, which is quoted by Yarrell as the authoritative work on the ornithology of that district. After the publication of this book he set to work to rouse the interest of coastguard men and lighthouse-keepers in bird life and migration, and in this way he organised a scheme for the scientific observation of the migratory habits of local birds and the occasional visits of strangers. A keen observer himself, and a successful stimulator of keenness in others, he studied as the main object of his life that which in others might have been only a hobby. He also took a lively interest in botany, archæology, and folk-lore, and was the first president of the Lincolnshire Naturalists' Union.

Mrs. Elizabeth Thompson, of Stamford, Connecticut, is dead. She was one of three "patrons" of the American Association for the Advancement of Science, and established the fund for scientific research which bears her name.

The Research Fellowships founded by the Salters' and Leathersellers' Companies respectively for the encouragement of higher research in chemistry in its relation to manufacture will be awarded probably before the end of the year. The grant made by each company is £150 per annum, and the Executive Committee of the City and Guilds of London Institute will, before the

commencement of the session, consider the applications and elect the candidates. Copies of the schemes under which the Fellowships will be awarded can be had on application to the hon. sec. of the City and Guilds Institute, Gresham College, Basinghall-street, E.C.

The German Naturforscher und Aerzte meets at Munich on Sept. 17-23, under the presidency of Prince Ludwig Ferdinand and of Duke Karl Theodore, the renowned oculist. These two princes of the Bavarian royal family have adopted medicine as a profession. It is stated that Dr. Nansen will lecture on his observations as a naturalist during his recent journey in the Arctic regions.

The monograph on the Atoll of Funaputi, which is to be issued under the auspices of the Royal Society's Coral Reef Committee, will not be published for some time, as the examination of the material will need special attention, and experts will have to express an opinion after examination of the borings. According to the *Athenæum*, there is enough material to make a volume of some 500 pages, if the geologists, botanists, and chemists are to report. It will be remembered that two expeditions have already supplied material for a tentative report; but the third expedition is probably the most important.

The report of the Geological Survey of the United Kingdom has been published recently, and shows that much work has been done in revising the maps on the 6in. scale. As to the results the Director-General draws special attention to the researches among the younger granites of the Highlands, particularly in the Cairngorm mountains and the Ben Cruachan group; to the numerous Cambrian fossils obtained in Skye; to the discovery of more new fishes in the Upper Silurian rocks of Lanark and Ayrshire; in addition to the remarkable series announced in the summary for 1897; to the evidence of the existence of volcanoes in Somerset belonging to the time of the Carboniferous Limestone; to the new light thrown on the structure and probable extension of the North Staffordshire coalfield; to the additional information obtained regarding the volcanic history of the western mainland of Scotland and the Inner Hebrides; and to the fresh data gathered from all parts of the three kingdoms with respect to the successive stages of the Ice Age. It is satisfactory to learn that the practical usefulness of the facts collected by the Survey and Museum of Practical Geology is becoming more widely recognised every year.

Preliminary arrangements have been in progress for some time in order that the National Physical Laboratory should be organised as soon as possible after the requisite funds were voted by Parliament. The six technical societies have nominated their representatives, the general board and executive committee have been constituted, and the greatest satisfaction will be felt at the announcement that Lord Rayleigh has accepted the chairmanship of these bodies. On the recommendation of the executive committee, the council of the Royal Society has appointed Mr. R. T. Glazebrook, F.R.S., now principal of University College, Liverpool, to the important post of director of the National Physical Laboratory. A number of sub-committees have also been organised by the executive committee, which have been requested to make suggestions preparatory to the drawing up of a detailed scheme of work and of the plans of the new buildings. The members of the executive committee are Lord Lister, P.R.S., Lord Rayleigh (chairman), Mr. A. B. Kempe, Treas. R.S., Prof. A. W. Rücker, Sec. R.S., and Sir Courtenay Boyle (*ex officio*), Captain W. de W. Abney, Sir N. Barnaby, Mr. G. Beilby, Sir E. H. Carbutt, Captain E. W. Creak, R.N., Prof. R. B. Clifton, Prof. G. C. Foster, Mr. F. Galton, Prof. O. J. Lodge, Sir A. Noble, Prof. J. Perry, Sir W. Roberts-Austen, Prof. A. Schuster, Mr. A. Siemens, General Sir R. Strachey, Prof. J. J. Thomson, Dr. T. E. Thorpe, and Sir J. Wolfe Barry.

In a memoir presented to the Paris Academy of Sciences, M. A. Chauveau states that the positive work done by the animal motor takes from the animal heat an amount quantitatively equal to the mechanical work done.

The following extraordinary paragraph has been published by the *Standard*:—"A Berlin engineer asserts that he has invented a new motor superior to any hitherto in use. It is, he declares, unlimited in its application, and may be used for carriages, waterworks of all kinds, and especially as a ship's propeller. One advantage claimed for the invention is that the apparatus is inclosed in a cylinder, and is not liable to external injury. Besides being more effective than the screw driven by steam, it is said to combine greater effectiveness with economy in construction, and at the same time to occupy smaller space. A trial made with a small model has, our Berlin correspondent says, proved, to some extent, the accuracy of the inventor's calculations, and a large model is now being made in order to test the value of the new system."

At the annual meeting of the Royal Botanical Society the sixtieth annual report was read, and disclosed a considerable improvement, at any rate in the number of members. The total number of Fellows and members was 2,102. The balance sheet to the end of 1898 showed a liability of £20,670 16s. 10d., which was more than covered by the amount of plant and buildings belonging to the society as a going concern. The report went on to say that, while increasing the refreshment-room accommodation, the council had sanctioned the establishment of a club within the society, which had proved a source of increased strength to the society, and had added greatly to the attractions of the gardens. The number of members of the club was now 560, including 220 ladies. The attendance at the gardens during the past twelve months reached 86,090, compared with 67,212 during the previous year. The chairman said the gardens were much more popular than they had been; but he would be very sorry to see their scientific character lost in that of amusement. The society was struggling on with too small an annual income; in fact, he did not think that the gardens could be kept up as they should be with the present low rate of subscriptions.

Liquid air is, it appears, to be used to hasten the process of eremacausis, and also to intensify the temperature of the crematorium. It is announced that a cemetery near New York is being equipped for the cremation of the dead in an electric furnace, supplied with oxygen by means of liquid air, thus reducing the process from hours to minutes.

Wireless telegraphy was tested during the recent naval manœuvres, and came out in a very satisfactory way; but it is now stated that wireless telephony has been tried by the Italian navy, and has been found to serve all useful purposes.

Signor d'Asar's wireless telephone, according to a correspondent of a morning paper at Rome, has been recently experimented with on a large scale at Spezia with excellent results. Messages were sent from the semaphore to ships at a distance of four miles, and warships were also able to communicate with one another just as if they had been connected by telephone wires. Admiral Bettolo, the Italian Minister of Marine, is said to be an enthusiastic admirer of the invention, and has given orders for its adoption throughout the Italian navy.

The latest discovery in America is a boy with such peculiar vision that he can see through substances in the same way as the Röntgen rays. His name is given as Afley Leonel Brett, of South Braintree, Mass. The boy is said to have diagnosed a number of fractures. In confirming the diagnosis of a broken hip he pointed out that the fracture was nearer the head of the bone than had been thought by the physicians. He examined a child who, it was supposed, had swallowed a coin, and declared there was no coin there. This was proved to be correct at the post-mortem, the child having died from other causes. The lad also uses this power by so concentrating the sight as to shut out ordinary daylight. The air, he says, is then filled with flashes of a pale greenish light, which illuminates the objects to be examined. This light, he says, is the same as the X-ray in the Crookes tube. Daylight is then darkness or a reddish black. Many wonders exist in America—especially during the slack season of the newspapers.

It is stated that the five-cent nickel coin of the U.S. currency was designed with special reference to its use as a unit of weight or measurement by the decimal system. It is exactly five grammes in weight and two centimètres in diameter. This is, of course, not an accident, and if there be any change in America's system of coinage, other convenient measurements and weights will be adopted according to the same system.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE GREGORIAN TELESCOPE.

[42684.]—In spite of some hard rubs from "H." (who evidently has but a poor opinion of "a certain Balolo") I will, with our Editor's permission, remind our able contributor that my letter on Compound Reflectors (41398), Aug. 26th, 1898, p. 40, was, on the whole, *a strong plea for the Gregorian.*

I will candidly admit that I, like many others, quite failed to see, *at that time*, the necessity for the accurate dimensions and measurements given by "H." But his exceedingly valuable series of articles on the Compound Reflector have been a revelation to me, and I think we must confess that readers of the "E. M." are greatly indebted to him for the pains he has taken to give a lucid account of a difficult subject.

I hope that his series of papers on Gregorian optics and construction may be republished in a separate form, as there is so much information therein not to be obtained anywhere else.

It was rather unkind of "H." to take no notice of my request that he would give me data for converting my short-focus Newtonian into a Gregorian! I did not feel this so much until I found out how much more gracious and complaisant he had been to Mr. "Ell Hay." And yet Mr. Hay is disappointing. For in 42669, p. 575, he says his Gregorian is no worse and no better than his Newtonian in definition, but most unpleasant in use! This is not what we want. How does his Gregorian perform on moon or planets? According to "H." the great virtue of the Gregorian lies in its power of forming correct images of objects having a sensible disc; and in this he assures us it is much superior to the dumpy Newtonian, although the latter may divide a close double star well enough. The method for finding practically the size and distance of "eyehole" *without the telescope*, as given by "H." last week, is very clever and ingenious. The *Edinburgh Encyclopædia* gives no account of the way to do this *with the telescope already made.* But that, as "H." says, is easy enough. Balolo.

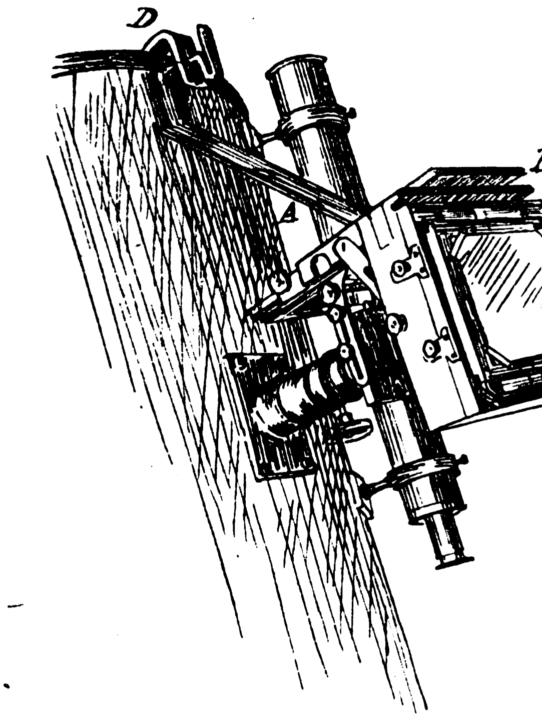
[42685.]—Being unwell, I can at present do no more than thank "H." for the details he gives of the two telescopes, and suggest to "Ell Hay" that a diagonal eyepiece will suit a Gregorian as it does a refractor, and that the former is no worse to use than the latter, as regards one's position.

A. S. L.

TELESCOPES.

[42686.]—It appears from various writers there is a good deal of trouble in getting secondhand telescopes. I have not had any trouble myself (of course, I am not a dealer); the reason is plain. I seldom take any reflectors but my own make, and I have every opportunity to overhaul, adjust, and try them before sending them out again; they are then equally reliable as new, and I am responsible. My second-hand ones are taken in when a client desires a different or larger instrument; they, therefore, do not get knocking about on the "market." I don't take a refractor before knowing or trying it; this course prevents disappointment. I have generally a list of those who are wanting such and such a thing when I "have one to offer."

Refractor makers, I believe, are also willing to take instruments and allow for them. But though the amateur knows he is quite safe in getting his second-hand instrument this way—some are fond of "bargains"—they sometimes, for a trifling difference, trust to what they call "picking up" one. The dealer buys many things in "the dark," or at sales; he is, therefore, as liable to be deceived as an amateur, and don't buy "lots" with the *intention* of deceiving; they don't find out their purchase till afterwards. They have not the opportunity to try them, and in the case of a reflector don't sufficiently understand them, so that an allowance must be made for a dealer. The dealer never buys only bargains; their expenses are great, and they must get a good profit. G. Calver.



THE NEWTONIAN REFLECTING TELESCOPE.

[42687.]—ADJUSTING LARGE MIRROR.—I do not know whether the following simple and certain method of adjustment has ever been tried or not; but I can certify that it admits of great accuracy. Point the telescope to sky, take eyepiece out, and fix a ½-plate camera, with its lens attached, in position as in sketch, and you will obtain, after focussing, a sharp image of large speculum, showing flat as a small round disc in centre. The three strips supporting flat mirror will also be shown. Now, with a pair of dividers, measure carefully the length of each strip, and if they are all equal the mirror is in adjustment; but if they are of unequal lengths, the mirror is, of course, out.

Fixing Camera to Tube.—As this plan of fixing a camera to a reflecting telescope is simple and efficient, and may prove useful to many, I will give details. The camera C, Lancaster's Instantograph, is fitted with a separate baseboard, B, with a long slot in centre. A is an iron strip suitably bent, one end of which is firmly clamped to telescope mount by means of clamp D, and the other end bent so as to be parallel with base-board. This end of the strip, which is slotted, is screwed on to base-board. When the focus is altered, the camera shifts up and down, and is clamped in position by means of its tripod-screw.

Barlow Lens.—I find that the definition of my telescope, the mirror of which is 12½in. aperture and 80in. focus, is greatly improved by using a Barlow in conjunction with the Huyghenian eye-pieces. Notwithstanding the great increase of power, I never now observe without the Barlow lens.

Cell.—It will, perhaps, be remembered that when I gave a description of my telescope in these columns a few years ago, some exception was taken to the employment of a disc of mahogany for cell-base, although it had been seasoned several years, and was well coated with shellac varnish. In order to see whether any improvement would result in the employment of a metal disc for mirror support, I had a disc of steel made some time ago, ¼in. thick, and both surfaces carefully levelled, that in contact with speculum back being made as perfect a plane as possible. Since this was done I have made many observations, but I cannot notice any perceptible improvement in definition resulting from the change.

Preserving Silver Film.—Since using a tight-fitting tin cap to cover mirror when not in use, I have had no trouble with silver film tarnishing, &c. I would recommend the rim of cap to be made of tin of a medium gauge.

Stellar Photography.—I use a ½-plate camera with wide-angle lens for taking the exposures, employing the telescope as a guide. My procedure is as follows:—The camera is screwed, by means of its tripod screw, on to a wooden saddle, which is firmly strapped to telescope tube. Both are now pointed to constellation which is to be photographed, matters being so arranged that the camera is focussed and adjusted for the star group whilst a fairly bright one occupies the centre of telescope field. Insert a medium power eyepiece and throw star out of focus; rack until there appears a large black disc surrounded by a bright ring. Uncover camera lens, and guide telescope so that the bright ring remains of the same thickness throughout the exposure. If it is desired to suspend the exposure for a time, the camera may be capped and exposure scope allowed to rest. On resumption, the telescope is again pointed to the star, and the the telecontinued. In case the equatorial mounting is out of adjustment, the declination clamp should be left loose, and the correction can easily be made whilst following the star.

Gateshead. T. D.

SOLAR EYE-SHADES FOR TELESCOPES.

[42688.]—WITH reference to the suggestion made by Mr. Ellison (in letter 42662) that the glass shade might be placed *within* the principal focus of the object-glass, instead of in the common place *on* the eyepiece. I may say that I use a $2\frac{7}{10}$in. achromatic by Ross, in which I have the coloured glass shades fixed in short brass tubes which fit into the several eyepieces of the telescope on their further side (that is, on the object-glass side of the eyepiece). With my instrument I find this plan to answer admirably, and the definition is excellent. With a large aperture I should doubt whether the heat would be sufficiently lessened at this position, but the place of the screen glass might be put still further within the focus.

Some years ago I used a 3½in. achromatic with diagonal solar tube, having a glass plane reflecting surface. With this I found that although the glass shade-glasses were not cracked, yet after a time they were spoiled by the appearance in their centres of a small swelling or pimple, the result apparently of partial fusion. Excepting perhaps with very small hand-glasses, I do not believe that it is safe to use a dark glass over the eyepiece in the usual way, although most 3in. advertised astronomical telescopes are sent out with them.

15, German-place, Brighton. R. J. Ryle.

RELATIVE AMOUNT OF ABERRATION IN COMPOUND REFLECTORS — LEARNERS AS AUTHORITIES.

[42689.]—I BEG to thank your skilled and courteous contributor, "A. S. L." for his kind appreciation of my attempt to illustrate, in letter 42620, the possibilities and conditions of aberration corrections in the Gregorian telescope, with casual reference to the Cassegrainian. I am sure we all heartily wish him many more years in which to exercise his keen but just criticisms of whatever relates to subjects of this kind, and, to our benefit in the past, we know his abilities have by no means been limited in "Ours" to this narrow scope.

The present note is given with the intention of deferentially adding to, not detracting from, his remarks on the subject mentioned above, and referred to by him in letter 42649. I am constrained the more to do so, as I feel certain that many readers who interest themselves in these matters, but who may happen to be less posted in optical science than your able correspondent, will be very apt to draw reversed conclusions from the comparison he gives, when he says, "The total amount of aberration to be dealt with is far greater in the former (the Gregorian) than in the latter (the Cassegrainian), and this seems to more than restore the balance in favour of the Cassegrainian."

In so short a note as 42649 the omission of many points was a necessity, and his omission to say that the above "balance in favour of the Cassegrainian" could only refer to the primitive form of compound reflectors of the early writers and of the textbooks—i.e., with *spherical specula* (for until recently no other curves were deemed possible), has drawn from me this addition to his remarks. This addition I humbly submit, with the hope that neither the able author whose letter I annotate, nor the general reader, will attribute to me the smallest wish to place the slightest discredit upon the communication of so valued a fellow-contributor: a contributor who, well versed in theory and of long practical experience, has never been found, like some recent would-be practical critics, attempting to pronounce with assumed "practical" authority upon the merits or demerits of arrangements the nature of which (to judge by requests just made for very elementary information) time alone has not as yet permitted them to learn beyond the merest rude elements, either as a science or an art.

And yet this critic would have us take crude experimental results, made withal, upon a vitiated basis, as authoritative dicta upon what, in well-instructed and experienced hands, has long been known to the contrary! (See "Hay" on Alteration of Newtonian, 42669.) Far different are "A. S. L.'s" remarks, and when I differ from him, as I on a few occasions have done, I feel that I am differing from one whose experience is worthy of respect in every way.

In making comparisons as to relative amount of aberration in Gregorians and Cassegrainians, let us separate the conclusions thus:—

(1) Let both telescopes have spherical curves throughout. Here there can be no doubt about the spherical aberration being somewhat (not "far") greater in the Gregorian than in the Cassegrainian, in which latter, if only the specula could be made more nearly equal in focal length than practice allows of, that aberration might be almost altogether eliminated—a Utopian condition only but faintly approachable in the very smallest sizes, where F : F' may be made as low as 4 : 1.

(2) Consider, now, both telescopes to have such figures on their specula as have already been stated, and long known to be theoretically capable in their combination of correcting this *spherical aberration*, the only really great aberration from which any form of reflecting telescope can possibly suffer, leaving out of consideration for the present the so-called Schaeberlean error entirely. With properly matched conics, we have just seen (42620) how the Gregorian may be made to have no remaining trace (theoretically) of *this spherical aberration*—i.e., the Gregorian becomes "aplanatic" in the sense in which English optical writers use that term, "flatness of field" remaining quite another consideration. That flatness has, however, also been shown to be equally attainable in the fully corrected Gregorian, and by the same means used to correct the error of sphericity. Also we have seen how, under similar geometrical conditions, with suitable curves for the Cassegrainian, spherical aberration also vanishes, but we are not to forget that *this correction is not one whit more easily effected or more perfectly attained in the Cassegrainian*, because it so happened that with spherical specula it was on the way, so to speak, towards that correction already.

Once leave spherical figures, and the convex small speculum becomes no longer an advantage in the least, as the parabola and hyperbola of the Cassegrainian come no nearer an aplanatic combination than do the parabola and the ellipse (or other curves) in the case of the Gregorian. Indeed, as already noticed by all practical men, the Cassegrainian cannot to the same extent as the Gregorian take advantage of the above *theoretical equality* in spherical aberration correction by reason of the almost insurmountable difficulty of figuring a true *convex* hyperboloid.

But suppose that difficulty overcome, the two telescopes are still but equal in above corrections, neither having the slightest advantage ("in that respect"). With even spherical specula (attempted) the same trouble supervenes, and hence the old writers, while noticing the slight theoretical advantage of the Cassegrainian, were careful also to mention the fact that practice by no means realised these expectations. (See Smith, Coddington, Barlow, &c.)

(3) In flatness of field, as in corrected spherical aberration, both types, by the use of properly-matched curves, are theoretically in perfect equality.

(4) The so-called Schaeberlean error, or error depending upon inequality of magnification in different zones of the image, can also, as we have seen, be fully got rid of in the Gregorian. In the Cassegrainian, instead of this correction, we have the error in question somewhat exaggerated.

(5) The final balance between the two compound reflectors, *when conic section curves are taken advantage of*, stands thus:—

(*a*) Spherical aberration (the major error) equally corrected in both.

(*b*) Curvature of field equally corrected in both.

No.	1899.	G.M.T.	From.	To.	Mag.	Dur.	Description.
		h. m.				s.	
1	Aug. 10	10 40	287° + 53°	275° + 37½°	2	—	Swift; streak.
2	„ 10	10 41	1 + 60	328 + 53	2	—	Swift; streak.
3	„ 10	10 48	310 + 61½	270 + 83	3	—	Swift.
4	„ 10	10 54	307½ + 82½	40 + 80	2	0 3	Swift.
5	„ 10	10 58	278 + 45	265 + 37	3	—	Very swift.
6	„ 10	10 59	350 + 79	302 + 58½	4	—	Very swift.
7	„ 10	11 11	282½ + 52	272 + 37½	2	—	Swift; streak.
8	„ 10	11 20	0 + 50	335 + 40	3	—	Swift; streak.
9	„ 10	11 23	90 + 85	206 + 76½	2	0 3	Swift; streak.
10	„ 10	11 27½	10 + 72	60 + 85	3	—	Very swift.
11	„ 10	11 37½	100 + 83½	192½ + 77½	4	0·3	Swift; streak.
12	„ 10	11 41	70 + 75	40 + 68	3	—	Rather swift.
13	„ 10	11 44½	347½ + 47½	325 + 30	2	—	Swift; streak
14	„ 10	11 46½	5 + 70	10 + 87	3	—	Very swift.
15	„ 10	11 49	373 + 55	262½ + 40	1	—	Swift; streak.
16	„ 10	11 50½	342½ + 47	326 + 34	2	—	Swift; streak.
17	„ 10	11 56	38 + 72	330 + 72	4	—	Very swift.
18	„ 10	12 0	2 + 42	342 + 23	1	—	Swift; streak.
19	„ 10	12 3	2½ + 43	347½ + 30	2	—	Swift; streak.
20	„ 10	12 4½	324½ + 37	328 + 70	2	—	Rather swift.
21	„ 10	12 5½	343 + 48	318 + 27½	1	—	Swift; streak.
22	„ 10	12 7½	10 + 47½	355 + 37	3	—	Swift; streak.
23	„ 10	12 11	73 + 57	87 + 53½	3	—	Swift; streak.
24	„ 10	12 14	4 + 44	343 + 27	1	—	Swift; streak.
25	„ 10	12 15	47½ + 68½	50 + 75	4	—	Swift.
26	„ 10	12 17	57 + 43½	60 + 35	2	—	Swift; streak.
27	„ 10	12 19½	60 + 52	67 + 46	2	—	Swift; streak.
28	„ 10	12 21½	59 + 66½	80 + 71½	4	—	Swift.
29	„ 10	12 24	48½ + 56	15 + 69	4	—	Swift.
30	„ 10	12 36	350 + 78	280 + 72½	2	0 3	Swift; streak.
31	„ 10	12 42	35 + 49	25 + 34½	2	—	Swift; streak.
32	„ 10	12 44	50 + 55	55 + 52	3	0·2	Swift; streak.
33	„ 10	12 44	37½ + 58½	35 + 60	4	0·2	Swift; streak.
34	„ 10	12 47½	342½ + 62	315 + 67	4	0·2	Very swift.
35	„ 10	12 50	15 + 27	2 − 1½	1	—	Swift; streak.
36	„ 10	12 50	40 + 60	38 + 63	3	0 2	Swift; streak.
37	„ 10	12 52	8½ + 2½	0 − 2½	4	0·2	Very swift.
38	„ 10	12 58	35 + 35	30 + 6½	2	—	Swift; streak.
39	„ 10	13 2	53 + 82½	56½ + 70	4	—	Very swift.
40	„ 10	13 5	28 + 35	22 + 18	2	—	Swift; streak.
41	„ 10	13 6	33 + 47½	25 + 32½	3	—	Swift; streak.
42	„ 10	13 7½	13 + 31	0 + 5	2	—	Swift.
43	„ 10	13 10	44 + 59	45 + 61	2	0·2	Swift; streak.
44	„ 10	13 12½	345 + 67	300 + 57	1	—	Very swift; streak.
45	„ 10	13 16	170 + 77½	195 + 65	2	—	Very swift; streak.
46	„ 10	13 18	2½ + 45	343 + 31	♃	—	Swift; streak.
47	„ 10	13 20	4 + 43	345 + 28	2	—	Swift; streak.
48	„ 10	13 23	340 + 40	340 + 82	3	0 3	Swift.
49	„ 10	13 24½	40 + 35	15 + 28	2	0·3	Swift.
50	„ 10	13 55½	45 + 50	45 + 45	♃	0·2	Swift; streak.
51	„ 10	13 28½	37 + 62	335 + 75	4	0·2	Very swift.
52	„ 10	13 28½	40 + 73½	135 + 61½	3	0·2	Very swift.
53	„ 10	13 30½	32 + 19	29 + 3½	2	—	Swift; streak.
54	„ 10	13 32	352½ + 42½	347½ + 33½	3	0·3	Swift.
55	„ 10	13 33½	10 + 32	48 + 51	3	0·2	Very swift.
56	„ 10	13 38	28 + 34	22 + 16	2	—	Swift; streak.
57	„ 10	13 38	30 + 45	20 + 30	2	—	Swift; streak.
58	„ 10	13 41½	22½ + 34½	33 + 15	4	0·2	Very swift.
59	„ 10	13 48	59 + 52	64 + 47½	3	—	Swift; streak.
60	„ 10	13 50	42 + 42	10 + 60	4	—	Swift.
61	„ 10	13 51	44 + 43	70 + 68	4	—	Very swift.
62	„ 10	13 55½	42½ + 61	42 + 63½	2	—	Swift; streak.
63	„ 10	13 57	25 + 72	340 + 77	3	—	Swift; streak.
64	„ 10	13 57	57½ + 67	80 + 72	3	—	Swift; streak.
65	„ 10	13 59	38 + 47½	32½ + 30	3	—	Swift; streak.
66	„ 10	14 1	40½ + 55	38½ + 52	2	—	Swift; streak.
67	„ 10	14 1	58 + 52	65 + 44	3	0 3	Swift.
68	„ 10	14 4	96 + 59	135 + 66	2	0·3	Swift.
69	„ 10	14 8	340 + 80	160 + 67	4	0·2	Very swift.
70	„ 10	14 10	25 + 27	17½ ± 0	2	—	Swift; streak.
71	„ 10	14 12	32 + 40	26 + 23	1	—	Swift; streak.
72	„ 10	14 13½	2 + 17½	351½ − 2	2	—	Swift; streak.
73	„ 10	14 15	313 + 67	270 + 76½	♃	—	Swift.
74	„ 10	14 15	195 + 74	241 + 59	3	0·3	Swift.
75	„ 10	14 18	20 + 40	350 + 20	3	—	Very swift.
76	„ 10	14 20	37½ + 58½	0 + 57	3	0·3	Swift; streak.
77	„ 10	14 22	46 + 50	47 + 46½	3	—	Swift; streak.
78	„ 10	14 23	60 + 87½	220 + 76½	1	—	Swift; streak.
79	„ 10	14 26	40 + 75	30 + 85	2	—	Swift; streak.
80	„ 10	14 27	103 + 61	150 + 65½	4	—	Swift.
81	„ 10	14 31	41 + 52½	40 + 48	4	—	Swift.
82	„ 10	14 38	30 + 25	9 + 15	3	—	Swift.
83	„ 10	14 38	30 + 29	3½ + 17½	3	—	Swift.
84	„ 10	14 40	21 + 62½	40 + 81½	3	—	Swift.
85	„ 10	14 41	42½ + 43½	38½ + 19½	1	—	Swift; streak.
86	„ 10	14 53	51½ + 21	41 + 17½	2	—	Swift.

(*c*) Zonal equality of magnification attainable in the Gregorian, *not so* in the Cassegrainian.

Therefore the last-mentioned error, plus the more probable greater departure from theory in the figure of the small speculum, remains against the Cassegrainian, "*leaving the balance in favour of the Gregorian,*" the reversed placing of the advantage being only possible on the old lines with spherical specula, and in this, modern practice has corroborated theory.

H.

THE PERSEIDS 1899.—I.

[42690.]—Watch was kept for meteors on August 10th, from 10h. 35m. to 15h. 0m. During this period the sky was wholly clear except from 11h. 0m. to 11h. 10m., the time of actual observation being, therefore, 4h. 15m.

A meteor as bright as Jupiter was seen by my brother about 10h. It fell from near β Ursæ Minoris through Boötes—a more exact position cannot be given. There was a slight streak.

From 10h. 35m. to 11h. 0m. the hourly rate of meteors was 14; from 11h. 10m. to 12h. 0m., 13; from 12h. 0m. to 13h. 0m., 21; from 13h. 0m. to 14h. 0m., 27; from 14h. 0m. to 15h. 0m., 21. No allowance has been made for the time occupied in recording.

Details of the whole of the meteors appear in the above table, from which I obtain the following radiants:—

Meteors.

A. 5° + 50° (5, 10, 14, 34, 54, 58).

B. 43 + 57½ (1, 2, 7-9, 11, 13, 15, 16, 18, 19, 21, 22, 24, 25, 28, 30, 32, 33, 36, 40, 43, 44, 46, 47, 50, 53, 56, 62, 64, 66, 70, 72, 76-79, 81).

C. 47½ + 59 (23, 26, 27, 31, 35, 38, 41, 42, 45, 57, 59, 63, 65, 67, 71, 85).

D. 64 + 34 (29, 49, 68, 80, 82, 83, 86).

E. 340 − 5 (48, 52, 55, 69).

The remaining table classifies the meteors according to their magnitudes against the several radiants:—

Magnitudes.

Radiants.	= ♃	1st.	2nd.	3rd.	4th.	Totals.
A	—	—	—	4	2	6
B	3	6	18	7	4	38
C	—	3	7	6	—	16
D	—	—	3	2	2	7
E	—	—	—	3	1	4
—	1	—	2	5	7	15
Totals..	4	9	30	27	16	86

Further observations are reserved until next week.

Walter E. Besley.

The Chase, Clapham Common, Aug. 12.

[42691.]—The Perseids were well seen here. On the night of the 10th I counted 37 between 9 and 9.45 Paris time. I could only see clear to the horizon on the North. Three struck me as exceptionally brilliant, one at 9.8 passing through the square of Ursa Major being fully equal to Vega, but leaving no trail that I could see. Another passed through Corona Borealis at 9.24, leaving bright trail of a greenish colour. At 9.48 one passed close to Arcturus. I just caught it with an opera-glass, and the trail appeared like small sparks. All seemed to radiate from close to Perseus.

Boulogne-sur-Mer. Verinder.

THE DELUGE.

[42692.]—Letters upon this subject have lately appeared in your pages—for you are good enough to insert most of the communications from your subscribers—but, when they relate to the above subject, do we advance much? The facts seem to me to stand this way: In years gone by, certain priests wrote that which they, with their limited knowledge, thought interesting and possible; this has been handed down, but how few men who think can accept a word of it as true.

In the first case, geologists show clearly that there have been many floods; they probably arise from the earth's motion relatively to the sun. There is about twenty-two thousand years between flood and flood. This being so, how many hundred years must have passed between the building of the Ark and its being floated.

Then as to its size and its capacity. Well, it it must have been less than some of our modern vessels. Now, will any one venture to say that the largest of our vessels is approaching the necessary size to hold two of each kind of animal and its food. The thing is preposterous.

Next comes the floating. Can anyone suppose any vessel to be strong enough (even if built of our present high-class steel) to withstand the floating and the stranding. We surely have enough everyday experience to show that to touch ground means destruction of the vessel.

It may be said that Divine power influenced and made the Ark an exception to the action of natural law. But if this supernatural power were introduced, it seems to me that animals and men would have been left to float about under its protection in the fresh seawater. It would be far better than being crowded together in a filthy box. J. W.

[42693.]—There is a serious objection to the line of argument Mr. Rouse (letter 42665) adopts. A tradition, to be accepted as evidence of the occurrence of an event, must not be contradicted by facts. I sing of facts, as Ovid says, and no one accuses geologists, anthropologists, philologists, zoologists, and archæologists of inventing the awful array of facts which confront the tradition of a universal Deluge. Jesuit and other missionaries have travelled far and wide, and in some cases an apparent diluvial tradition may be but a relic of their teaching. However, local inundations (such as that of the Yang-tse-Kiang) naturally make us expect diluvial myths in various localities.

Lenormant and others have tried at various times to deduce Chinese characters from Cuneiform without any very great success. But if we are to suppose the Mongolian progenitors emigrated from Armenia a few thousand years ago, it is difficult to see why they took with them the contemporary

writing, but not a ghost of the language or grammar, Chinese being radically different from any of the so-called Aryan languages. It seems better to credit the Chinese with the independent invention of a method of writing. If one traces both methods back to the simple pictorial representation of objects, any discoverable similarity becomes easily explicable. I may add that these attempted identifications were generally to support a theory that Central Asia was the locality from which the human races dispersed. It has since been shown that there is no solid basis for the hypothesis.

As for our Diluvian sophist (letter 42667), Genesis vii. 21-23 are too explicit to support his quibbles. To imagine that Plutarch describes a Noah's Ark at Thebes is just as comical as to conceive a philanthropical partnership between Rameses the Great and his much-beflogged fellaheen. Mr. Garbett omits to mention why, if the extinct animals he names were alive in B C. 3102 (his date), pairs of them were not preserved in the Ark. For all the rest of the animal kingdom to merit drowning there must have been a shocking amount of depravity amongst the poor beasts. One supposes the monstrous turpitude of the rabbit equalled the notorious vice of the humming-bird, and the abandoned shamelessness of the slug, the gross moral delinquency of the gazelle. Such odd reflections make it difficult to discuss a recent universal Deluge with becoming gravity. J. Dormer.

PROFESSOR BONNEY'S STORY.

[42694.]—THE "Fellow of the R.A.S.," on p. 576, refers "Glatton" to Prof. Bonney's "Story of Our Planet;" but does he mean the Rev. Professor's *Sunday* or *Monday* story of our planet? because these are widely divergent. On some Sundays he teaches "As it came to pass in the days of Noah, even so shall it be also in the days of the Son of Man. They ate, they drank, they married, they were given in marriage, until the day that Noah entered into the ark, and the Flood came and took them all away." Moreover, he gets £1,000 a year indisputably for this doctrine of the "Story of Our Planet," but possibly nothing, or less than nothing, for the different story that he has compiled. I would advise "Glatton" to keep to what brings the Professor his £1,000 a year, and save even the price of the book that the "F.R.A.S." recommends.

E. L. Garbett.

WIRELESS TELEGRAPHY.

[42695.]—STILL another system of communication between two distant stations by means of Hertzian waves has lately been devised by Prof. Braun, of the Strasburg University, said to be quite different from Marconi's, and that of the Buda Pest firm of Shaefer and Co. The inventor and his assistant, Dr. Canto, of the same university, have been experimenting for some time under the auspices of a syndicate, of which Herr Zole-Koeln, banker, is chairman, and G. W. Bargmann, Hamburg, Manila merchant, one of the leading members.

On the 13th July last a practical demonstration of the merits of this new means of communication between two distant stations was given before the finance committee and a number of invited guests, which turned out very satisfactory. The messages were sent by means of an ordinary Morse writing telegraph, which has long been in use on a *wire line* from the Cuxhaven lighthouse, or rather a temporary wood erection near it, to the well-known *Kugelbaake-Helgoland*, four kilomètres off.

After a short address by Dr. Cantor, in which he accentuated the reliability of their process, and the hope that they might soon succeed with even simpler apparatus, the practical test was given. The audience waited in great suspense the answer to the transmitted message from the receiving station.

In due time the bell rang, and the clicks of the Morse instrument were heard, though a rising thunderstorm somewhat interfered with their regularity, as they are with the ordinary wire line connections of telegraphs and telephones. Wind and rain seem to have no impeding effect. On the whole the audience was satisfied that a step forward had been made in this wireless telegraphy.

A. Caplatzi.

REDUCING INTENSITY OF LIGHT.

[42696.]—MR. ELLISON (letter 42662) may probably obtain what he requires from Messrs. Horne and Thornthwaite, of the Strand, who some years ago introduced Levander's solar and sidereal diaphragm eyepiece. The instrument takes the place of the ordinary draw-tube, and therefore slides into the body of the telescope, and may carry the fitting of a Barlow lens or of a dark glass at its further end. The other end carries a draw-tube to receive any eyepiece, while midway is a diaphragm, the aperture of which can be varied by a screw having an external milled head. A description of the instrument will be found in the *Monthly Notices* of the R.A.S., XXXIX. 199. U.

UP "DEVONIAN," G.W.R.

[42697.]—THINKING it might interest many of our readers, I give below times I took of a run in the new train running this summer from Exeter to London, a distance of 194 miles, without a stop. The train is allowed 3 hours 50 minutes for the journey. Both the driver Warren and the stoker Richards deserve credit for the way in which the pace was evenly maintained throughout the entire journey. Date, July 19, 1899; Engine, 7ft. 8½in. single bogie Wellington, 3028; train, six eight-wheeled coaches (five corridor) equal 155 tons behind the tender; weather fine, dry, and calm.

Stations.	Miles.	Chains.	Booked Times.		Actual Times.			Speeds.
			h.	m.	h.	m.	s.	
Exeter (St. David's) ..	0	0	12	0	12	0	0	—
Cowley Bridge Junction	1	23	—		12	3	38	21·3
Stoke Canon..........	3	34	—		12	6	34	43·2
Silverton	7	13	—		12	10	49	52·8
Bradninch	8	31	—		12	12	10	54·4
Cullompton	12	43	—		12	16	44	54·5
Tiverton Junction	14	70	12	19	12	21	4	32·4
Burlescombe	19	16	—		12	26	2	52·2
Whitehall Siding......	19	74	12	26	12	27	0	45·0
Wellington	23	56	—		12	30	45	60·4
Norton Fitzwarren	28	61	—		12	34	41	77·2
Taunton, W. end (loop)	30	52	12	38	12	37	10	45·6
Taunton, E. end (loop).	30	72	—		12	38	10	15·0
Creech Junction	33	16	—		12	42	7	34·9
Durston Junction	36	45	—		12	45	41	56·6
Bridgwater	42	27	12	52	12	51	13	62·6
Dunball..............	44	69	—		12	53	38	62·7
Highbridge	48	51	12	58	12	57	14	62·9
Brent Kuoll	51	31	—		1	0	50	45 8
Uphill Junction	55	70	1	6	1	7	7	42·9
Worle Jn. (abreast)....	58	62	—		1	10	45	47·9
Puxton	59	78	—		1	12	13	49·1
Vatton	63	47	—		1	16	0	57·3
Nailsea	67	41	—		1	19	59	59·1
Flax Bourton	69	53	—		1	22	16	56·5
Bedminster	74	43	—		1	27	15	58·7
Bristol, Pylle Hill, Jn..	74	73	1	26	1	28	25	19·3
Milepost, 118	75	75	—		1	30	25	80·7
Bristol, East Depot....	76	78	1	32	1	32	44	26·2
St. Anne's Park	77	19	—		1	33	16	29·5
Keynsham............	80	16	—		1	37	18	44·1
Saltford	82	48	—		1	39	59	53·7
Twerton.............	85	46	—		1	43	12	55·1
Bath	87	5	1	45	1	45	15	43·5
Bathampton	89	27	—		1	48	53	37·6
Box.................	92	4	—		1	52	8	50·1
Corsham	95	49	—		1	57	6	43·0
Thingley Junction	97	65	—		1	59	39	51·8
Chippenham..........	99	79	2	3	2	1	57	56.7
Dauntsey	106	16	—		2	9	17	50·8
Wootton Bassett	111	5	—		2	15	24	46·1
Swindon.............	116	53	2	23	2	21	38	53·9
Shrivenham	122	31	—		2	27	38	57·3
Uffington	127	33	—		2	32	38	60·3
Challow	130	4	—		2	35	17	59·7
Wantage-road	133	43	—		2	38	41	61·5
Steventon	137	33	—		2	42	26	62·0
Didcot	140	66	2	50	2	46	28	50·7
Didcot, East Junction..	141	11	—		2	46	59	36·3
Moreton Cutting	143	9	—		2	50	10	37·2
Cholsey	145	38	—		2	53	3	49·2
Goring	149	9	—		2	57	14	52·2
Pangbourne	152	31	—		3	0	42	56·7
Tilehurst	155	22	—		3	3	41	58·1
Reading, West Junction	156	75	—		3	5	30	54·9
Reading..............	157	75	3	10	3	7	0	40 0
Twyford	162	72	—		3	14	19	40·7
Waltham Siding	167	45	—		3	19	4	58·9
Maidenhead	169	54	3	22	3	20	58	66·7
Taplow	171	39	—		3	22	37	65·9
Burnham Beeches	172	78	—		3	24	10	57·6
Slough	175	39	3	28	3	26	35	62·4
Langley..............	177	57	—		3	28	52	58·5
West Drayton	180	57	—		3	31	59	57·8
Hayes...............	183	1	—		3	34	21	58·3
Southall.............	184	69	3	38	3	36	20	56·0
Hanwell.............	186	47	—		3	38	7	58·0
West Ealing..........	187	33	—		3	38	56	60 6
Ealing Broadway	188	17	—		3	39	42	62 6
Acton	189	56	—		3	41	16	57·0
Westbourne Park	192	53	—		3	45	4	46·8
Paddington	193	75	3	50	3	47	30	31·4

Dalays: Checked to 15m.h. at Cullompton, and also to 5m.h. at Brent Knoll, with a slow to Worle Junction, besides the regular slows at Taunton, Bristol loop, Bath, Chippenham, Didcot, and Reading. Total time lost was 19m. 30s.

Booked time for journey, 230m.; speed, 50·6m. h.; actual time for journey, 227½m.; speed, 51·2m. h.; net time for journey, 208m.; speed, 56 0m. h.

Flying average: Bradninch to Acton, 181 miles 25 chains in 189m. 36s.; net time = 57·4 miles an hour.

Maximum speed was 82 miles an hour near Wellington. The running of this train reflects great credit on the company.

Ealing. O. R. Walkey.

IMITATION IVORY KNIFE-HANDLES.

[42698.]—LET me warn housekeepers and others against buying the imitation ivory knife-handles and other articles now becoming so common.

Last Tuesday week at the house of Mr. Bettle, confectioner, Market-hill, Woodbridge, Suffolk, a table-knife was lying on a table about 6in. from a gas-stove which was alight. Suddenly Mrs. Bettle was alarmed by seeing a sudden flash of light and a quantity of smoke, and discovered that the handle of the knife, which was made of some composition in imitation of ivory, was ablaze, and in a few seconds nothing remained of the handle but powder. Many fires are probably thus caused. E. S.

FLYING CRAFT MADE PERFECT.

[42699.]—IT is evident T. May (letter 42675) has not studied the subject of mechanical flight to any very great extent, or he would know that the very identical plan he suggests was the first ever tried. Quite naturally, men at first thought that flying the air could only be accomplished by means of a pair of wings shaped like those of the bird, and supplied with motive power from within the machine as near like the bird supplies the force as possible. Let me assure T. May that this is a very old plan, and a very useless one to boot. Just as well might George Stephenson have studied the anatomy of the horse, and then proceeded to construct a machine that should imitate it. Would he have succeeded? Well, he had just the task before him, in connection with the land, that we have before us now in connection with the air—ours is a trifle more difficult by reason that there is nothing stable in the air on which we may plant our machine. Barring this one fact, there is no difference between Stephenson's task and ours, that I can see, and I venture to say: Just as he succeeded, after overcoming any amount of opposition and ridicule, so shall we, in like manner, succeed, and our success will, in the course of time, be more effective and more complete in every way than has been Stephenson's, great and wonderful as that has been. For, remember this: the world cannot possibly stand still; it must advance as long as it exists, and once in the air, there can be no more changing about; once in the air, man will never come back to the land and sea. There will be two reasons for this—first, to do so would be to go backward, a thing man never does; onward is the grand order, and we cannot disobey it. The second reason is, when once we have a machine that will carry us safely through the air without dirt, dust, and noise, we shall think of beginning to get back some of the room and some of the land that the iron horse has robbed us of all over the world. Just fancy the number of acres in fertile little England that is taken up by railways, and what might not be grown thereon; but we are not going to fly the air by trying to do the impossible, as T. May suggests. We must use our own intellect to some purpose, because we have to discover at what points we can follow nature, and where, as I have already said, we must leave the paths of nature and strike out for ourselves. When once we can fairly see this, the work is accomplished—we have only to form the machine, and, of course, that will be no more difficult than it is now to form a locomotive engine or a steamship. I should like to respectfully inform "Desmond" that I have got a little beyond mere theory. I have been in a position to construct a practical flying machine on the lines I roughly sketched out in my letter of August 4, for the last four years. At any time during those four years of precious time I could have formed into shape that which I feel certain will be in years to come the universal carriage of the air. The fairy road through the air is the grand highway that is to be. Of this I am as certain as that the sun will rise to-morrow morning. But to go back to T. May's contention—namely, that our only chance is to imitate nature in form as well as principle. It was because they clearly foresaw the utter fallacy of attempting such a ridiculous plan that induced Mr. Maxim, Prof. Langley, and many others to go to the other extreme, and try to fly the air in a different way altogether to that which the bird practises—namely, to fly without wings. This, as far as actual flying goes, is a great advance on the utterly impossible gigantic-bird theory, and Mr. Maxim most assuredly would have succeeded in not only crossing the Channel as he promised, a few years ago, but in all probability would, ere now, have crossed the Atlantic, also in the air, for he demonstrated the possibility of mechanical flight at Bexley Park beyond the shadow of a doubt; in fact, his machine had such a lifting power that it actually tore or forced up one of the guard rails that was intended to keep the machine from flying away into the air, as it would have done had not these rails been placed over the wheels to prevent it doing so; but the one great drawback to the aëroplane is the terrible fact that no machine built on this plan can ever be one single moment safe in the air. Now, the true and only practical plan, as I have already said, and as I am prepared at any time to prove, lies just midway between these two utterly

impossible plans—one impossible, because it follows nature too close, the other impossible because it does not follow nature at all. The true flying machine will do the work on the same principle that the bird does, but in quite a different manner. As regards "Desmond's" remarks as to the speed of the wings of gnats versus swallows, and so forth, let me point out that this is, after all, pretty much a case of figures. Let "Desmond" take for his standard, say, a swallow. Now imagine a bird, made on the same lines as the swallow, but only just half the size. This will be rather difficult, as every bird is built on slightly different lines to any other. However, we will imagine a bird exactly half the size and weight of the swallow, but otherwise just like it. This bird would of a necessity flap its wings twice to the other's once; but the points of the wings in each case would travel exactly the same speed. Now, imagine half the size of the smallest, and the wings would make four strokes to one of the other, and yet travel at the same speed, so that if "Desmond" can get at the exact length of the gnat's wings, he will get the knowledge he asks.

Thomas George Challis.

FLYING CRAFT MADE PERFECT.

[42700.]—In my letter on p. 558 I entirely forgot to mention one very interesting fact in connection with the working of the bird's wings when in the act of flight. This is the extremely interesting fact that the wings descend more sharply than they ascend. Years ago I was very much puzzled why the wing of the bird did not draw the bird downward with as much force, or more, that it pushed or drove it upward, seeing that by the shape of the wing—viz., concave or hollow the underside, there naturally would be a greater partial vacuum under the bird than there would be above it, just the place where the greatest vacuum was wanted. The explanation of this apparent mystery is this extremely interesting fact: The bird, as I have already said, drives the wing down more swiftly than it lifts it up; thus we see this singular fact that the wing is really longer going up than going down; this causes the amount of vacuum created on either side of the wing to be just equal notwithstanding the difference in shape. This fact places vacuum out of the whole operation altogether. As far as the act of flying is concerned, vacuum neither helps nor retards the bird, but is exactly balanced. This proves again that all flying things get the power to fly in the air under any possible condition—windy, calm, dead still, or any condition in fact. Anywhere where there is air the bird can raise himself up in the air and go forward though it, and let us make no further mistake at this point. This power to rise and go forward in the air is all got by simply beating or striking the air harder and more effectively with the underside of the wing than with the top, and to do this the bird has to do as E. Wilson suggests, draw or contract the wing on the up stroke and expand it on the down stroke in order to first take a greater surface of air, by reason of the expansion, and, second, strike the air harder by reason of the fact above mentioned—namely, the wing descending sharper than ascending. This explains everything. There is no mystery anywhere, though men of science, that know very little of mechanics, have at one time and another manufactured almost any amount of mystery concerning this really plain and simple feat of flying the air. Edgar Wilson, writing in a recent number of the "E.M.," says that Lilienthal could perhaps have recovered himself when taken by a sudden gust of wind had his apparatus been differently made; but, with all respect to Mr. Wilson, this is a mistake. No machine with large, flat, or, worse still, concave, surfaces, will ever be safe in the air one single moment. It is impossible. Such machines will be at mercy of every gust of wind that may in any instant spring up, and sooner or later they must be destroyed, that is if they ever get far enough from mother earth. This is the reason why I have suggested to Prof. Langley that it is not improvement, but a thorough new principle on which to design his machine. In the machine of my design the car will be the largest surface contained in the whole machine, and that will be round so that the wind will glance off all sides; but allow me to say that, though apparently so dangerous to those not well versed in the subject, the navigation of the air will, there is every reason to believe, be the safest mode of travel ever devised by man, and there are several reasons I would give for this. However, there is not space here to go into these reasons. I may say this much, however, it would be quite possible for two flying machines to meet in collision in mid-air, and not a single life be lost thereby. Every flying machine will act as a parachute should the engines stop working.

Thomas George Challis.

[42701.]—I should like to make a few remarks respecting this subject. I have studied the problem of aërial flight for a good number of years, and, although my experiments connected therewith have been upon a very modest scale, they lead me to the conclusion that Mr. Maxim and Dr. Pettigrew are, with respect to the particular systems which they have openly advocated, both right. In my opinion, a successful flying-machine could, as far as elevating and propelling are concerned, be made upon three different systems—viz., the aëroplane with screw propeller for driving; the rotating screw propeller upon a vertical axis for lifting, with similar means upon a horizontal axis for driving; and the feathering wing for both lifting and driving. The present difficulty in these days of light powerful engines and potential energy stored in small compass is not so much that of lifting and driving as that of maintaining the equilibrium in the air. The flying-machine of the future will be a heavy body, having very powerful light engines and high-speed motion, and capable of great speed in travelling. A light body having a slow motion would be useless, practically speaking, as it would be at the mercy of the wind. There will be no balloons or aërostats in connection therewith.

The experiments I have made with wings strongly convince me that the figure of 8 theory of Dr. Pettigrew respecting wings properly applied is the only wing theory likely to meet with success. One has only to construct a wing upon and use it in accordance with Dr. Pettigrew's system to convince oneself of its enormous lifting and propelling power. I am strongly of opinion that Dr. Pettigrew has discovered the true actions of birds' and insects' wings.

Many birds contract the wing during its ascent, which, together with its peculiar formation, causes it to offer less resistance to the air upon its upward movement; but the upward and forward motion of the bird is, without doubt, due to the "feathering" effect of the wings.

I quite agree with the remarks of Mr. F. H. Wenham in your issue of the 28th ultimo.

Liverpool, August 8. R. J. Urquhart, C.E.

[42702.]—I trust you will permit me to enter the arena of discussion now going on the subject of flying, &c., in order to point out several erroneous statements—viz., the limiting to *one way only* of attaining certain results, when there are numerous ways and mechanical methods of accomplishing the same end; also to endeavour to defend Dr. Pettigrew's theory, figure of 8 line, to some extent practically demonstrated by me before a meeting of the Aëronautical Society of G.B., 1870. I will first take the statement relating to the flexure of wings of birds, "the pivot on which the whole problem turns." Surely Mr. Challis does not mean to assert that the flexure of wing, including reductions of superficial area, is the only process by which flight is attainable: it only applies to birds, the Chiropterea, and a few other species. Nearly all the other species have a different method of leaving and rising from the ground. Mr. Maxim never meant the construction of a machine to fly like a bird, but simply to prove the great power and lightness of his engines and the efficiency of the fixed aëroplane principle, which still remains undecided. "We may remain behind Nature except in lifting power. . . This great lifting power is to be attained by the process of the flexure up of the wings, and deflexure down of the same wings. We are doubtless much behind Nature at present, both in lifting and travelling. Mr. C. will be satisfied to travel at five miles an hour. I feel sure that nobody else will be, after describing his peculiar screw, and placing it in front to draw the whole machine. This is the only way of steering." I fail to understand that if the flexed process is so highly efficient, why the combination with the screw does not make a purely flying machine or a purely screwing one. The fact is, there are many different methods of steering. A bird that has lost his tail does not appear to affect his steering qualities much. His wings are like a pair of scales turned upside-down, but are in this case far more sensitive to the least pressure accelerated by velocity than our very best adjusted scales are affected by a few grains. The body of the bird being the fulcrum feels the least disturbance or difference of pressure, and at once instinctively re-establishes the balance either by a slight muscular tension or angular alteration, or a reduction of the superficial area of the opposite wing. Mr. C.'s large machines, I take it, viewed from under, will resemble a flock of birds flying in a line, or a series of lines, from a few yards to several miles long, and we can safely assume that the longer the line the greater will be the range of safety for balancing. Then comes the assertion that man can never fly. Will Mr. C. kindly prove by figures the truth of his statement? and, again, "by gravitation *alone* can we obtain safety." With a motor sufficiently powerful we may to some extent disregard gravitation, as in case of a projectile, the extension of length and breadth, the combination of machine and balloon as to the shape, &c. The fact is, the shape or form of the machine is no more limited than the numerous forms we find in nature. If there is anything "childish," it can only be Mr. C.'s remarks on Dr. Pettigrew's theory of the figure 8. Dr. Pettigrew recorded the fact that the locomotive extremities of most of the animals (birds, fishes, and insects included) describe a more or less perfect figure of 8, modified or amplified by the various motions and rates of travelling of the respective animals, and generalised the theory more as a means to an end, and not as a basis from which a machine should be constructed. Mr. Sutcliffe is more generous, and frankly accepts the theory up to a certain rate limit. How does Mr. S. arrive at this limit? It seems to me that, all things properly and rightly proportioned, there can be no such limit. I may add the engineers of the future may compute the efficiency of the active surfaces of aërial machines by their dynamic tracings or indicator diagrams of the respective surfaces. Mr. S. makes the assertion that birds that fold their wings entirely after each projection do not weigh more than 2oz. Mr. S. can only mean the sparrow class; but the fact is that the woodpecker class weigh several times 2oz; they fly on the same style as the sparrow. If I have succeeded in widening the scope of investigation, and in logically proving that there are, *not one*, but many ways by which the same results can be attained, the object of this note will also be conclusive.

Louis Senecal.

[Previous discussions on this subject have usually degenerated into mere word-wrangles. We do not mean that this shall, and warn correspondents that if they have nothing new to say, they need not trouble themselves merely to write attacking other correspondents, as their letters will not appear. —Ed.]

A "FLY" PROBLEM AND ANOTHER.

[42703.]—I would suggest the best way of answering this problem is to take the second question first. Imagine the fly, therefore, to have alighted on the carriage. Clearly, I think, the load will have been increased by the weight of the fly; but at the same time relieved of the weight of an equal bulk of air displaced by the fly. That is to say, the actual increase in the load will be the weight of the fly weighed in a vacuum less twice the weight of an equal bulk of air. Now, imagine the fly exactly poised in mid-air, the load will remain the same as before, for the upward thrust of the wings is just equal to the downward pull of gravity, and this thrust will be transmitted through the air to the body of the carriage, and thence to the axle. If, however, the fly commences to rise, the load, it appears to me, will increase in proportion to the additional thrust exerted by the wings, less, however, the amount required to overcome the resistance of the air; whilst, again, if the fly were to fall without effort, there would be no additional weight on the axle at all during the second or two it was falling; save, again, a small quantity due to the resistance of the air. Thinking over this problem brought a train of ideas which have ultimately taken shape as another somewhat similar problem, on the solution of which I should much like to hear the opinions of some of "ours." Imagine an iron cylinder hermetically sealed and exhausted to an absolute vacuum; at one end a pistol-barrel containing a spring and a bullet. At the centre of the earth is a cave, likewise hermetically sealed and exhausted, and within this cave is the cylinder, hanging, of course, in space, like Mohammed's coffin. All being at rest, the spring is automatically released, driving the bullet against the opposite end of the cylinder. What will be the effect upon the cylinder? W. J. G. F.

THE FUTURE OF AERIAL LOCOMOTION.

[42704.]—My warmest thanks are due to Mr. Challis and G. Sutcliffe. I am pleased to see that my opinion of the flexion and extension of the bird's pinions coincides with other fellow subscribers of the English Mechanic. There is also another point I wish to point out, and that is—in all wings, whether natural or artificial properly constructed ones, when the wing is elevated in the upstroke the outer half of the pinion darts forward; contrarily, when it is depressed in the downstroke it is impelled backward, a result which is entirely independent of the flexion and expansion of the wings. This last is caused by the great elevator and depressor muscles of the bird in conjunction with smaller ones exercising a restraining influence on the wing when it is beaten. In other words, the muscles are elastic ligaments, to enable the wing when forcibly depressed to restrain and moderate the force of the beat when desired, and to allow it to spring back again easily. Now, when I say the outer half darts forward, I do not mean that the inner half remains rigid; on the other hand, the whole wing itself darts forward when beaten, the outer half or tip extending more so. It is essentially a forward movement when in motion—a fact due to the anterior or front margin of the wing being semi-rigid and thicker than the rear margin—posterior—comprising the feathers. Therefore Mr. Challis will pardon me if I persist in adhering to my first statement that, on the foregoing basis, individual flight

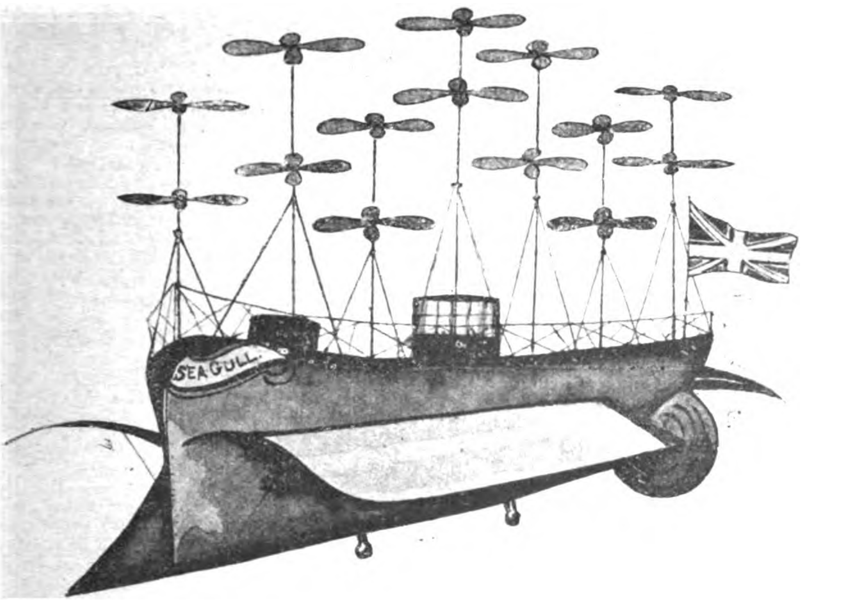


Fig. 2.

may be attained. Of course, man cannot fly by his own unaided efforts; but with suitably constructed wings, and with springs to assist elastic cords to represent the elevator and depressor muscles of the bird and the wing so constructed that it can, when in action, form a true kite, parachute, screw with reversing planes, and a lever to which the air affords a supporting fulcrum (as demonstrated by parachutists, or the bird on extended immovable wings)—flight by man, I repeat, may yet be attained.

I am surprised that such a veteran aëronautical reader as Mr. Wenham should say that a downstroke in still air is almost nil as regards supporting effect. Very evidently he forgot at the moment that the wing, when the bird is once in motion, is entirely indifferent to calm, storm, or oppositionary trend of the current. It creates in calm its own supporting currents, and utilises existing ones. For conclusive proof, who that has seen birds fly in almost absolute calm, or in storm, can doubt for an instant the fallacy of this reasoning? At the same

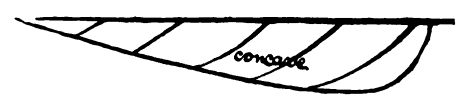


Fig. 1.

time I do not forget that we are indebted to Mr. Wenham for pointing out in this journal as well as at the first meeting of the Aëronautical Society, that an advantage of the long narrow pinions of the albatross lies in the fact that if the current of wind strikes the front margin of an inclined plane, this would be equivalent to the air striking the whole.

J. Sutcliffe (letter 42652) concurs a good deal with my own views. Yet I would point out that not only do "certain small birds" flex their wings, but I have no hesitation in saying, without fear of contradiction, in reality, *every bird does*; those species with short small surface wings flexing the pinions to a far greater extent than the larger and ample-surface winged class, as the eagle, hawk, osprey, albatross, &c. The reason that several attempts at *flying* have failed because the materials of the wings gave way, must undoubtedly have done so; because, in addition to poor construction, they were *rigid*. Had they been plastic and yielding, and conformed to natural types, I sincerely believe they would have been found more practical and efficient. In Fig. 1 is shown an artificial wing, imitating the natural wing in all its natural requirements. To a tapering cane is affixed transverse tapering canes pointing in the direction of the tip, the whole being covered with fine cambric. It is structurally and functionally a reversing screw propeller, reversing its planes as it is alternately raised and depressed. When it is held loosely in the hand and vigorously beaten up and down, it will be found that it darts forward in curves or waves. In the downstroke it darts downward and forward; in the upstroke, upward and forward. In the natural wing as it is impelled upward the body of the bird falls; when it is depressed (and acting as it does against gravity and the air impinging on its concave under surface, to necessitate its beaten with greater force than in the upstroke) the body rises, thus forming the figure of 8 line of progression as stated in my former letter (42625), bearing in mind that the bird is in motion. It should be stated that the wings are elevated and depressed much higher than the body rises and falls; yet, none the less, it really does so. The weight of the bird contributes to flight, and the reason that small birds fold their wings close to their bodies after giving a few swift strokes is because without any supporting surface an increased momentum is given; but when the wings are suddenly expanded, downward motion is transferred into a curved direction. For instance, when an eagle forces the osprey to give up a fish caught, the wings are folded, the eagle falls with ever-increasing momentum, when it suddenly expands its broad wings and vertical tail, and the vertical fall is changed into an oblique and curved movement.

Mr. Challis (in letter 42651) implies that he pins his faith in the vertical beating of artificial wings as the most practical method of obtaining artificial flight, and asserts his opinion that there will be scores of these wings. In my judgment, I sincerely believe that there are two ways of navigating the air—viz., the artificial wing and the screw. He also says that we cannot imitate nature exactly, but in principle only. Precisely. The principle of nature as exemplified in the bird is the screw. We understand that the bird impels itself upward and forward by screw propulsion, resting on concave surfaces at the same time. Screws have also given many encouraging results. Why not, then, employ the principle of nature in our own way, as shown in Fig. 2, which embodies my views, and which I firmly believe is the future of aërial locomotion. The future is to the *air-ship* and not the aëroplane. It is to the screw that the conquest of the air will assuredly fall. E. Wilson.

63, Lower-road, Rotherhithe.

HOW INSECTS FLY—THE MECHANICAL BIRD—AERIAL SCREWS.

[42705.]—Replying to "Desmond" (letter 42673), it may interest him to know that both Prof. Pettigrew and Dr. Marey advance an opinion that insects operate their tiny wings as horizontal screws. My own researches enable me to say that this theory is perfectly correct, and if "Desmond" cares to experiment as follows, providing he has sufficient interest, he will discover the truth of this remark. By holding a common fly by its legs, permitting the wings to move freely, and allowing the rays of the sun to fall on the insect as it is viewed from above, it will be found that although the blur of the swiftly moving wings is difficult to analyse, certain it is that to the expert mind that the wings are in reality screws working horizontally, steering being effected by the aid of the universal joint at the shoulder, which enables the insect to rise, fall, or turn at any degree of obliquity. It is surprising what great weights compared to size of wings some insects have, and which is extremely encouraging when concentrating notes as a basis for designing an artificial flying apparatus on the same principle. For instance, take the stag-beetle, which has a large body with small surface wings, and which, according to the conclusions of M. Lucy, the stag-beetle is 460 times *heavier* than the gnat, yet only has 14 times more surface or wing area. In the case of the bird, compare grouse, with their large heavy bodies and extremely small wings. Yet the "secret of flight" is all on the same principle in aërial locomotion (as in aquatic), and that is the screw. The bird flies in a vertical heliocopheral flight, the insect in a horizontal. Now, can "Desmond" contradict and demonstrate the fallacy of this reasoning? If he thinks he can, I can give a practical demonstration as a conclusive proof. Without desiring to wound his susceptibilities, allow me to point out to him that we are not all theorists, similar to him, judging from his remarks, but base our designs on experiment.

In reply to letter 42675, I wish I had known Mr. T. May was also noting the perfect flying of the seagulls at Blackfriars Bridge as well as myself. With regard to his suggestion to imitate flight by a mechanical bird with artificial wings, the following paper, read before the Aëronautical Society by a Mr. J. Marshall on similar views, may prove instructive. Briefly, he proposed and constructed a system of two pairs of artificial wings—*à la* Dr. Pettigrew—the top pair to act as elevators and propellers, the lower pair as sustainers, operated by steam power. His conclusions are that it is well known that action and reaction are equal and opposite, and that force expends itself in the plane of least resistance; consequently, whatever power is employed to raise the wings reached in a downward direction, and, finding a ground support, was thus enabled to elevate the weight, the wings being an ordinary lever; but when the power necessary to operate the wings was contained in the vessel, quite another action was set up, the force escaping in the path of least resistance, and is non-effective, simply because a counteracting influence is established by reason that the support from the ground is withdrawn. However, discarding the lower wings and utilising an aëroplane, better results were obtained.

"Young Learner" (letter 42674) very evidently labours under a misapprehension in asserting that screws are not effective. Mr. George Davidson, in his lecture to the Aëronatical Society, showed a practical demonstration of aërial screws only 4ft. diam., which lifted a weight of 48lb. per H.P., machinery weighing only 10lb. per H.P. Is this non-effective? I, myself, have made plastic screws of artificial wings which flew splendidly with only indiarubber. Why should not, then, light machinery elevate far greater weights on a proportionately increased scale? If the bird flies on an oblique plane, screws can operate a machine to do likewise. They contain this advantage over other systems in that they desire no preliminary run to create impetus, the revolving screws containing a certain amount of inherent motion. In my first conception, as shown in another column, I have improved on the original in many ways, as, for instance, the screws are so constructed as not to break the column of air, twin screws for propulsion, &c. It has been found that the faster the speed the greater the elevating power, and it is to the foregoing superior advantages the screw possesses over other systems that I so strenuously advocate their adoption. It is obvious that the artificial-bird system is really the same principle in another form; but, as I have frequently pointed out, the screw is the best understood and most practical, the ultimate and successful evolution of which will greatly change the social and political conditions of the world.

It would be unfair to suppose the Editor can lengthen this discussion indefinitely, so this must close it so far as I am concerned.

Edgar Wilson.

BALLOONS IN SECTIONS.

[42706.]—During rather a long life I have heard and read of several accidents to balloons, either bursting, or their being ripped open by contact with houses, trees, &c., some of the accidents being accompanied with loss of life, or severe injuries, to the occupants.

A young married sister was very much impressed on reading an account in the papers of the accident to Mr. Spencer's balloon near West Norwood. During the night it occupied much of her thoughts, it ultimately suggesting to her mind whether such accidents could be prevented, or, at least, reduced to a minimum. Several things suggested themselves, among them, that if the balloon was made in two, three, or more independent sections, each being filled and controlled separately, but still inclosed in the one network, would do this. The idea is so simple I am surprised it has not occurred to me. It certainly is one that would greatly lessen the possibility of a total collapse of the balloon, for it is scarcely possible the whole of the sections could be rent at same time. I cannot say the idea is original. If it is (I certainly have not heard of it before) it may perhaps call the attention of practical men to the possibility of constructing balloons in sections.

Pepys-road. Geo. E. Parker.

THE DANGERS OF CONTACT WITH LIVE ELECTRIC CONDUCTORS.

[42707.]—Dr. Hubert Kath, at the instance of Messrs. Siemens and Halske, of Berlin, has lately inquired into these dangers, and reported the results of his inquiries to the Society of German *Electrotechnikers* at their annual meeting. According to the experiences hitherto made and recorded, the effects of accidental or purposely provoked contacts are of two kinds: fatal contacts and contacts from which recovery is generally possible. The former kill by destroying the nerve centres essential to life. They generally result from large currents of, say, 1,000 and more volts and 2 to 7 ampères, equal to

about 14H.P. *Accidental* contacts with currents of such intensity are happily not frequent. They are mostly used for electrocutions, as at New York.

The second kind of effects are produced by currents of 10 to 100 times less power. Though they prostrate the victims and produce *apparent death*, recoveries are very frequent, if proper means are applied. These sort of currents seem to paralyse the lungs of the unfortunates. The shock experienced produces the sensation of being drowned, and the kind of restoratives are recommended as those used in cases of drowning: artificial breathing and rubbing especially. That the same currents produce often very different effects must be attributed to the condition in which the body who experiences the shock happens to be in at the time. The skin may be moist or dry. The workman's hands may have touched salt, solutions, or have been soiled with filings or other metal dust. He may have weak lungs or be charged more or less with liquor, &c. These facts cannot be too well known, I think. **A. Caplatzi.**

TURN OUT THE TOES.

[42708.]—The following extraordinary statement appears in the *Globe*, which, however, does not supply any names:—"A doctor has announced his belief that in diagnosing a patient's case it is as essential to observe his walk as to feel his pulse. From recent investigations in this branch of what we may venture to call pedestrial therapeutics, it appears that a person in vigorous and robust health walks with his toes pointed to the front, and that as health begins to go the toes turn gradually out and a perceptible bend appears in the knees. It will certainly come as a surprise to a good many people, drill instructors especially, to learn that it is correct, in the best sense of that loosely-used word, to walk with the toes pointed straight to the front. At the same time there seems to be something in the idea. There is a suggestion of force and directness in toes kept rigidly to the front which is not conveyed by the present orthodox fashion of toes turned slightly outwards."

Now a "person of vigorous and robust health" walks just as he was trained to walk when young; but I think it will be found that the majority of people of the educated classes, or those who have been drilled, invariably walk with the toes pointing outwards, which seems the natural way for the foot to tread. I can well remember, when a youngster, having a daily drill of the kind, which consisted simply of putting the heel of one foot against the big toe of the other, and then trying to touch the heel of the other with the toe of the front foot. That is impossible, I believe; but the drill is in use at all dancing academies, and especially at those establishments where they train acrobats and ballet-dancers. I have some recollection of seeing a paper read before one of the scientific societies, in which it was pointed out that those races which habitually walked with the toes pointing outwards were the conquering races of the world. I should like to hear what some of your readers have to say about the matter. **S. R.**

POISONED AIR AND CANDLES.

[42709.]—Candles will burn in air that would instantly kill any man. This was notably shown in a case of suffocation about two years ago at the East-end of London—Blackwall or Poplar. Nobody should descend into a well till a caged bird has been lowered, especially if "foul air is to be found in almost every well," as "M. E. W." says "everyone who knows anything about the subject is aware," p. 580. Caged birds should be kept specially for this purpose wherever wells have to be examined. **E. L. Garbett.**

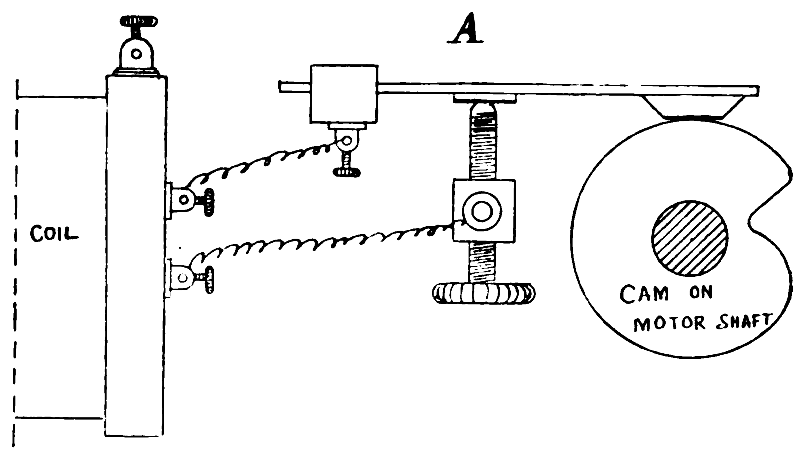
MOTOR CYCLES.

[42710.]—It might be of interest to some of those readers following the very able articles now appearing in the English Mechanic on the making of motor cycles, and especially those who are thinking of making them in accordance with the design set forth, to draw attention to two details which are the subjects of letters patent in this country, and which have been referred to by one or two correspondents.

First, with respect to mechanically-released contact maker, I have the specification before me, it is numbered 19734, A.D. 1895, and the claims are—First: "In an explosion engine a make and brake contact device, acting in conjunction with an induction coil, and having a flexible blade, which is caused to vibrate mechanically by moving some part of the engine substantially as described, and for the purpose specified." Second: "An apparatus or device for controlling the electric ignition of the working charges of an explosion engine, and for regulating the speed thereof, substantially as described with reference to the accompanying drawing." The drawing marked "A" is a facsimile of that in the above-named specification.

Those who would like to use a mechanically-released contact-maker might be glad to know that

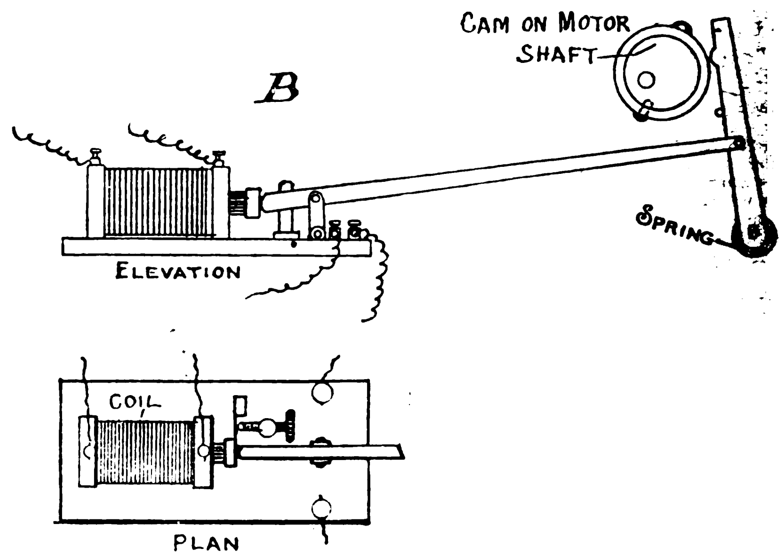
A



the one referred to is not the first arrangement of mechanically-released contact-maker which has been suggested, and, I believe, used. I attach a drawing marked "B" of this device. It will be seen by comparison of the two devices that in the first named the cam directly releases the spring contact-maker, and enables it to come in contact with the screw point, and in the second through a lever and strut pressing against the spring blade by means of a more powerful spring, and releasing it by the cam on the motor-shaft.

Second, with regard to the securing of the cylinder to the crank-casing by long bolts lying

B



parallel with, and close to, the cylinder walls, this is claimed only in respect of explosion engines, and the "invention" appears to be merely the application. It is an old and obvious arrangement even in the case of cylinders and cylinder cover; but I believe it is one of the "master patents" of a well-advertised concern, and unless a user intends to stick to it through thick and thin, for the present it would be better not to bother with it. It appears to me to have no special merit where castings are employed for the cylinders.

I have been looking for a clear and direct anticipation of this arrangement, having seen it, I believe, in some old gas-engines, in order to settle the matter in the interest of readers of the article on motor bicycles; but up to the present I have been unable to obtain what I want.

Referring to remarks made by several writers recently in your columns respecting motor cycles, it has been said that a high speed cannot be got out of a long-stroke engine. If 1,500 revolutions per minute is a high speed, that can easily be got with a stroke equal to two diameters, and even two-and-a-half diameters. I have used both proportions. The chief objection to long strokes is, they necessitate a larger flywheel, and for motor cycles this is objectionable, as room is scarce. As regards the use of gun-metal and phosphor bronze for cylinders, I believe one or the other is successfully used on some of the Bentz cars. If the metal is hard and the piston and cylinder end are both made of it, I do not see why it would not do better than soft cast iron.

Regarding motor bicycles, it is difficult to arrange a motor upon the ordinary safety, taking everything into consideration. I would suggest using a front driver with 30in. and 24in. wheels, and applying the motor to the smaller back wheel. I am making one for myself on these lines, and when finished I shall be glad to give my experience of its running and the main particulars of its construction.

Liverpool, Aug. 8. **R. J. U.**

REDUCING INTENSITY OF LIGHT.

[42711.]—In reference to Mr. W. F. A. Ellison's remark (letter 42662, p. 576) about a perforated stop, I think the work in which he has read of its being used must be Chambers' "Handbook of Astronomy," where, on p. 285 of Vol. II. 4th edition, is the following:—"Dawes adopted and recommended the practice of covering the entire object-glass with perforated cardboard, such as that employed in Berlin wool-work. The effect of this expedient in producing sharpness of definition he considered to be very marked. When the object to be viewed was not bright enough to bear the loss of light arising, he found that something like the same good results might be obtained with a piece of cardboard of the size of the object-glass pierced with holes of equal size (about ½in. in diameter), arranged in concentric circles."

About a year ago, I tried the effect of placing a piece of perforated cardboard, blackened dead-black, immediately in front of, and resting against, the o.g. of my 3in. achro., and found, like Mr. Ellison, that, although it served the purpose of reducing the light admirably, it was impossible to get any definition at all. It made the sun appear to have 3 or 4 concentric limbs, as Mr. Ellison says, and I also noted they were alternately coloured purple and green, the colours being exactly like those of the secondary spectrum, but not so bright. I should be glad if any of the contributors to the English Mechanic on optical matters could explain the discrepancy between Dawes's statement and the result of Mr. Ellison and myself.

Aug. 14. **S. B. Gaythorpe.**

In connection with the visit of the Société Belge de Geologie, an excursion to Charlton, Erith, and Crayford has been arranged by the Geologists' Association for September 9. Members who can speak French are specially requested to attend. Mr. A. E. Salter, 14, Amersham-road, New Cross, S.E., is the excursion secretary.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96178.]—**Small Telescope.**—If Frank Schlaudeman will get a dark glass head, he can limit the intensity of the light. The better plan, though, would be to get a strip of neutral tint in the form of a wedge, with a plain glass of the same form, and place the thin end of one to thick end of the other; he would get a great range by viewing the image through it. THEODOLITE.

[96183.]—**Fitting Conical Axis.**—To fit a theodolite centre on axis, the hole in the hollow or middle centre must be broached out with a good broach, and then ground out upon a brass plug, turned to fit the whole length of the hole, using pumice-stone crushed on a metal (brass for preference) plate with oil. This grinding requires to be carefully done. After a little grinding, the hole must be cleaned out by twisting a piece of rag and pulling it through, and the plug wiped clean must be twisted round in both directions will show where it bears. It must then be made to fit all along as before, a very old smooth file being used for this purpose. When the plug or grinder fills the hole all over and the hole appears polished, a mandrel must be fitted with which to turn the outside. This should be of steel with brass collars soldered on it, so that these collars will fit the ends of the hole about ½ or ¾in. The mandrel should have sharp centres running in brass holes, and be coned to 60°. When roughed out, the male centre, which is best made of bell metal, should be fitted and ground in similar to the grinder, and, when nearly let down to its shoulder, be finished by grinding with scraped blue-stone and oil. The mandrel must now be fitted again, and should have about the same length of bearing at each end and also fit with equal force. The outer surface can now be fitted into its socket in the same manner. To get a good result it is necessary to do it all between dead centres. In grinding the centres in, care must be taken to ease the parts that rub hard with a graver. THEODOLITE.

[96184.]—**Graduating Centres.**—There is no occasion to put lines; the directer will centre the limbs by the central hole. THEODOLITE.

[96185.]—**Tribach Stage.**—This is better than the usual four screws if well made and designed. The screw fittings should be of good length and fit, and the screw-holes cut, and a clamp-screw fitted, to make up for wear. THEODOLITE.

[96256.]—**Electros.**—The copper shells must be put on a hot plate, the temperature of which is gradually raised. One method is to place them on an iron plate floating in a bath of molten stereotype metal. The back of the shell is coated with chloride of zinc as the flux and stereo. metal is filled in to "back up" the shell. The solder may be ordinary tinman's solder or alloyed tinfoil, which is to be melted, and brushed over the back of the shell before pouring in the metal. If the shells twist, they must be kept flat by weighting down until cool. Properly speaking, there is no such thing or process as cold soldering; but an amalgam can be made which acts as a sort of solder without the application of external heat. S. R.

[96260.]—**Northern Heights.**—If by this phrase the parts known as Highgate, Hampstead, Mountview-road, Priory-road, and Muswell Hill are meant, I would suggest that the words "even after traffic and railway work ceases" require some explanation. I know the district well, and I should like to know when railway work "ceases." As soon as the crush of the passenger traffic is over, the goods' trains come on the scene, and run all through the night. I have no knowledge of the special reference to increasing vibration of the ground; but it is quite a mistake to suppose that the railway traffic ceases. It does not; a microphone would detect it all night long. ESPAR.

[96333.]—**A Monkey Puzzle.**—If each of your correspondents taking part in this discussion gave a strict mathematical definition of the meaning he attaches to the statement "the man has gone round the monkey," it is probable that no two of them would agree. Further, it is quite likely that the majority of such definitions would be ambiguous from a strictly scientific standpoint, and therefore useless. In almost every reply so far published the writers have got fogged over one or other of the following points:—1. The distinction between relative and absolute motion. 2. The consideration of orbits which are not plane figures. 3. The probability that the transitive verb *to move round* is invariably used with reference to some plane, though not necessarily to movement in that plane. 4. The old difficulty of the "non-lunar-rotation men," who confound the movements of the several particles of a body with regard to each other, and the movement of the body as a whole with regard to another body. The whole question hinges on the meaning we give to the transitive verb "to go round." Your correspondents have so far confined themselves to examples of the use of the word colloquially in various ways. The method by which restricted meanings have been arrived at is obvious. Thus, when we go round anything we usually "get to the other side of it," therefore to go round anything means to get to the other side of it; but this is not logic. When "Lyttle Booke's" friend went half-round the house on the turntable he did not get to the other side, and why? Because the house "went round." (To go round, verb intransitive, with a totally different meaning—i.e., to revolve on an axis either within or without the body.) "Little Booke" argues that his friend did not go half-round the house, and, no doubt, it would have been wiser to remain stationary, so that by not going round he would have got round! But a truce to this nonsense. The expression has long been used in a strictly scientific sense, which I would attempt to define thus:—(1) Suppose the path of a point P relative to a point O lie in a plane, and O lie in the same plane, and θ be the angle that O P makes with a given straight line O X in the said plane and fixed relative to O. Then if, during a given time, θ has every value from O to 2π at least once, then P will have revolved round O at least once. (2) Suppose O lie not in the same plane as the path of P, or suppose the path of P be not a plane figure (in practice it never is); then P will have revolved round O referred to any plane, if the projection of P on the given plane have revolved round the projection of O on the same plane. (3) A body A will have revolved round another body B referred to any plane if every particle in A have revolved round each and every particle in B referred to that plane. According to these definitions, your correspondent does go round every object in Grosvenor-square. The man who walks round St. Paul's has been round the cross. The rim of the wheel does revolve round the hub, and the spokes do not suffer in the least, for they also revolve round the hub at the same angular velocity. With strict scientific accuracy we all go round the earth every 24 hours (here note the confusion between motions referred to different points, or relative and absolute motion). The two boxers continually "circulate" round one another, though they face all the time; and lastly, "J. H. R." certainly goes round his ring, though why this should "settle the matter" I do not quite understand. Of course, Mr. Bottone and others are at liberty to give any meaning they like to the words "go round"; but, at least, we should have "definitiveness," as "Lyttle Booke" puts it, which could only be secured by an accurate scientific definition of the meaning they adopt, and this we have not yet seen. C. P.

[96333.]—**A Monkey Puzzle.**—I do not think I assert that a state of things exists at 2ft. which does not exist at 18in. or 12in.; 2ft. was simply taken as an example. Suppose the monkey to be a geometrical point in the centre of pole; when the man has walked round the pole, has he not also been round the point? Now remove the point any distance, and let both go round centre of pole keeping in unison, is not this result different? I agree with "Scorpio" that the difficulty lies in the word "round." It would be interesting to know "J. R. J.'s" views on this puzzle. F. C. S.

[96333.]—**A Monkey Puzzle.**—Might I suggest the following supposition to the correspondents who have written on this subject? Suppose the man who walked round the pole had a ball of some 26 yards of string, and that on commencing his circular tour he tied one end of the string to a peg fixed in the ground, and that as he walked he kept unwinding the string and letting it lie loosely in his track, and on arriving at the peg whence he started, he tied the two ends of the string together. The following questions now naturally suggest themselves:—1. Does the string encircle the pole on which the monkey is perched? 2. Does the string also encircle the monkey which is perched on the pole which is encircled by the string? If not, how has the string got between the monkey and the pole? 3. Does not the string mark the path of the man round the pole? 4. If so, does it not follow that the man went where the string lies—i.e., round the pole. Conclusion: If the string encircles the pole and monkey, the man went round the pole and monkey. If the man did not go round the pole and monkey, then the string does not encircle the pole and monkey. Each reader is at liberty to pay his money and take his choice. LOW FELL.

[96333.]—**A Monkey Puzzle.**—"Lyttle Booke" seems to have overlooked the first part of my reply, where I took the moon's motion as an illustration. It seems to be the opinion of many correspondents that if you see every part of the monkey in succession, you must have been "round" it; but not otherwise. This will happen, however, if the man stops, and the monkey goes on rotating. Has he been "round" it then? It is a question of verbal definition entirely.

Oystermouth. SCORPIO.

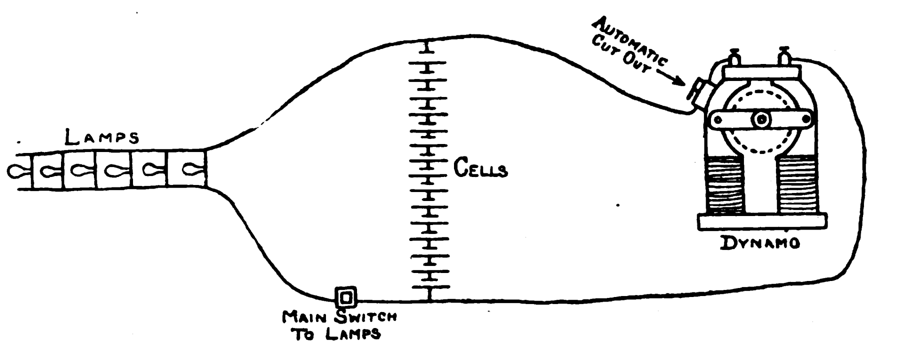
[96347.]—**Hydraulic Press.**—The compressing force or power is found from the ratio of the plunger and ram to each other, and from the ratio of the leverage of the pump handle. Thus if the plunger be $\frac{1}{2}$in. or $\frac{4}{8}$in. and the ram 6in. or $\frac{48}{8}$in. in diameter, and the arms of the pump handle as 1 to 4, then—

4 squared =	16,	and 48 squared =	2,304
Multiplied by	1	and	4
Equals—	16		9,216

—i.e., as 16 to 9,216, or as 1 to 576, so that a force of 1lb. applied at the long end of the pump-handle would produce a pressure of 576lb. on the ram. N.

[96372.]—**String and Key Experiment.**—In reply to "F.R.A.S.," p. 575, I might say that, as far as I am concerned, imagination never entered into the experiment at all. I read of the experiment (where, I cannot recall), and tried it with various persons of both sexes, and at different times. The result was always the same. I submitted it to a scientific friend, and he, in my absence, obtained the same result, but could offer no explanation. I admit I was somewhat sceptical when I first tried it; but had I not been convinced that it gave the results stated, I should not have sent it to the "E. M." It would be interesting to hear of other readers' successes with this. F. C. S.

[96389.]—**Electric Lighting.**—To MR. BOTTONE.—Procure a good automatic cut-in and cut-out. Arrange this on the dynamo. You will need 25 cells to keep up a voltage of 50v., and the dynamo must give 65v. for charging. The cells need not be large for your purpose. Then arrange the cells in series with one another, but in parallel with lamps, as shown in annexed sketch.



S. BOTTONE.

[96402.] — **Grammaphone.** — "W. E. P.," Limerick, has asked for advice respecting discs which have become impaired by use, I take it, and not faulty at the time of purchase. It is, in my experience, not an uncommon defect, and although, as Mr. Bennett says, it cannot be remedied without running the risk of damaging the next line, I have found the best way to get over the difficulty is to use a sharp penknife, and with the point make a small shunting groove from the fault to the next good line, keeping the angle very acute, as in a railway shunting. By these means I have found that the needle is helped along, and the record very slightly the worse, if any. Certainly it is better than lifting the arm by hand, and better than throwing away a record which may have nothing else the matter with it. I have found it good to make several shunting grooves to insure the needles catching in one. The needles which I use for my machine are ⅝in. at the time of purchasing, and I should feel obliged to Mr. Bennett for his opinion as to the advantage of shortening after he has given the matter a trial. J. R. J.

[96403.]—**Burnt Steel.**—It is doubtful whether any remedy will be found. Burnt steel is steel that

has had the carbon burnt out of it, and if it were possible to put carbon into iron by simply dipping it into some magic solution steel manufacturers would soon do so instead of employing the present costly and tedious process of converting iron into tool steel. Years ago, when I worked in a smith's shop in Shere, Surrey, a man came along the road and asked for work. There was none to give him. He then offered for sixpence and a drink of beer to let us into a great secret for restoring burnt steel. We agreed. He took an old flat file, made it white hot in fire, quenched it, and broke the end off to show it was burnt. He then produced some white powder, which he said was equal parts of salt, saltpetre, and salammoniac. While these were being dissolved in water, he accepted part payment for the job in beer. The file was again heated to red, and thoroughly well hammered into a cold chisel; heated again to red, quenched in the magic solution, the temper drawn, and a very good chisel it was. The man took his sixpence, with some more beer, and departed, all parties being satisfied. Some time after, another hand was engaged, a Sheffield man, used to making vices. He scoffed at the idea of the magic solution, and undertook to produce the same result, using only cold water, and his chisel was as good or better than the other. He then explained to us, who seldom worked steel, that it was the hammering that had done the trick, and that the files had too much carbon in them for ordinary tools. Some of it had been burnt out, and the particles driven up close together again by the hammer. It is only by gross carelessness that steel is burnt, and new steel is now so cheap that in most cases it must be safer to get a new piece than to go on working it.
C. G. NORTON.

[96403.]—**Burnt Steel.**—Burnt steel may be restored to its normal state by slowly reheating and annealing. It would be interesting to know if "Regent's Park" has ever tried any of his wonderful prescriptions; also the reaction that takes place when, after the burnt sample is heated to cherry red, it is plunged "in mixture when steel is cold"!
BAZIN.

[96405.]—**Crystoleum Painting.**—"Amicus" might try the following. I have not tried it myself; but, with the intention of making a crystoleum, I thought out what would certainly prove a much simpler process. Get a good negative, and take a positive from it on a process plate by contact printing, as with lantern-slides. Select the smoothest of the plates. In developing, take care not to lose the high lights—let the shadows take care of themselves. Don't miss out the alum bath. After that, and when the positive is thoroughly dry, "Amicus" will have to satisfy his own taste. He may paint with oils direct on to the film, or first give it two coats of amber or other transparent varnish; then sandblast it when hard, so as to soften the colours, which he would then paint on. At any rate, whether sandblasted or not, some good negative varnish would do no harm, but would act as a medium.
LYTTLE BOOKE.

[96407.]—**Cancer.**—The English name of the Chelidonium majus is celandine. "It is found in waste places, and in old walls in this country, and may be recognised by its small yellow flowers, and the orange-coloured juice which exudes from its stem when plucked. This juice is poisonous, and is a popular application for the cure of warts. It has been used with success in the treatment of opacities of the cornea, and been administered internally as a stimulant." A full description of its virtues will be found in old Culpeper, in which he recommends it as "good in old, filthy, corroding, creeping ulcers (answering to our present cancer), wheresoever to stay their malignity of fretting and running, and to cause them to heal more speedily. The juice rubbed often upon warts, will take them away, and applied to other such like spreading cankers, will quickly heal them." From this description the action of the remedy appears rather that of a natural solvent than a stimulant, which would be the right property, and the course I have always pursued in the cancer cases I have had to treat. I have never used the celandine, so I cannot say whether it would have that particular effect; but should I meet with another cancer case, I will give it a trial; but in a preparation of the simple herb rather than the juice, with its imputed poison.
INCOG.

[96409.]—**Trees Overhanging Garden.**—The right to lop off protruding boughs is as has been told, but not until the winter months, when the sap goes down. As to the offending boughs being the property of the tree-owner, let him cut them off and remove them at his own expense; but no law requires the injured party to send every bough, twig, and leaf, say, 100 miles off, to suit the late owner's convenience. If possible, let them be neighbourly, and settle it.
J. B.

[96411.]—**Wimshurst Machine.**—"Somerset Lad" will find that most of the coloured glass is not suited for influence machines. Before selecting any glass he should test its quality as an insulator. He may do this by warming a strip, then rubbing it with a silk handkerchief, when, if of good quality, it will attract small scraps of paper. The cracking of the plates from centre probably is due to an imperfect cutting of the hole, and the commencement of fracture existing at time of purchase. These imperfections grow day by day, owing to the unequal expansion of the glass.
J. W.

[96423.]—**Filtering Water.**—By having a rain-water separator of C. G. Roberts, Haslemere, Surrey, you can get fairly clean rain-water. In the way you speak of, you cannot.
REGENT'S PARK.

[96425.]—**Wimshurst Machine.**—The defect may be threefold. (1) The jars may not insulate well. Varnish these carefully, from tinfoil upwards. (2) The plates may have been "fingered" a good deal in cutting, and, being fitted with sectors, hence greased and oxidised on the surface. Make up a thick cream of magnesia carbonate and water; paint over the plates with this cream. Allow to dry thoroughly, then wipe off with a dry flannel. (3) The brushes do not touch the plates equally at all periods during rotation. See to this, and get the touch of the brushes as equal as possible.
S. BOTTONE.

[96425.]—**Wimshurst Machine.**—The obstinacy in starting is unquestionably due to the brushes or the sectors being either dirty or lacquered. The essential feature to produce freedom in the excitation is an absolutely metal connection between brush and brush, and also between each brush and its sector. Dealing with any one of the plates, the two sectors which are in the same line of diameter should be touched by the two brushes at the same moment.
J. W.

[96426.]—**Magnetism.**—Vitreous: Glass and slag. Stony: Slate, marble, stoneware, steatite, porcelain, mica, asbestos. Resinous: Shellac, resin, beeswax, various gums, bitumen, ozokerit. Elastic: Indiarubber, guttapercha, ebonite. Oily: Various oils, fats of animal and vegetable, solid paraffin, petroleum oil. Cellulose: Dry wood, paper, fibro-celluloid.
REGENT'S PARK.

[96426.]—**Magnetism.**—The best, and in fact the only, thing that will intercept the lines of magnetic force is a sheet of soft iron.
S. BOTTONE.

[96427.]—**Boot Polish.**—Try this stain: Oxalic acid 1oz., alum 1oz., annatto 1oz., isinglass ½oz., sugar of lead ½oz., dissolve in water (1 quart) for ten minutes. Apply with sponge. To keep leather supple, a few drops of cod-liver, castor-oil, or vaseline sponged or brushed over.
REGENT'S PARK.

[96429.]—**Steam Pump.**—The cause of the noise in your steam pump is that where it runs fast the water cannot follow it; a vacuum is formed, and when it meets the water the shock is heard.
WM. GRIMSHAW.

[96433.]—**Locks on the Trent.**—The Trent Navigation now begins at Sawley, about 100 miles above the Humber; the locks between that place and Burton-on-Trent having been long abandoned. The river is joined by the Derwent, and by the Trent and Mersey Canal at Sawley. Thence the locks are three miles, Cranfleet dock, where the Soar runs in from Leicester, &c. Seven miles, Beeston, two locks; 13 miles, Holm Lock; 34 miles, Newark Lock; 35 miles, Nether Lock, where one gets on to the tidal water. Beware of the "æger." Loughborough is not on the Trent, but on the canalised part of the Soar, about 9½ miles above its junction with the main stream at Sawley. There are seven locks between Loughborough and Sawley. Between Loughborough and Leicester there are some eleven locks in 15 miles. There is a book, "A New Oarsman's Guide," published by G. Philip and Son, 32, Fleet-street, E.C., which gives full information respecting all the navigable waters in Great Britain and Ireland.
COXPLANKET.

[96438.]—**Glass for Wimshurst Machines.**—About $\frac{3}{32}$in. thick for machines from 12in. to 18in. diameter, and ⅛in. for machines from 18in. up to 24in. diameter. Beyond this allow $\frac{1}{16}$in. increase for every extra foot in diameter. The best way to test the glass is to wipe it with a dry, hot diaper, lay a sheet of tinfoil under it and another over it, and see whether it will retain a charge given to it by any electrical machine. The tinfoils should be smaller by 1in. all round than the glass plate to be tested.
S. BOTTONE.

[96438.]—**Glass for Wimshurst Machine.**—The common, but flat, window glass is the best quality for these machines, and may be used up to, say, 2ft. 6in. diameter. To test it, you should get a strip, then warm it, and then rub it with a silk rag. If the quality is good, it will attract fragments of paper.
J. W.

[96441.]—**Wimshurst Plates.**—To MR. BOTTONE.—Coloured glass is generally not so good as ordinary window-glass. See also reply 96426, then test your glass as therein advised. Plates generally crack from centre, because the boss fits too tightly, and the glass is not mounted elastically. See reply 96391, p. 582.
S. BOTTONE.

[96442.]—**Waste Rubber.**—I suppose the querist does not know what he is asking for, or, rather, does not apprehend the meaning of his question. There are some patented methods of desulphurising indiarubber, and some have been described in back numbers; but it is quite certain that any really successful method of restoring vulcanised rubber to the state of pure rubber would form the subject of a patent, and it would be a very valuable patent too. The process of "curing" seems to permanently change the nature of caoutchouc. See p. 316, last volume.
S. R.

[96439.]—**Quadratic.**—

$$\sqrt{x+3} + \frac{\sqrt{x-2}}{\sqrt{x+3}} = \frac{11}{3} = 3 + \frac{2}{3}.$$

Now it is pretty obvious, from the symmetrical nature of the equation, that $\sqrt{x+3}$ is integral, and equals the integral part on the right-hand side —i.e.,

$$\sqrt{x+3} = 3.$$

$$\therefore\ x + 3 = 9. \quad \therefore\ x = 6.$$

The same result is obtained by equating the fractional parts on each side. We might have proceeded as follows:—Let $\sqrt{x+3} = p$ and $\sqrt{x-2} = q$.

Then— $p + \frac{q}{p} = \frac{11}{3}$

or— $p^2 + q = \frac{11p}{3}$

or— $3p^2 + 3q = 11p$

or— $3p^2 - 11p = -3q.$

Here we have an indeterminate of the 2nd degree, and by giving to q the values 1 . 2 . 3...., we find p, the only value that satisfies, is got by making $q = 2$, thus:—

$$p^2 - \frac{11p}{3} = -2.$$

$$\therefore\ p^2 - \frac{11p}{3} + \frac{121}{36} = \frac{121}{36} - 2 = \frac{49}{36}.$$

$$\therefore\ p - \frac{11}{6} = \pm\frac{7}{6}.$$

$$\therefore\ p = \frac{18}{6} \text{ or } 3, \text{ or } \frac{4}{6} = \frac{2}{3}.$$

Therefore, as before, $x = 6$ — the second value not available. Neither of these methods is entirely satisfactory, as they are not strictly rigid. But there are many equations which cannot be solved in any of the ordinary direct methods, of which this is one.
INDUCTORIUM.

[96439.]—**Quadratic.**—The "quadratic" to which "Ontario" refers—viz.:—

$$\sqrt{(x+3)} + \sqrt{\left(\frac{x-2}{x+3}\right)} = \frac{11}{3} \text{ or } 3\tfrac{2}{3},$$

is a doubtful species of that genus, for when reduced it takes the form (putting $y = x - 2$)—

$$81y^4 - 720y^3 - 9{,}596y^2 + 8{,}620y + 380^2 = 0,$$

for which modern theory requires four solutions. This probably resolves into two quadratic factors, which are not immediately obvious. Intrinsically, the original equation is of "one" dimension, being of the form—

$$\sqrt{(x+a)} + \sqrt{b} = c, \text{ and } x = c^2 + b - a - 2c\sqrt{b}.$$

We may solve it as a simultaneous equation by putting—

(i.) $x + 3 = a^2$

(ii.) $x - 2 = b^2$

Whence— $a + \frac{b}{a} = 3 + \frac{2}{3},$

Where by inspection we see $a = 3$, $b = 2$, $x = 6$.

Or, subtracting (ii) from (i), we have—

(iii.) $5 = a^2 - b^2$

the difference of two square integers, and since—

$2^2 - 1^2 = 3$ which is too small; the next trial gives $3^2 - 1^2 = 8$ which is too large, and, therefore, we get $3^2 - 2^2 = 5$ which satisfies the condition.
HENRY T. BURGESS.

West Norwood, Aug. 12.

[96443.]—**Platinum.**—To MR. BOTTONE.—You can distinguish between platinum foil and tinfoil by holding the foil in the flame of a spirit-lamp. Platinum will stand a white heat and will come out of the ordeal as bright and as clean as when first put in the flame, while tinfoil, on the contrary, will melt almost immediately it touches the flame.
S. BOTTONE.

[96444.]—**Porcelain Enamel for Glass.**—I think you will have difficulties in getting any enamel that does not require firing. They are mostly sold by English colour-makers. Samples perhaps from Hancock, Worcester; Emery, Cowbridge, Stafford; Wenger, Hanley. Lacroix, of Paris, is said to be a first-class maker. If you can make one out of water-glass and zinc-white, it may perhaps suit your purpose; but whether it requires heat cannot say.
REGENT'S PARK.

[96446.]—**Saccharine as Food.**—Cane sugar is not susceptible of the alcoholic fermentation. It

must be first of all converted into glucose (i.e., grape sugar), which can occur through the action of diastase if the action of cane sugar be added, as is seldom done, in the mash-tun; but is more usually effected by the action of yeast in the fermenting-tun. Its employment, therefore, has this disadvantage over that of ready-made glucose—viz., that more yeast is required. This increases the possibility of more dead yeast cells being acted upon by the alcohol, with the production of "yeast-bite." Further drawbacks to its use are that the beers brewed with it attenuate excessively, and have a tendency to produce diarrhœa, while the common raw sugar contains a great many nitrogenous impurities, which produce unsound fermentations, and when these are used frequent changes of yeast and quick consumption are necessary, &c. Another kind, which is made for brewer's use, is called invert sugar—known commercially as saccharium. The material is in this instance cane sugar, and the inversion is effected by dilute acid. It is higher in price than the glucose, and has the further disadvantage of being in a semi-moist state. Dr. Burney Yeo does not advise saccharines or sugars for diabetics.

REGENT'S PARK.

[96448.]—**Worm in Desk.**—Procure a pint of good clean benzoline; dissolve in this 1oz. of naphthaline (albo-carbon). Take your dish out of doors, so as to be out of the way of fire or candle, &c. Now paint the desk all over liberally with the benzoline, until you have used it all up. Allow the desk to dry out of doors. You will have killed all insect life by this treatment. S. BOTTONE.

[96448.]—**Worm in Desk.**—For several remedies see pp. 19, 42, 71, and 560 of the last volume. There are several replies about worms in furniture. I generally cure the trouble by rubbing in lard—forcing it, and then melting it; but it may be possible to force oil in. Anything of that kind will kill the insects. M. T.

[96448.] — **Worm in Desk.** — Apply strong corrosive sublimate solution to spots, and if colour is affected expose to the action of ammonia fumes or by brush. REGENT'S PARK.

[96451.]—**Moles.**—Lunar caustic, acetic acid, or Chelidonium majus will remove warts.

W. EWART-GIBSON.

[96451.]—**Moles.**—External use of creosote:—1 drop of tincture, 80 drop of water; apply two or three times daily. Also croton oil, or seton threads.

REGENT'S PARK.

[96452.]—**Meal Powder.**—This is "mell cake" broken down to powder between plain rollers of gunmetal usually; but why not buy of "Pinnel." If any difficulty in getting it, F gunpowder (grain) may be crushed in a leather bag, by laying bag on hard surface, and beating it with a hammer, then sift through fine sieve; leather such as used for shoes. See "Pyrotechnists' Treasury, 1887" (Chatto). REGENT'S PARK.

[96453.] — **Capacity of Accumulators.**—To MR. BOTTONE.—(1) Because, owing to the porosity of the surface of the plates, the actual surface exposed is nearly six times as great as the mere superficial area. The superficial area of each plate, counting both sides, is, 5in. by 4in. by 2in. = 40in., hence the seven plates equal 280sq.in., or nearly 2sq.ft.; but owing to the "pits" the actual surface is much greater. (2) No; better renew the acid, because when the chromic-aid has given up its oxygen, it is of no further use as a depolariser. When the chromic solution turns olive-green it is spent, and is only of use to kill weeds in the garden path. S. BOTTONE.

[96454.]—**Wimshurst.**—To MR. BOTTONE.—Take a piece of twine about ⅛in. thick and 20in. long; pass it between the plates, and tie it by its centre once round the spindle, bringing the ends out at opposite diameters of the plates. Now cut these ends back so that they reach to only ⅛in. of the edges of the plates. S. BOTTONE.

[96454.]—**Wimshurst.**—W. Milnes is wrong in supposing the vulcanite discs were drawn together "all round the periphery." If he again looks he will find them drawn together at the top and the bottom, but that they are thrust asunder at the horizontal line—or, in other words, at the collecting combs. The difficulty may in great part be overcome if he places another washer, or perhaps two more washers, on the axle. The discs are probably rather thin for their diameter, but thicker discs will cost proportionally more. J. W.

[96459.] — **Meteorology.** — I should certainly doubt that the statement of high cirrus clouds travelling at the rate of 144 miles an hour under any circumstances; as weather signs, I have watched them for many years, and have always observed them as having the slowest motion of any form of cloud, as being formed in a region far above the influence of any storm current. As weather signs, I have always looked when there are the indications of the breaking out or existence of more or less violent storms in the remote distance, of which the movements of the barometer may show the possibility of their reaching these shores before being exhausted. The last three days there have been some very fine displays of "cirrus," and especially last evening (August 13). They were very high, and I had the greatest difficulty to discern any motion. They gradually resolved into patches of vapour, which, reflecting the sunset, filled the entire heavens with fire. This morning the sky is almost obscured by heavy clouds, the temperature 1° above yesterday. During the night the barometer has fallen one-tenth, showing our position on the outlier of a remote depression and storm area, the influence of which is shown by the influx of heavy cloud from the S.W., over the long-prevalent and existing E. The change may be only temporary, and the barometer re-ascend to about the 19th, with again much cirrus as the portent of distant outbreaks. Then may come a temporary cooler wave as the result of extreme electric phenomena. TEMPUS.

[96460.]—**Dissolving Amber.**—Amber will dissolve without previous preparation in *chloroform* and *benzole*. If previously roasted and powdered, it will dissolve in turpentine and oil of lavender. I believe it dissolves in amyl acetate, but this I have not tried. S. BOTTONE.

[96461.]—**German Baths.**—Carlsbad, according to E. Lee (1846) on "Mineral Springs of Germany":—One good resolvent analysis in 1822 of the Sprudel by Berzelius in 16oz. of water:—

Carb. soda	9 695
Muriate	7·975
Sulphate	19 869
Carb. lime	10·050
Fluate	0 024
Phosphate	0·001
Carb. strontian	0·007
Earthy phosphate	0 002
Silex	0·577
Carb. iron	0·027
Carb. manganese	0·006
Grains	49 607
Carb. acid, cubic inch	11·850

Marienbad:—Resolvent and clearing analysis by Berzelius in 16oz. water:—

Kreutzbrunner:—

Sulphate soda	35·733
Muriate	12·716
Carbonate	9 616
„ lime	3·686
„ magnesia	2·548
„ iron	0·165
„ strontian	0·087
Manganese	0·035
Lithion	0·107
Earthy phosphate	0 025
Silex	0·363
Grains	64·975
Carb. acid gas, cubic inch	8·384

Ferdenandst.	Carolinenb.
21·128	3·141
8·433	0 671
8·061	0·873
3 765	1·030
2·858	3·676
0·357	0·435
0·005	—
0·086	—
0·063	—
0·053	—
0 622	0 236
45·400	10·210
Carb. acid gas, cubic inch—	
13 736	12 000

No mention of Nauheim, but particulars of some 29 other waters are given. You can get bottles of some of them at London agencies, and you could test at home instead of expense, which may run into months abroad. The Carolinen is a chalybeate.

REGENT'S PARK.

AN incident of the present state of the copper market is the receipt at New York of a lot of 9,989 bags—about 250 tons—of copper coins from India. These coins, which are consigned to the Orford Copper Company, are shipped as scrap copper, simply because they are worth more, at the present price of copper, than their face or coin value.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96048. Brazil or North Borneo, p. 385.
96052. Gastight Piston, 385.
96061. Gas Engine, 385.
96063. Cycle Chain, 385.
96079. Reflector, 386.
96085. Refrigerator, 386.
96086. Lead Paper, 386.

96248. Springs, p. 473.
96249. Wood Staining.—Photography, 473.
96257. Turning Ebonite, 473.
96265. Ink made of Banana Peel, 473.
96266. Transferring Collodion Positives on Copper Plates, 473.
99267. Cockney Accent, 473.
96272. Turning, 473.
96275. Textbook on Filing, 473.
96284. Burnishing-Ink, 473.

USEFUL AND SCIENTIFIC NOTES.

THE Knapp roller boat recently set out on a voyage from Toronto. The roller boat would not roll, and, according to the *Canadian Engineer*, became unmanageable even in a moderate wind. Five days after leaving Toronto the roller was reported as being tied to a tree about two miles west of Bowmanville, Ontario, having rolled forty-one miles in five days.

Moulding Glass.—The following method of moulding glass, adapted to the manufacture of articles open at one or both ends, and of any reasonable dimensions, is attributed to M. L. Appert, of Paris. The object is attained by means of a mould open below for admission of a core, which may be in one piece throughout or divided transversely into two portions separable from each other. The core is similar in form and dimensions to the article which it is desired to mould. The mould, which is divided lengthwise into two or more portions, to admit of the finished article being removed, is provided with lateral grooves or depressions, to prevent the fluid glass from being pushed upward by the core instead of being compressed against the wall of the mould. Means are provided for applying heat to the lower portions of the mould. In applying the process, a core with a conical point is used when making articles open at both ends; whilst for articles closed at one end, the end of the core is of the same form as the bottom of the article required; and the mould is provided with a movable cover, arranged to oppose a yielding resistance to the glass, and having vents to allow of the escape of the air and the excess of glass, such vents being, however, regulated, to prevent ejection of more than is desired of the mass of glass. The core is withdrawn to its lowest position in the mould, then the fluid glass poured in, and the core forced upward until it has finished its course, when the excess of glass is cut off.

THE following directions as to taking metal samples for analysis are given by M. Ad. Carnot, Director-General of Mines:—In order that the sample analysed should represent the average composition of the whole mass to be analysed, it must be taken of sufficient thickness, or partly from the surface and partly from the centre, because sometimes there is considerable difference of composition between the two, especially as regards the carbon content, which is higher at the surface than at the centre in grey pig rapidly cooled, and lower at the surface in the case of wrought iron. When a drill is used it should be made to pass completely through the metal while forming fine and equal borings, so that their mixture shall represent as faithfully as possible the general composition of the whole. Hard and brittle pig-irons, such as white forged pig and spiegeleisen, may be reduced to pieces by hammer on an anvil, and then pulverised in a steel mortar, the inside surface of which has been hardened. Grey pig cannot be pulverised by impact; but a fine powder may be made by a hard file, which is also useful for malleable irons and mild steels. The file may be advantageously replaced, as regards rapidity, by a drilling or planing machine if worked slowly so as not to heat the tool, which should have a blunt edge, especially if the metal be at all hard. Hardened steels, which are very difficult to work with the file or drill, may be softened by being raised to a red heat provided they be kept out of contact with the air—liable to lower their carbon content—and this may be effected by heating the part in a porcelain crucible placed inside another of clay, having pieces of coal between them, although such an operation modifies the chemical condition of the carbon. In the case of unhardened or annealed steels, powder or thin borings may be obtained by means of a file or blunt drill made of very hard steel.

QUERIES.

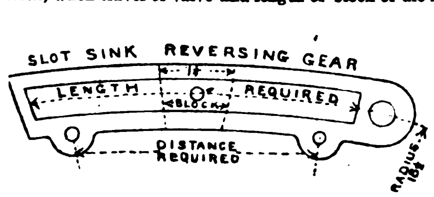
[96462.]—**Wimshurst.**—I have been constructing an eight-plate Wimhurst machine, as described in J. Gray's book on "Electrical Influence Machines." Beyond the plates there is no novelty in it. The construction of the plates is, I believe, original, and was suggested by a friend on hearing I was about to build a machine. They are made up of sheets of paper of the required diameter, boiled in paraffin wax, and a sufficient number of them compressed together to make a solid plate. This process makes a very rigid plate of the highest insulation, has no liability to break like glass or deteriorating like ebonite. For the same thickness it is more rigid than ebonite. The sectors are waxed on the plates, a groove afterwards being cut where the neutralising brushes run. I have been very particular in details, but cannot get the faintest suspicion of electrification from the machine. I have tried giving the plates an initial charge, without effect. I cannot see why the plates as constructed should not be an improvement on glass, especially as the sectors are almost completely covered with paraffin wax. I have tried to work it as a two-plate machine, with adjustable neutralising rods, but without success. I should feel much obliged if Mr. Wimshurst or Mr. Bottone would suggest to me where I am at fault, or give any reason why the paraffin plates should not work.—G. GREENHAM.

[96463.]—**Hovis Bread.**—Can anyone tell me what "Hovis" bread is made of, and how the material is prepared? Is it easy of digestion, and more nourishing than ordinary bread?—G. C.

[96464.]—**Great Laxey Waterwheel, Isle of Man.**—Can anyone say who designed and erected this great wheel, which is 72½ft. in diameter and 6ft. in width? It is an "overshot," and the water, conveyed in pipes from high-level reservoirs, ascends through a circular pillar directly behind the wheel, and is then led over the top of the wheel—an almost unique arrangement, as I should think. Power developed, about 150H.P.—N.

[96465.]—**Telephone.**—Will any reader kindly give me details, &c., of a simple telephone receiver and transmitter to work at about one mile, or particulars where I can get full instructions?—GOSSIP.

[96466.]—**Length of Slot.**—Would any reader please tell me how to work out the length of slot in link? Also to get distance between centres of eccentric rod ends, as per sketch, when travel of valve and length of block or die is



given? Example: Travel of valve, 1¾; length of block or die, 1¼; radius of centre of link, 18½.—ROBERT CRAWFORD.

[96467.]—**Inclination of the Pole.**—Will "F.R.A.S." kindly say what is the generally-accepted explanation of the inclination of the poles of the planets and their satellites? I cannot find this in Lardner, Herschel, Gregory, or Lockyer, and may we hope for his opinion on the monkey puzzle, which has excited more than an ordinary interest, because of its relationship with the lunar question probably?—J. R. J.

[96468.]—**Filling for Wood.**—Can anyone tell me by what process the German joiners fill up the end of the grain of wood? Their finish on the end of the grain is as good as with the grain.—HERBERT STONE.

[96469.]—**Indiarubber Stamps.**—Can any reader give me the following details of process for making indiarubber stamps—component parts of mixtures and temperature for working same?—G. A. L.

[96470.]—**Friction of Water in Pipes.**—What is understood by the expression "head in feet lost in passing a given quantity of water per minute through 100ft. of pipe"? A table accompanying this gives against 500 gallons and a pipe of 8in. inside diameter, 1·04ft. Does this mean that if my pipe or main is 27,000ft. in length (a project in actual contemplation), the frictional resistance to the flowing water, apart from any hydrostatic pressure, would be such as to increase the resistance equal to a column of water 280·8ft. in vertical height, for $\frac{27,000 \times 1{\cdot}04}{100} = 280{\cdot}8$. As I have, in addition, to deliver the water to a height of 410ft. above the pump, does this mean that the total resistance equals a vertical column of 410ft. plus 280·8ft. = 690·8ft.? Can you favour me with a rule for estimating this friction, and say if there are any other resistances than this, or hydrostatic pressure to be taken into account? To what extent do bends affect it?—M.

[96471.]—**Loan Amortisation.**—Are there any loan institutions existing in England which lend money at rates starting from 4 per cent. interest, and yet are repaid by a part of the interest being devoted to the paying back of the capital till annulled? Thus: say £1,000 is borrowed at 4½ per cent. interest, the capital to be paid back out of the interest in 44 years by a sum amounting to £1,967·57, whereas in the ordinary way the borrower would have paid £1,980 in interest alone, and still be indebted the amount of the original sum borrowed, or £1,000. This seems a very advantageous arrangement for borrowers, as in this way a debt extinguishes itself (against regular payment of the stipulated interest) instead of existing as an incubus upon the borrower. In addition to crediting the amortisation interest, there is a further credit at the rate of 3½ per annum on the part of the capital annulled each year by the amortisation interest, amounting in the second year to £0·35, and in the last or forty-fourth year to £31·47; the capital dwindling down from £1,000 to £31·47 in the forty-fourth year, and which is covered, as shown, by the credited interest on the paid-back or annulled portion of the capital, leaving only a balance of £1 10 to be paid by the borrower at the prearranged rate of interest in order to be quit of his liabilities. At 4 per cent. interest, ½ per cent. is devoted to amortisation.—X.

[96472.]—**Soret's Fluorescent Eyepiece.**—Can any correspondent give me details of construction and use, or refer me to any readily accessible book?—C. R. L.

[96473.]—**Hand Camera Shutter.**—Kindly give details to make a hand-camera shutter, either pneumatic or otherwise, for an Adams's Yalus twin lens. Kindly give a sketch.—YALUS.

[99474.]—**Colouring Rubber or Vulcanite.**—The platen roller of typewriters when received from the factory are of a nice, soft, white appearance; but after a few weeks' use this disappears. I have a few rollers slightly damaged, and would feel obliged if any reader will tell me how I can produce its finished appearance. The rollers I refer to are made of rubber, while others are of vulcanite.—COLONIST.

[96475.]—**Reflector.**—Will be obliged for design of simple stand for 10ft. focus reflector. There is a stand illustrated in Vol. X, by "Foreigner," which is said to give equatorial; but details are not shown.—H. N.

[96476.]—**Absolute Temperature.**—What is the meaning of "absolute temperature"? Also, "what is supposed to be the temperature of stellar space"? Also, "the boiling point of liquid hydrogen"? and the "zero of temperature"?—B. L.

[96477.]—**Old Coins.**—I have a number of old copper coins laying on velvet in a coin cabinet, and on looking over them I find that most of them are incrusted in places with verdigris. Can any reader kindly suggest a method for removing it without defacing the coins.—A. TURNER.

[96478.]—**Poultry.**—Will any reader kindly tell me the reason why fowls pull out and eat each other's feathers, as I have about twenty of last year's pullets who have almost completely stripped each other of their plumage?—A. TURNER.

[96479.]—**Bunsen Burner.**—Could any reader say what is the advantage of a Bunsen burner? Say you had a ½in. pipe without a Bunsen leading to an ordinary range oven, and one with the same size of pipe but fitted with a Bunsen, which would give the most heat, and which burn the most gas? And would a Bunsen burn well with, say, $^1/_{16}$in. hole, discharging into a $^7/_{16}$in. tube, with a piece cut out of tube, say ½in. square for the air, and eighteen holes for the flame each $^1/_{16}$in. diameter?—NOT SURE.

[96480.]—**Preserving Flying-Fish.**—Can any reader inform me of a way of preserving flying-fish, so that the skin retains some of its colour and smoothness?—D. COBWEN.

[96481.]—**To Mr. Bottone.**—I have made a small dynamo (Siemens H pattern) from your castings. I cannot get it to produce any current, but it will work as a motor. The only thing that can be wrong is the connection of the magnet and armature wires. Does it matter which are connected to which? If so, why?—D. COBWEN.

[96482.]—**Insects in Floor.**—I have a dark room in my house in the basement, the flooring of it having a great many small holes in it the size of a pin's head. We are much troubled with a great many small brown insects coming up through them. Could any of your readers tell me how to exterminate them or keep them from increasing?—A. J. SCOTT.

[96483.]—**Speed for Waterwheels.**—Can any reader kindly give a simple rule for calculating the horsepower of waterwheels, and say the usual number of revolutions per minute they should be driven?—J. PEARCE.

[96484.]—**Cubical Contents.**—An embankment on level ground is 100 yards long, 17ft. on top, and 10ft. high, the sides having a batter of 1 in 3. Calculate its cubical contents.—ENQUIRER.

[96485.]—**Humane.**—Re the article on "Human Species," will Mr. Blackwood or some other reader please say whether the offspring of a woman whose mother is a deaf mute are likely to be affected or not, the mother and father of the child not being affected.—ANXIOUS.

[96486.]—**Loune's Vacuum Engine.**—Can any of "ours" give sections, &c., of above?—E. R. DALE.

[96487.]—**Torpedo Boat Destroyer.**—Could any reader kindly tell me where I could find drawings of sections of a torpedo boat destroyer, as I wish to build a model 3ft. 6in. long, but am at a loss for correct design of hull?—T. J. P.

[96488.]—**Pitch of Worm.**—Will some of my fellow turners give me some information of the following? I have seen small worms coming into shop to have new ones made in place; they are about 1½in. diam. off some lubricators. Would someone inform me the way to get the pitch of them? The wheel is usually sent in with them. The way I have seen them done is to rig up some wheels something near and keep changing wheels till they get right pitch. Surely there is some better way than this to get wheels and pitch?—TURNER.

[96489.]—**Wimshurst Experiments.**—How should I attach Leyden jars and other apparatus to discharging rods of 4-plate Wimshurst in case? When I connect with copper wire the electricity appears to escape, as I get very little at the jars. Also, how can I make pith balls and figures dance? I have a bell jar standing on tin bottom connected by chain to earth, with ½in. brass rod passing through cork, with brass ball at each end of rod. I get a spark between ball inside jar and the tin bottom, but the figures do not move. There appears to be no provision on Wimshurst for attachment of wires except by twisting wire round the rods.—H. H.

[96490.]—**Lantern Query.**—Can any of your readers tell me whether it is possible to get a good 10ft. picture from a Russian iron magic-lantern, costing £4 4s., fitted with a Stocks patent petroleum lamp? And if so, what would be the best foci of front lenses, and best distance from the screen? I have such a lantern; it has 7in. equifocus, and I cannot get a good picture larger than 4ft. 6in. at a distance of 16ft. from screen.—BEGINNER.

[96491.]—**Electrical.**—Could one of your electrical correspondents give me a description, and, if possible, a diagram of the working of Wright's patent rebate indicator, used by electricity supply companies who charge for current on the Brighton system? I cannot find any reference to it in any book on electric lighting, &c., I have seen, or in back numbers of the "E.M."—S. B. G.

[96492.]—**Motor Cycles.**—Is it possible for the writer on the above interesting subjects, or "Monty," to describe the two-speed gear which is used in connection with the motor tandem quadricycle now being sold by Brown Bros.? I should imagine a clear description of this would be highly esteemed by readers on motor cycles.—INTERESTED.

[96493.]—**Parachute.**—Would any correspondent give me the following particulars? The ratio between the supporting area of parachute and the weight supported, and the ratio between the size of the air-hole and the size of parachute.—PNEUMO.

[96494.]—**Wireless Telegraphy.**—Could an A B C apparatus be operated without connecting wires on the Marconi system?—OPTICAL L.

[96495.]—**Oilstone.**—Can any reader tell me how to repair 11in. Turkey stone (broken through in two places), so as to avoid chisels catching when rubbing up?—CEMENT.

[96496.]—**Canary Complaints.**—He is a "mule," a cross with a linnet. Every few days he drops off his perch, huddles himself in a corner, evidently in great distress, and looking for all the world as if he were dying. In a few hours he comes round, gets on his perch, and hops and chirps about as happy as an Outlander in possession of the franchise. When he came into my possession he had a ring bare of feathers round his neck, probably caused by overstraining through the holes to reach his food, when irregularly attended. This baldness has gradually spread over his head and chest. His habits are regular; fed every day, cleaned out twice a week; but does not improve. Any information on these two complaints will greatly oblige.—PRETORIA.

[96497.]—**Magnetic Effects.**—I believe that the electrical resistance of some metals becomes greater when under the influence of a magnetic field. Can you inform me (1) in what metal is this most marked? (2) In what proportion does the resistance vary with the strength of the field? (3) What is its specific resistance under ordinary circumstances? (4) Where can it be procured? I should be much obliged for any information on the subject.—H. E. DONNITHORNE.

[96498.]—**Boat.**—I intend having 18ft. sailing-boat built, with centre-board, and fitting same with 2H.P. petrol. motor. Have any of our readers any experience to offer? Should be glad of short specification. Also any books that would assist in this matter.—AERIAN.

[96499.]—**English Lever.**—I have an English lever watch, a fairly good timekeeper, but not just up to what I would like. In comparing its timekeeping with a regulator clock, I find it does not gain or lose more than a minute per week, but then it sometimes varies as much as that in one day; there is a want of steadiness. Would some reader let me know if Swiss-made watches are good timekeepers?—P. DEWAR.

[96500.]—**Inspector of Weights and Measures.**—Can any of your readers tell me the time it takes to qualify for an inspector of weights and measures? What are the prospects of obtaining a situation when qualified?—INDECISION.

[96501.]—**Oil and Gas-Engines.**—I think of building a small stationary oil-engine, and shall be glad to know if the dimensions given for the motor-car engine now appearing in the ENGLISH MECHANIC would be suitable for a stationary engine, and if not, what alterations would be required to be made.—LEARNER.

[96502.]—**Cement for Cork.**—I wish to stick some cork chips, &c., so that I can fill up a boot for cripple. I cannot get one piece large enough, and I want to mix up a quantity, put in, and cut room for foot after. Have tried ordinary glue, but it will not act.—G. W. B.

[96503.]—**Shire.**—What is the origin of the term shire as tacked on to the names of counties? "Shire" itself is, I suppose, the Anglo-Saxon "scir," a division; but why do some counties take "shire" as part of their designation—e.g., Gloucestershire, Wiltshire, Devonshire, Hampshire? A fanciful explanation is that the county only adds shire to its name when the county town has the same appellation; but that will not do, as will be seen in one of the above examples; and on the other side there is Durham—I do not think I ever heard of Durhamshire. I presume the use is only arbitrary, and mere usage has made the terms correct. In legal documents the usual phrase is the county of—so and so, not shire.—ARCHAIC.

A VERY interesting piece of work has recently been accomplished at Jersey City Terminus of the Pennsylvania Railroad Company. The necessity having arisen for increasing the length of the train shed, which is covered by an arched roof of 253ft. span, it was determined to move back the two end bays bodily a distance of 125ft. towards the river, the extension to the roof being erected in the space thus provided. The weight shifted was 300 tons. The arches, as already stated, were of 253ft. span, and the centre height was 92ft. 3½in. To prevent the arches spreading during the work of renewal, the springings had at the outset to be tied together by 2in. tie-rods. The ribs were then jacked up clear of their foundations, and the weight transferred to nests of rollers running on a double track laid with 85lb. rails. To prevent the arches overturning during the process of removal, a large A-frame of timer was secured to the structure near the crown. The legs of the A-frame just cleared the platform when the arches were upright, but prevented any dangerous tilt occurring in either direction. During removal the arches were shifted at the rate of 5ft. to 10ft. a minute, and the work was accomplished without any accident to men or material.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, August 16, and unacknowledged elsewhere :—

Joseph Collinson.—Householder.—Enquirer.—G. W. H.—M. C. F.—Mabel.—C. J. F.—D. C. Baly.—Denture.—J. W.—T. E. Espin.—R. T.—W. Ewart Gibson.—A Fellow of the Royal Astronomical Society.—Meteor.—Fish Plate.—J. Lane.

Cosmo.—Yes. We can send the set of "best books" to any address abroad. We will pack them in a strong case free of charge, and send them by any agency you direct. We cannot tell you exactly what the freight will be—probably three or four shillings; but you can pay that on delivery at your end.

Scorpio.—We are not going to reopen the whole question of vaccination. We said so a fortnight ago. We ourselves regard the utter futility of vaccination as absolutely demonstrated, and that to discuss the general question is lost labour. We thought the special point raised a fortnight ago worth discussing, apart from the main issue.

Benj. Ruddlesden.—Presumably the powder you send is that described in reply 96336, "Chimney Cleaners," p. 538, July 28 last. The powder is packed in the way described probably because the makers find it the best method. The reply referred to no doubt gives all the available information; but we cannot make analyses and give particulars as to the method of preparation of such articles.

J. H. Perkins.—Same question, in principle, as that about the top of the wheel moving faster than the bottom. In an instantaneous photograph of a bicycle in motion the upper spokes are indistinct because they are moving faster across the line of sight than those at the bottom. If the top part of a wheel travelling along a road did not move faster through space than the bottom, at any given moment, how would the wheel advance along the road? See the indices of back volumes, or refer to any work which describes the cycloid.

Jas. Edwards.—The query was noticed (in a way) on p. 493, when it was suggested that a sketch would help to elucidate. Of course, it has not been entered in the list of "Unanswered."

T. V. M.—See Hints to Correspondents No. 4. Any metal shop can supply aluminium in sheet or ingot. Surely there is a shop in Leicester where it is sold. As to joining it together, see the many replies in back numbers on soldering aluminium.

T. Erickson.—There must be some mistake. Never heard of a machine moved by dynamite. There are electro-motors for bicycles—but Cui bono?

Moto.—"Auto-Cars," by D. Farman, published by Whittaker and Co., will suit; or if you read French, "Voitures Automobiles," published by E. Bernard et Cie., Quai des Grands-Augustins, Paris. Do not know of any American "journals" specially devoted to motor-cars.

Know Nothing.—If you can refer to, say, the last six volumes, you will find an answer to your question given many times over, probably even to the exact size of your dynamo.

Steam.—Please see Hints to Correspondents, No. 4. Any of our advertisers who deal in boiler fittings can supply them.

Ivanhoe.—Can only refer you to some textbook on magnetism; but to the first question the answer is No.

W. Teago.—Platinum is a white metal about as hard as copper, as ductile as iron, but inferior in tenacity. It is very refractory, and can be melted only by the oxy-hydrogen furnace or blowpipe and the electric furnace. Acids have little, if any, effect upon it, and it does not oxidise in the air at any temperature; but it is corroded when heated to redness in the air in contact with caustic alkalies. You can form a rough idea of whether the piece of metal is platinum by comparing its weight (it is heavy) with that of other metals; but test it with acids, and then with an ordinary blowpipe.

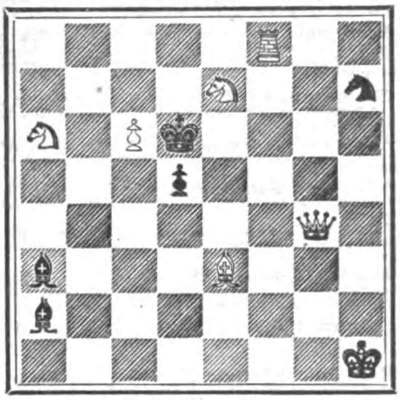
D. H.—Cases like these are much too serious for amateur advice, given in utter ignorance of the habits and past history of your friend. The probability is that he inherits a scrofulous taint, or that he is suffering from wrong living, and no one but a skilled medical man can help him. It can, at any rate, do him no harm to read the "Medical Column" in the *Weekly Times and Echo*, edited by Dr. Allinson, and live for a few months as there directed.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1688.—By F. Healey.

Black. [5 pieces.



White. [7 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Aug.* 28.)

Solution of Problem No. 1686.—By H. Otten.

Key-move, Kt-Q 3.

NOTICES TO CORRESPONDENTS.

Problem No. 1686.—Correct solutions have been received from Mahtale, A. Tupman, Richard Inwards, Quizeo, T. Clarke, Rev. Dr. Quilter, Hampstead Heathen, Whin Hurst, F. B. (Oldham), J. Mason, Carte-Blanche.

P. Laubach.—Correct solution received. Regret that space is too limited ror criticism.

USEFUL AND SCIENTIFIC NOTES.

The British Fire Prevention Committee have recently carried out a number of experiments on "non-flammable" wood, wire glass, slag wool, and the like. The object of the test with "non-inflammable" wood was to ascertain in a reliable and independent manner whether thin boards (¼in. rebated) would sustain or spread flame when in contact with fire of such high temperatures as 1,000° Fahr., for terms of five, ten, and fifteen minutes respectively. The wire glass both in skylights and windows was to show its resistance under a fierce fire increasing to a temperature of 1,000° Fahr., water being applied before and after the tests, which lasted 30 and 45 minutes respectively. The slag-wool ceiling was to withstand a fire increasing to a temperature of 2,000° Fahr. for an hour, followed by the application of water. The reports embodying the important results of these tests will be issued in due course.

Rubber Tires.—Some important observations concerning the action of the various gases upon caoutchouc and upon rubber tires have been made recently by M. d'Arsonval. If bits of caoutchouc tubing are placed in gaseous carbonic acid, under a pressure varying from 1 to 50 atmospheres, the substance increases considerably in volume and absorbs large quantities of the gas—so much so, that it often acquires ten or twelve times its original volume. At the same time, the caoutchouc becomes more gelatinous and less elastic. On leaving it exposed to the air, the carbonic acid disengages itself in bubbles, making a crisp sound on leaving, and in about an hour's time the caoutchouc has resumed its original aspect and properties. When carbonic acid is simply inclosed in a caoutchouc bag, it passes out rapidly through its walls. Oxygen does the same, though much more slowly. Here lies the explanation of the gradual deflating of pneumatic tires, says the *Electrician*. Newly-inflated tires deflate much more rapidly than those on which the pump has often been used, since the latter contain almost nothing but nitrogen, the oxygen having passed out through the tire without waiting for a puncture. The oxygen may be collected on the other side of a thin rubber partition. When tires are to remain inflated for a great length of time, they should be filled with nitrogen.

The Tonic Properties of Sea Air.—Considerable speculation has from time to time been made as to what causes the invigorating and tonic properties of a seabreeze. Ozone is very commonly accepted as at any rate an important factor in this connection, since it is invariably present in air that has been in contact with sea-water, and especially agitated sea-water, and to a smaller extent in the air of the country; but it rarely occurs in the air of towns and crowded places. Ozone, however—and with it probably traces of hydrogen peroxide—is undoubtedly formed by air skimming over the surface of fresh water, and hence the breezes coming over the lochs in Scotland and large lakes and rivers in other places become ozonised and bracing. The Briton has an instinctive fondness for procuring his change or spending his holiday down by the water side, be it sea, lake, or river, probably because he finds, though he does not know exactly why, that the air of water-side places does him more good than the air of the country, where there are trees and beauties of landscape, but no large tract of water. The freshness of the early morning air is due most probably to the formation of dew on the previous night, the transition from the vaporous to the liquid state causing ozonisation of the air with which the condensed watery particles come into intimate contact. This freshness disappears as the day wears on, because of the readiness with which ozone is destroyed by organised and organic substances. The exhilarating effect of a sea-breeze may, however, be ascribed to other bodies which are foreign to inland air. The sea air contains a traceable amount of salt and iodides, attaining a maximum of 0·022 gramme per litre, or about one and a half grains per gallon. These mineral ingredients derived from the sea doubtless accentuate the tonic action of sea air, and further it is probable that ozone interacting with chlorides and iodides would lead to traces of chlorine and iodine being present. Many persons describe the smell of strong sea air as iodous or chlorous, and it has even been said that the starch used in face-powders turns blue at the seaside on account of the iodine in the air, forming blue iodide of starch. If that be so the blue and haggard appearance characteristic of many faces exposed to a strongly salt-impregnated breeze would find an interesting, but perhaps embarrassing, explanation.—*The Lancet.*

An American electrical paper recently instituted a competition for a name for an electrically-propelled carriage. About four hundred names were suggested, from which we have selected the following :—Accelawatt, Equine-nit, Bacrotom, Automo, Aut, Faraday, Autopropelectric, Electragon, Moto, Trolley-ho, Locomobile, Telecar, Electrapel, Autovolt, Autogo, Elecar, Pacolet, Franklin, Automote, Chevaless, Moby, Plantemobile, Electrola, Antihorse, Voltcar, Quatrecycle, Odomotor, Autema. "Electromobile" was the name adjudged the most suitable.

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Gent's **Safety**, Eadie fittings. Exchange 5in. centre lathe.—HICKTON, 73, Bow Common-lane, Bromley, London, E.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, AUGUST 25, 1899.

MOTOR CYCLES.—XIV.

A LUG must be brazed to the compression stay-tube which connects the bottom bracket to the bridge tube, to which the carburettor is to be bolted. Fig. 88 shows this lug with the carburettor and float-chamber indicated in position by dotted lines. The lug itself is to be cast in malleable iron. I have not dimensioned the facing to which the carburettor is fitted, except the thickness, as it is made the same size as the square facing on the bottom of the carburettor, as given in Figs. 35 and 38. A semicircular channel is cast across the face to accommodate the petrol supply-pipe leading from float-chamber to carburettor. It will be noted that the same studs which hold the float-chamber to the carburettor are also employed to secure these parts to the frame-lug. This view also shows how the exhaust branch pipe is secured to the coil in the bottom of the carburettor. Sufficient of the end of the copper coil is left to project ⅜in. through the boss. This is then to be screwed ⅛in. gas thread. The exhaust branch pipe is also screwed to match, and the joint between the two made by means of a socket and lock-nut, which must both be smeared with red-lead before screwing up. The outlet for the exhaust-branch at the other end of the coil is filed off flush with the boss.

In the side view of the lug in Fig. 88 I have not shown the float-chamber, to avoid confusion—it would show behind the lug in this view. The exact position of this lug on the compression stay-tube is of no great importance; but it must be sufficiently far back to miss the driving chain, which is easily arranged as the stay-tube runs upward at a fairly sharp angle. The postion will be better defined in a general arrangement, which will be found in my next.

Fig. 89 shows the handle-bar switch, used for cutting off the current when turning a sharp corner or applying the brake. Its parts are lettered as follows: A is the handle-bar tube, on to which is brazed the mild-steel collar B. This collar is ⅜in. wide and ¼in. thick. The extreme end of the tube is screwed any convenient thread, say 20 per inch, for a length of 5/16in. On to this thread the collar C is screwed, which prevents the handle-bar grip D from being displaced endwise. Inside the handle-bar is the rotating contact-plug E, which is secured to the handle-bar grip D by the two screws I, which pass through slots cut in the handle-bar tube. G is a block of insulating material, preferably vulcanised fibre, having secured to it two contact-strips F F. To these strips the wires of the primary circuit are secured by means of the two screws K, and between them the contact tongues of the plug E work. L shows the end of one of the four screws used to hold the insulating block in position. Some means must be provided whereby the rider will be able to tell if the switch is in the "off" or the "on" position, and to retain it in either position. This is conveniently done by means of the flat spring H, recessed into and fastened to the handle by the screw, the other end dropping into notches cut in the collar B.

Taking the switch in detail, the handle-bar grip comes first. This should be turned from any suitable material, such as horn, vulcanite, or even ivory, if the expense is not objected to, to the dimensions given in Fig. 90. Make the bore a nice fit to the handle-bar tube, which is to be of 1⅛in. diameter by No. 16 B W.G. Braze a collar on the handle-bar, Fig. 89 B, making the taper of its outer edge a continuation of the taper of

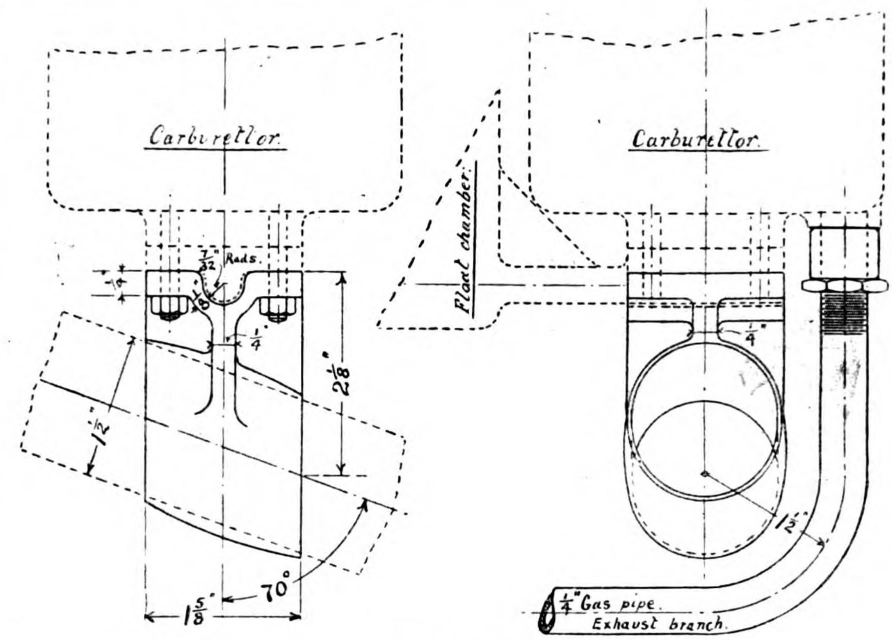


Fig. 88.

the horn handle. This is best made of mild steel, and should be turned to size and shape before brazing on. The insulating block is next turned up from a piece of vulcanised fibre rod to the sizes in Fig. 91. The dovetail grooves are to take the contact-strips, Fig. 92, which are of brass, bent and filed up to shape from 1/16in. plate. The narrow edge of the strip where the contact plug works should not be more than 3/32in. wide.

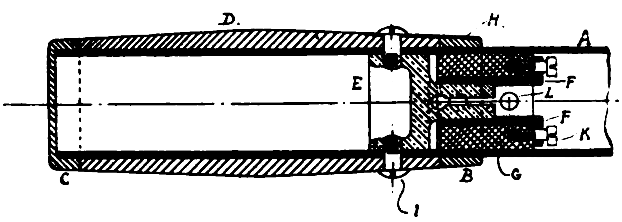


Fig. 89.

The strips should fit quite tightly into the grooves, and project very slightly into the bore of the insulating block, just sufficiently so to insure the contact-plug bearing on them, and making good contact. The back of the contact-strips need not be rounded. The contact-plug can be turned from brass rod or from a casting; but the drawn rod is preferable, as being more free from flaws and having more spring. Dimensions are to be taken from Fig. 93. The part of the plug which works in the insulating block is filed

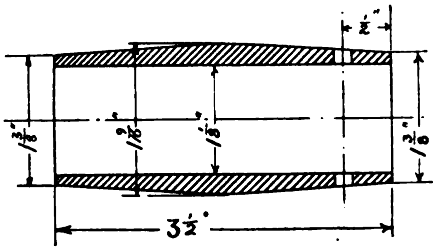


Fig. 90.

flat on both sides, leaving it 3/32in. wide for ⅜in. of its length. A rotary movement of the handle to the extent of ½in. will suffice to either turn on or cut off the current. To keep the handle in place, the cap, Fig. 94, is screwed on to the end of the handle-bar. It is made of mild steel, and the thread should fit tightly. When finished, it is to be plated, and therefore to prevent injury when screwing it on, two ⅜in. holes should be drilled through the back, into which the pins of a pinhole spanner may enter.

To assemble the switch we shall require the finished handle-bar, and the first thing to do will be to drill a hole ⅜in. diameter through the back of the tee-joint in the centre of handle-bar. This hole must be bushed with vulcanised fibre or vulcanite, the bush to have a 3/16in. hole through it. Now take a length of insulated flexible twin-wire, such as is used for suspending incandescent lamps by, and pass one end through the hole in the bush just inserted, and carefully thread the wire along the inside of the

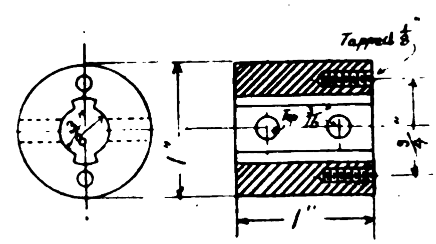


Fig. 91.

handle-bar, bringing it out at the left end. Untwist the end and twist each bunch of fine wires tightly together, so as to make it like a solid wire for about ¼in. back, the insulation being removed, of course. With a small

Fig. 92.

pair of pliers turn each end into a ring with an internal diameter of ⅛in. These ring ends are now to be soldered one to each of the contact-strips, which must be removed

from the insulating block (this latter being removed from the handle-bar) for this purpose. See to it that the soldering does not obstruct the hole through which the ⅛in. screw passes, and solder the wire ring concentric with the screw-hole. The contact-strips can now be replaced in the insulating block, the two screws put in, and the whole replaced inside the handle-bar and secured

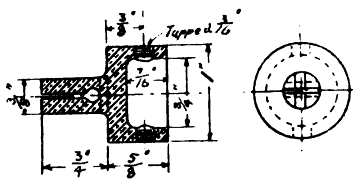


Fig. 93.

with four ³/₁₆in. countersunk set-screws. The face of the insulating block should be 3½in. from the end of the handle-bar. Any undue slack in the wire can be pulled back, but it should have a little, to avoid strain on the connections. Before fitting the block into place, note that the two ends of the wires where soldered to the contact-strips are not in contact anywhere. Now slip the handle, Fig. 90, on to the bar with the holes for screws above and below as seen in Fig. 89, which is a sectional *elevation*, not *plan*. Mark through these holes on to the handle-bar, and drill ⁵/₁₆in. holes to the marks. Push the contact-plug, Fig. 93, into the handle-bar till the tapped holes in the plug coincide with the holes in the bar. The switch is now in the "on" position, or should be if the insulating block has been correctly placed, and should be tested with a battery and galvanometer, or bell, to make sure. Remove the plug and elongate the holes so that the plug can be rotated by means of the screws I, Fig. 89, far enough to entirely break contact with the contact strips: the direction of rotation being in the contrary direction to the hands

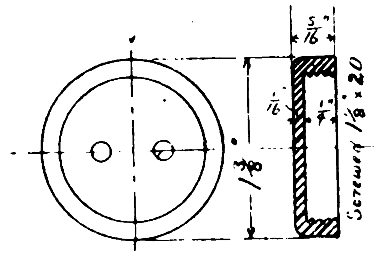


Fig. 94.

of a watch when holding the open end of handle-bar towards you. Having these slots cut, fit the two screws into the block through handle and bar, and let them fit tightly. Under the top one a flat steel spring about ¹/₃₂in. thick should be fitted, the part of the spring where it projects over the collar brazed to the handle-bar being ³/₁₆in. wide. File two shallow recesses in the collar, one for the "on," and one for the "off" position, bevelling the edges of recesses and under edges of spring to make disengagement easy. Stamp the words "on" and "off" in the recesses, screw the cap on the end of the handle-bar, and the switch is complete.

MILLWRIGHT'S WORK.—VI.

FIG. 30 illustrates wall-plates of cast iron, which are better than plates of wrought iron or steel, and neater in appearance. The bosses will measure from 2in. to 2½in. through, and the castings must make a fair bedding on the masonry.

When brackets for plummer-blocks have to be carried against the iron pillars of a shop, which is often a convenient arrangement, the brackets are either made to fit against facings cast to receive them, or they fit round an arc of the pillar. In the first case, studs or bolts are the means of attachment to the pillar. In the

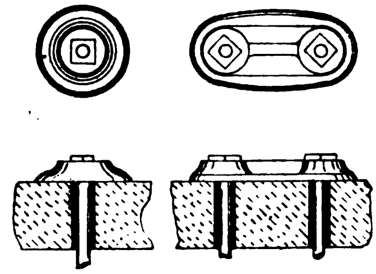


Fig. 30.

second, the bolts pass through caps behind, and the bracket is gripped by the friction of broad surfaces.

Fig. 31 shows a pillar bracket to carry a

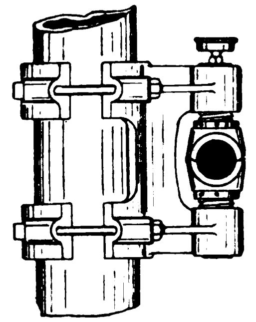


Fig. 31.

common block. Often, instead of separate clips A A, a single continuous clip is used, with set-screws in addition to the clamping bolts. This is heavier, but adds to the security of the fitting.

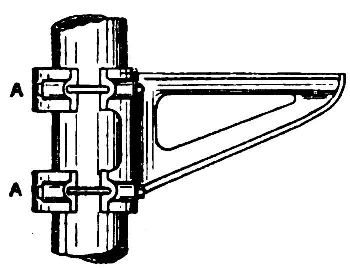


Fig. 32.

When swivel bearings are used, the outlines of the bracket are modified to suit. Then they are made either to be adjustable in the vertical direction only, Fig. 31, or in both directions, as in Fig 32. The latter of course have the advantage, because, though the bracket is fixed rigidly to the post, the swivel bearing can be moved up or down in its bracket, and the bracket can be slid laterally to and from the post, the bolts sliding in the grooves. These two designs are by the Unbreakable Pulley Co., of Manchester.

Hangers vary much in type. In the first

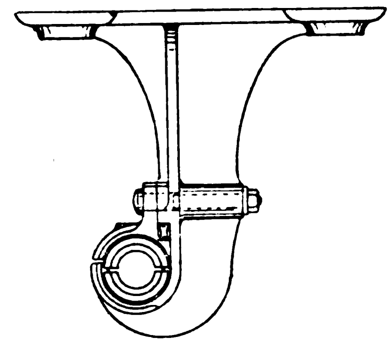


Fig. 34.

place, they are either single or double. One of the commonest of the latter is seen in Fig. 33. The idea in designing the double hanger is to avoid one-sideness in stress and strain. Except, however, for very heavy shafting, say over about

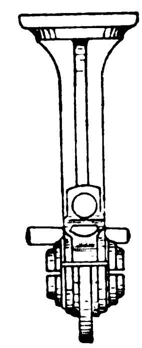


Fig. 35.

3in. in diameter, the single hanger is sufficiently good, when properly proportioned. The shaft also can more easily be put in place, because it need not be slid endwise.

The double hanger in Fig. 33 is shown with

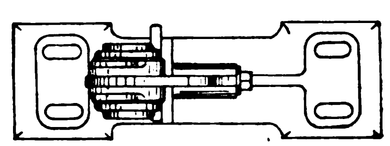


Fig. 36.

the brasses making a turned fit in their seatings. Angular brasses were formerly largely fitted, as in plummer-blocks. There is no power of adjustment in this bearing, excepting that in a lateral direction, by moving the hanger bodily by means

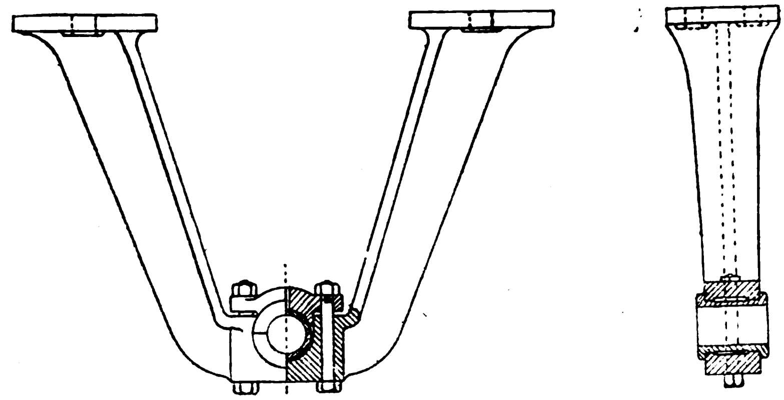


Fig. 33.

of its slotted bolt-holes. Many double hangers are cast with a bar connecting the feet, which lessens liability to fracture.

A form of hanger, of which, variously modified, the writer made a good many years ago, is shown

in Figs. 34-36 in elevation, side view, and inverted plan. The bottom brass fits into an angular seating in the main casting. The cap is secured with one bolt in a slot hole, to permit of vertical adjustment. To prevent the cap from slackening back, a wedge is inserted, as shown.

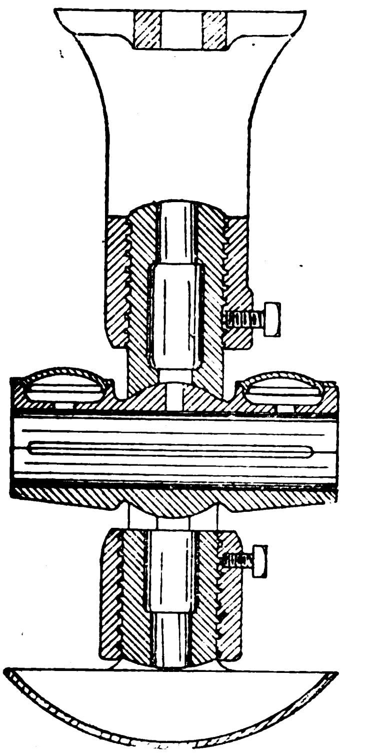


FIG. 37.

The hanger with adjustable bearings is now frequently used. In many cases it is a modified plummer-block, the foot of which is bolted to a face planed vertically in the hanger. In others, the stem, or stalk, of the hanger has a circular section upon which an extension sleeve of the bearing slides, and is pinched with set-screws. The conditions of fixing which exist in factories render many such variations in arrangement desirable.

The Sellers' hanger is shown in section in

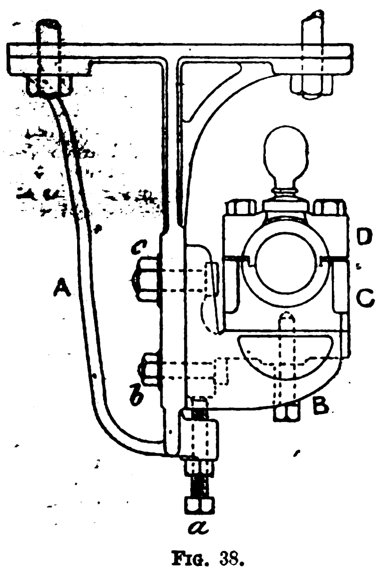


FIG. 38.

Fig. 37. It is seen to have the universal swivel movement of the Sellers' plummer-block, and the vertical adjustment also, by means of the screwed stems.

Figs. 38 and 39 illustrate a neat adjustable hanger made by Smith and Coventry. The hanger casting A has a flat vertical face, which receives a bracket B, which sustains the bearings C, D. B is adjustable vertically through slot-holes by the adjusting screw *a*. It is also capable of a pivoting movement about the bolt *b*, the bolt *c* moving in a slot-hole in B. The bottom bearing C fits B by means of a turned stud, and a screwed stud holds it down in place.

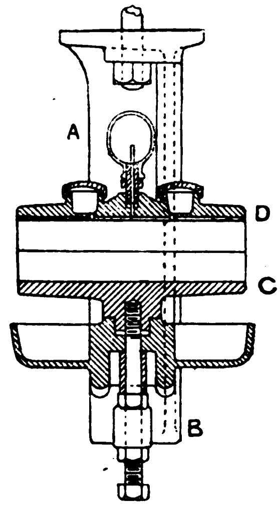


FIG. 39.

D is retained on C with set-screws. The lubrication is very similar to that already noticed in Article IV., a central needle, and side tallow cups.

Fig. 40 shows a hanger in which the bearing H is adjustable vertically through a sleeve sliding

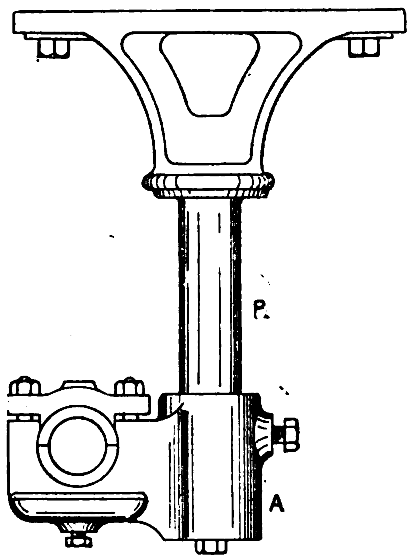


FIG. 40.

on a turned stem B. This also permits of swivel adjustment in a horizontal plane, and is suitable for the lighter shafting. J. H.

ORNAMENTAL TURNING.—XXVI.

By J. H. EVANS.

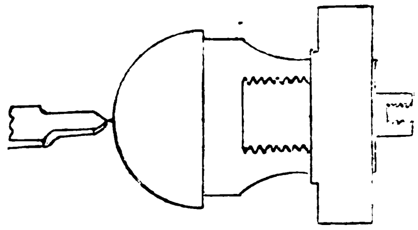
HAVING given the necessary details which will enable anyone at all proficient in the use of tools to make the additition of the dome or spherical chuck to his lathe, I now propose to continue the subject as suggested in my last, by showing as clearly as possible the most effective way of using it for the production of the many beautiful specimens of work of which it is capable.

A few simple diagrams will greatly facilitate our researches in this direction. We will take first the shaping and decorating of the simple hemisphere, and in doing this the first thing to do is to select the material, and, if for any specific object, decide the exact dimensions required for our purpose. This now is a matter of indifference, as we are simply defining the uses of the chuck, and the same movements apply equally for varying diameters.

The work must be chucked either in a metal chuck or a wood plug firmly driven into one, and as the range of adjustment in the slide of the chuck is necessarily somewhat limited, the chuck should be kept as short as possible. The work must then be reduced by hand-turning approximately to the desired shape—viz., a hemisphere. Of course, the more correctly the same is formed the less irregularities there will be to remove when on the dome chuck. Before the work is transferred to the chuck, the transfer must be placed thereon in order to insure the axial truth. Another point to study is this: be sure that the chuck which holds the work is less in diameter than the material to be operated upon, as it then admits of the cutter passing out at the extreme diameter if it is required so to do, which, in many cases it is.

The adjustment of the chuck for this, I may say, primary example, is a simple matter, and is as follows:—By reference to the diagrams Figs. 1 and 2, the settings will be clearly demonstrated. When the work is reduced to the desired form, a minute test-point should be left at the centre for the purpose of future adjustment; as to axial truth, there are two ways of adjusting the centre, as shown by Figs. 1 and 2. Having

FIG. 1.



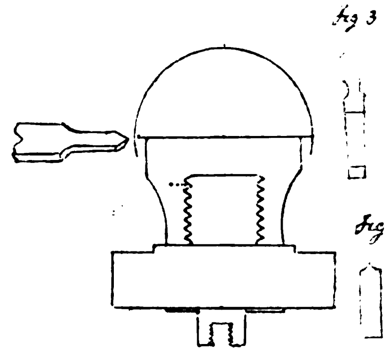


FIG. 2.

placed the work on the dome chuck, the latter is adjusted to the vertical position, as seen in Fig. 7 in my last. The slide-rest is set parallel with the lathe-bed, and a double-angle tool placed in it. This is moved laterally until in perfect agreement with the test centre, and to more conveniently ascertain this to be perfectly correct, the chuck is moved to the horizontal position, which will bring the test-point towards the operator, as seen in Fig. 1. The nut at the back of the right angle arm is now released, and the slide of the chuck moved out to the position. That will allow the tool to trace over the hemisphere, after which the nut is again tightened. If the plane form is accurately turned, the drill or fly-cutter may take the place of the fixed tool. If, however, any appreciable error exists, it is easily discovered, and that portion that is in excess of the other part may be removed by replacing the work on the mandrel nose and re-turning it, until by trial it is found sufficiently near.

The precise hemisphere, however, may be obtained in another way if thought desirable. The drill-spindle is placed in the slide-rest, having a broad square-end drill, and by taking a light cut, just enough to remove all superfluous material, to effect this the chuck is partially rotated under the influence of the left hand, arrested by the segment stops, and when the first cut is decided as to depth, the worm-wheel is moved two or three divisions only, and by repeating this process throughout the whole diameter of the wheel, the hemisphere is brought to the correct shape. This, I am bound to confess, is a very long and tedious job, and as it is not really necessary, I do not advise its adoption; at the same time, I explain it as it forms one of the movements which may be required.

We will now assume that the plain form of the hemisphere has been so far produced, and that it is desired to decorate it with a series of reeds;

there are two ways, again, of producing these. The drill-spindle carrying a quarter-hollow drill, Fig. 3, is perhaps the most suitable, for reasons that will explain themselves hereafter. The fly-cutter is always preferable, and whenever it can be employed without the framework interfering with the passage of the cutter through the work, I strongly recommend its use in preference to the drill. For our present purpose, if the vertical or universal cutter is used, a double quarter-hollow, Fig. 4, will be that which is most suitable for the purpose.

Having decided by the two proverbial trial cuts the amount of penetration required in accordance with the partial rotation of the worm-wheel, it only remains to continue the same movements throughout the entire diameter of the same, to complete the pattern. It is, I hope, needless for me to say that the number of divisions taken must divide equally into the 96. The result of these proceedings is shown by Fig. 4, which will be the same, whether the drill, Fig. 3, or the cutter, Fig. 4, is used; but, as I have already mentioned, the fly-cutter is always the most satisfactory.

The result, as seen in Fig. 5, is a very effective one, but the decoration of the dome is not by any means confined to this particular form—a round nose, or a step-drill, also a figured moulding tool may, of course, take the place of that we have just considered, and as it is only the difference in the precise shape of the tool, I need not say more on this point, except that, by leaving an interval of polished space between the successive reeds, is most effective; also these may be pierced

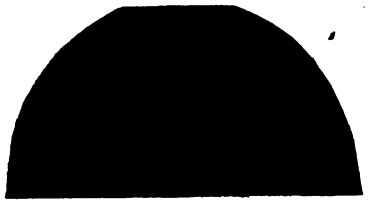


Fig. 5.

seriatim with a series of round-nosed tools varying in size, or cutting pearls after the same manner, but with a suitable bead-drill.

It may happen that when setting-out the divisions of the worm-wheel, the cut will be brought so close together at the top of the dome as to almost become obliterated, while at the diametrical line it will be all that is desired. This, to a considerable extent, may be avoided by slightly lowering the slide of the dome chuck, thus causing the depth of the cut to be correspondingly reduced at that part of the dome. This alteration, if considered necessary, would, of course, be carried out when deciding the penetration of the trial cuts.

By reference to Fig. 2 we see that the work represents more than the hemisphere. This is arranged in accordance with the desire of the operator, and it will be at once obvious that the increased proportion of the curve is accomplished by the further rotation of the mandrel between the segment stops.

We have now considered the decoration of the hemisphere sufficiently to clearly demonstrate the manipulation of the chuck for this particular purpose. Such subjects as may require a dome at the summit, but not of the pure hemispherical character—that is, a flatter curve may better answer the purpose—this, like that we have now studied, is first roughly shaped by hand to the desired curve, then placed on the dome-chuck, and the slide lowered until the point of the fixed tool traces as nearly over it as it can be made to do. By these adjustments a large variety of curves are available. Cylinders with circular tops are of much source for many decorative objects. This will be fully shown as we approach the illustration of finished specimens.

We come now to the production of the combined curves—by this I mean that the concave curve may be made to join the convex with equal precision, and a large number of solid forms of this character may be rendered very beautiful indeed. By reference to Fig. 6, this will be seen as placed on the dome-chuck, having been first shaped by hand. The chuck is then adjusted to follow the dome or convex curve, the centre of the tool being precisely coincident with the dotted line A. The fixed tool is then removed, and the Universal cutter substituted, adjusted to cut vertically, and the cutter selected suitable for the type of decoration desired. The cutter is set out to the necessary radius—as an example, the engraving, Fig. 6—the two curves are both of 1in. radii, therefore the tool must be set out to this extent; the cut is then set in by means of the depth-screw. I may here point out that the steel

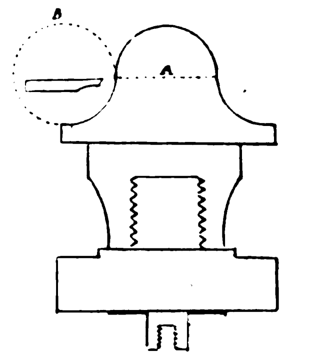


Fig. 6.

bridle, to place the top slide of slide-rest under control without the use of the lever, should in all cases be employed, more particularly with this chuck, as it will be recognised that both hands are already usefully employed. Having set the penetrations to the required depth, decided by the stop-screw, the concave curve will be thus cut. The cutter is still revolved at a high speed; but, until the chuck is moved, it passes out through the course of the dotted line B; but, on the chuck being rotated through the allotted space, the cut is passed over the dome or convex curve. This done, the chuck is returned to the vertical position, the cutter withdrawn, and the worm-wheel moved to the division that has been decided upon, and these movements being performed in unison through the whole diameter, the pattern will be completed. This particular example does not afford the opportunity for any display of elegance, but like those preceding it, is simply a rudimentary specimen, illustrative of the manner in which the combined curves are obtained.

There is a large field for the display of elegant taste in the designing of tazzas, vases, &c., composed of this class of work. The different ways in which such can be decorated is practically endless, and will afford a most interesting subject to study.

I have, I think, now given a fairly clear insight into the working of this chuck, for what

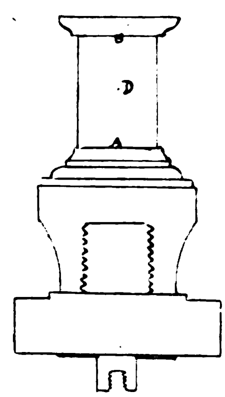


Fig. 7.

may be justly termed its legitimate purposes—viz., the cutting and ornamenting various curves, convex and concave. But it has still another, and I may say entirely independent, use; and this is the formation and ornamentation of polygonal solid forms, which may contain any number of sides or facets; these may be, as stated, contained in one solid form, or built up in several pieces, in which, of course, the same section is maintained throughout. Such work is found of great service for the decoration of caskets, boxes, and also pillars that may require a base and capital composed of like features. These are all obtained with equal facility as the foregoing examples already considered. The proceedings are as follows:—

The dome-chuck is again set accurately to the vertical position and tested by the set-square. In this position it remains securely held by the segment apparatus. The work is first shaped by hand approximately. In the circular form the dimensions must be considered with regard to the various diameters, as applying to the measurement across the corners when the polygon form is finished. When thus prepared it is mounted on the dome-chuck while in the before-mentioned vertical position, and if from any cause there is little or nothing in the shape of material to spare, the transfer chuck must intervene; if, however, there is sufficient space, this may be dispensed with, as the limited traverse of the slide of the chuck may be found inconvenient in the case of works of large dimensions.

The slide-rest is now set transversely, or at right angles to the lathe-bed, and the eccentric cutter takes the place of the fixed tool previously used to adjust the rest to the correct height of centre. A round-nose tool is employed to shape up the sides of the square, or whatever shape is decided upon. By reference to Fig. 7 we see an outline of a short pedestal as mounted on the chuck ready for process; the eccentric cutter is set out so that it will describe a circle covering the size of that part between the base and capital A to B, the work being adjusted by the slide of the chuck so that the centre D corresponds with the axis of the lathe mandrel. The cutter is now revolved at a high speed and passed over the part to be cut by the main screw of the slide-rest, and it is necessary to first cut somewhat nearly to the required depth, and then turn the worm-wheel round one-fourth, or 24 divisions, when the

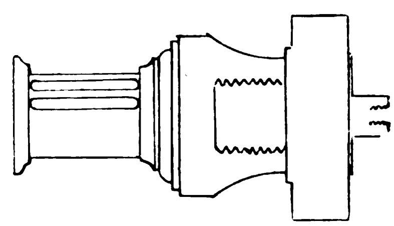


Fig. 8.

tangent frame is fitted as I recommend, to move in and out of gear, this is a very simple matter, and does not necessitate the repeated movement of the chuck from the vertical position, in order that the winch handle may be made to operate for the purpose of taking 24 monotonous turns of the same.

Having cut two sides, it will be easily seen if the depth is sufficient to bring up the corners, and until all four are cut a slight amount should be left, and the final adjustment as to depth made for the terminal cut. If the height of the pedestal be greater than can be covered in one cut, in consequence of the limited extension to be obtained in the slide of the eccentric cutter, the work must be raised or lowered by the main screw of the chuck, and the same process repeated. When the body is thus cut to the desired size the base and cornice may be shaped to the form of a square in the first instance, and afterwards shaped by moulding tools with the entire figure contained in one tool or by separate tools revolving in the universal cutter, set to operate horizontally, or by moulding drills in the drilling instrument. If the latter is employed, the work must be brought to closer contact for the succeeding cuts to complete the figure by again raising or lowering the arm of the chuck; but when the eccentric cutter is used this may be avoided by increased radius being given to the tool. When the base and capital are alike, both can be cut at one cut.

Referring to Fig. 8, we see that the same can be treated in still another way, and this is by a series of flutes or other decoration being continued along each facet. The dome-chuck is now turned to the horizontal position, which brings the work to the position seen, the centre being still, of course, maintained, the chuck arriving in this position by simple partial rotation. The example is illustrative of the power of fluting the flat sides of the square, and to effect this the work is raised or lowered by the slide of the chuck to the desired position to suit the number of flutes required, the traverse of the drill being arrested by the fluting-stops in the usual way.

I will now conclude what I may term the primary or rudimentary manipulation of this important instrument, and will introduce in my

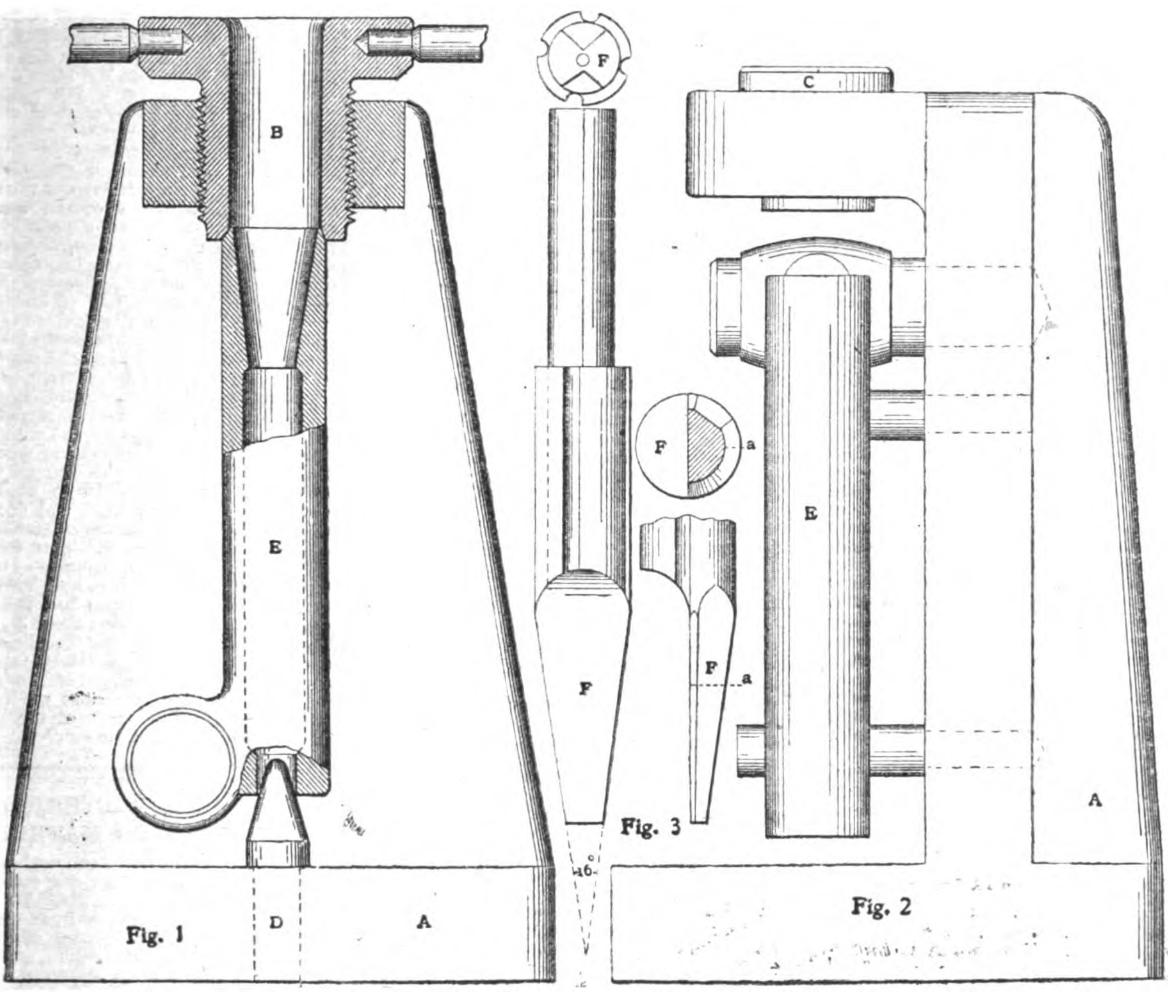


Fig. 1 Fig. 3 Fig. 2

next a few examples of more finished work, which may be regarded as an extension of what I have already described, and will, I trust, lead up to still more extensive and interesting productions.

A BICYCLE JIG.*

THE accompanying cuts illustrate another style of jig used frequently at the Peoria Rubber Company's works. Two views of the same style of jig serve to show different methods of holding work, and another cut gives an idea of a reamer for making the taper-hole for the seat post and handle-bar stand cones.

The machine business (generally prolific of conventional terms) gives the name of spider jig, I believe, to such a one as is seen in Fig. 1, owing to the appearance of the clamp-bushing combine at the top, with its four spreading arms or long handles. This bushing B clamps centrally the piece E and guides the reamer F, Fig. 3.

For opening the hole resting on the stud D, Fig. 1, the piece is held in a reverse position, as seen in Fig. 2, the offset hole in E resting on a heavy stud, with a smaller one for a back stop and another for a side stop. No clamping is done in this work, except to secure the jig to the drill-press table.

The reamer F is milled half-way off and bevelled, as shown, to cut, being 16° taper in this case, and well provided with flutes for the lubricator to run down, the latter being pumped on to the tool continuously. The material worked on is malleable iron, and the reamer illustrated here gives the best of satisfaction.

GERMAN WORKSHOPS.

WE extract the following from an extremely able and interesting report in this month's *Amalgamated Engineers' Monthly Journal*, a trade-union organ, which, as now conducted, reflects the highest credit on the splendid society that owns it, and on its able executive:—There are one or two general features common to German workshops. In the first place, the fencing of machinery, the general protection of workmen and provision for their comfort is much more complete than in this country, and the shops are more spacious and cleanly. This may be, to some extent, due to the stringent governmental inspection, brought about contemporaneously with, if not as the result of, accident and other insurance laws; but I am inclined to think that much of it is due to voluntary initiative on the part of employers. I saw many things which went much beyond the law's requirements, and which are altogether unequalled in this country.

Another common feature is the modern appearance of most workshops and the use of first-class appliances. Everywhere new factories are building, and most of the shops that I visited were extending. Machinery was everywhere being put down, and a great deal of that at work is dated this year or last.

And a no less marked feature common to German workshop life is the leisurely manner in which the men go about their work. Although piecework is common, I saw nowhere any bustle. With one exception, in all the shops visited, men smoked during working hours, and in most of them there were canteens or other provision for getting refreshments while at work.

Hours of Labour and Wages,

of course, compare unfavourably with those current in this country, although there is certainly not the marked difference which is here generally supposed. And when due allowance is made for the stopping time for refreshments, it is doubtful if the actual working time much exceeds that in the area covered in this country by the Employers' Federation. At Düsseldorf, the outside or inclusive hours are 60 per week, with one main break in the day—namely, from 12 to 1.30. In Augsburg the hours are the same as at Düsseldorf. But there are two recognised breaks for refreshments in the forenoon and afternoon, of a quarter of an hour each, which takes three hours per week from the inclusive time. At Chemnitz the hours are about the same, but vary a little from shop to shop. At the main place visited there is an elaborate coffee boiling arrangement in the middle of the shop to which the men can go three times per day and get coffee at 3 pfennig (1¼ farthings) per cup. In this shop the hours are from 7 to 12, and from 1.15 to 6.15, except one day in the week, when work ceases at 5. The inclusive hours are, therefore, 58¾ per week. At another, however, which was visited, the hours were 61 per week. At Berlin the working day is shorter than elsewhere; but, curiously enough, and very confusing to me in making inquiries, it varies considerably, in some cases being different in length in different departments of the same firm. The maximum inclusive time is, however, 59 hours per week, and the minimum 54, made up as follows:—6 to 12 and 2 to 6, except on Saturdays, when work stops at 5, = 59; from 7 to 12 and 1.30 to 5.30, = 54. But in each case deduction has to be made for refreshment stoppages, amounting to half an hour daily. And it may here be said that the shortest working day obtains in the largest, best equipped, most scientifically organised, and best paying concerns that I saw, those of the Allgemeine Electricitäts-Gesellschaft, which employ some 14,000 people, and Messrs. Siemans and Halske's, employing nearly as many.

The Wages Vary

more than the hours, not so much, however, as between town and town as between man and man. There is no standard or minimum wage rate inforced by the unions in the engineering trade upon their members, or, for the matter of that, the unions in any other trade except the printing. In most of the shops that I visited piecework was more or less general; one firm, however—that of Reinecker, of Chemnitz—absolutely bars it, every man being on day work. In the first shop visited at Düsseldorf the manager told me that the wages of the 1,200 people employed averaged over 4s. per day. This included boys and labourers. Most of the fitters and turners were on piecework. There was no sub-contracting, each man being paid through the office, and skilled men earning about 6s. a day as a rule; young men less. The smiths, however, earn more, the earnings of the leading heavy workman averaging 12s. to 13s. per day. The apprentices, who work altogether, get 9d. per day for the first year, and serve three years. I found that these conditions were those generally obtaining in Düsseldorf, excepting in regard to apprentices, who serve, as a rule, four years, starting at 6d. and advancing to 1s. 6d. per day, but earning by piecework an additional 30 to 40 per cent. on their day-work rate. Attendance at technical schools twice during the week is made a condition of employment on the lads in Düsseldorf, and is encouraged in the case of young men. In some cases wages are paid only once a fortnight. The wages of labourers are 3s. per day, those of moulders 7s. per day and over.

At Augsburg the wages are a little lower than at Düsseldorf, living also being a little cheaper. I was told, however, by Mr. Krantz, manager of the Maschinenfabrik Augsburg (of whom more anon) that no skilled mechanic there earned less than 5s. per day, and many of them earned more.

At Chemnitz the rate, or average earning, is perhaps a little lower than at Augsburg, and the general standard of life appeared to be lower than any other place visited. There is little regard here for women, who are seen carrying the hod, sweeping the streets, and even using the pickaxe, being paid

* By A. H. Cleaves, in the *American Machinist*.

from 1s. 9d. to 2s. 6d. per day. The average earnings of the engineers are about 5s. per day, exceptionally skilled men earning more.

At Berlin the earnings are distinctly higher, many of the men at Siemens and Halske's earning nearly a shilling per hour. It was somewhat difficult to get a knowledge of the rate for engineers throughout the district, but in the shops visited, which between them cover nearly 30,000 work-people, the earnings are about 38s. per week per man. I was told, however, at Berlin and elsewhere that the present level of wages is higher than ever before, and that this was due to the high tide in industry of the last few years.

In Regard to Holidays,

they are much the same as in this country, except that the minimum number is fixed by law. No work is allowed in any factory, or workshop, or place of business—excepting restaurants and certain other places scheduled in the Act—on eight days in the year. These are: Christmas, two days; Whitsun, two days; Easter and Good Friday, two days; Ascension Festival, one day; and Repentance, one day. Sunday labour is also forbidden, excepting under "urgency and emergency," even shops—except restaurants—being compelled to close at two o'clock. Concerts, theatres, &c., are open on Sundays, which is the principal day for entertaining enterprises. In addition to the above, there are holidays peculiar to districts. In the Lower Rhine district, for instance, the three days immediately preceding Ash Wednesday are generally observed as holidays, it being a time of carnival, to which the nearest approach in this country is the "wakes" week in the Lancashire towns. In Düsseldorf and most of the other towns on the Rhine there are two more holidays in July, when the Old Shooters' Guilds hold their annual festivals. These are called "Kirmes" (Kermess).

My observations covered three places in Düsseldorf, those of Messrs. Haniel and Lueg, the Hohenzollern Actiengesellschaft, and Ernest Schiess, which were visited in the order named. The first two are pleasantly situated in the outskirts of the town.

Messrs. Haniel and Lueg

are manufacturers of centrifugal pumps, mining plant, and hydraulic machinery. A speciality of their business is pipe-moulding, which is done by special machinery, invented by themselves, and over 2,000ft. per day are turned out. The railway runs right into the yard, which is roomy and set out by flower-beds, flanked by bicycle exercise space, having a lean-to at one end for the housing of the machines. Close by are shower-baths for the use of the men, and well-appointed dining-room and first-aid arrangements. The engines and much of the machinery were made by the firm. The woodworking machinery is from Leipzig, most of the lathes and planing machines from Schiess and another firm in Chemnitz; but there are a few of Whitworth's, and one of Davy's of Sheffield. There are some beautiful lathes in the turnery, one or two of them having three and four rests, but by no means worked to full capacity, which also applies to most of the machines. I noticed one or two cases of two machines being worked by one man. I also saw here a beautiful little machine (American) for slotting key-ways, being about 3ft. in height, the cutters being drawn down by gear in the base, the top being a turned surface about a foot diameter, to which a wheel, weighing perhaps half a ton, was attached in the course of a few minutes while I stood by. There are overhead cranes, and the works generally are well equipped and full of work, having some very heavy work on hand at present, some of the turned parts for mine drawing gear being over 20ft. in diameter, and being turned in horizontal plate lathes. The manager, Mr. Riemer, very kindly conducted me round, and was most willing to give all information. He had spent some time in England many years ago, and knew English conditions fairly well. He had been successful in obtaining hydraulic work for, I think, Italy, for which Messrs. Armstrong had tendered. The firm, he said, was doing well, and he looked forward to increased prosperity.

The second shop is not so large nor so well found as Haniel and Lueg's. It is being extended, however, on improved plans. The speciality is a locomotive without a firebox, it being charged with steam to run, if my memory serves me right, about 20 miles. The woodworking machinery here is from Robinson's, of Rochdale, and there are many lathes and other machines from Hulse's, Craven's, and Smith and Coventry's. Most of the new machines, however, are of German make, coming either from Chemnitz, Düsseldorf, or Hanover. Here, again, the men appeared to be working very comfortably and leisurely, and the boys had decorated the machines with green boughs and flowers, it being the day before Whit Sunday.

The third is the tool-shop of

Mr. Ernst Schiess.

In some respects this shop is even better than the first one visited, though more cramped, being in the centre of the town. It is, however, very lofty, and well equipped with electrically driven travellers and other modern appliances. The men are not catered for as at Haniel and Lueg's, although there are washing conveniences here as elsewhere. They make very heavy machine tools, and the work is really very good, although, judging from my observations, the firm is likely to find a difficulty in the world's market as far as price is concerned. All the machines in the shop are of their own make, excepting two or three of Brown and Sharpe's milling machines, and a very large planing machine also from America. The lifting tackle is very good, and made by a firm—Maschinenbau-Actiengesellschaft, formerly Bechem and Keetman—which I understand is a sort of German Tangye, in Duisburger. The men appeared to work just as comfortably as in the others, although I noticed one or two cases of men working more than one tool. I had a long talk with the managing director, a very genial man who spoke English, and who knew all about English makers, and spoke highly of Messrs. Craven's and Smith and Coventry's tools. None of his tools, he said, were yet in this country, or in America, although they had had inquiry recently from Carnegie's people, of Pittsburg.

The next shop visited was that of

The "Maschinenfabrik Augsburg,"

over which I was conducted by Mr. Krantz, the managing director, on the afternoon of the opening day of the Augsburg Conference. There are from 3,000 to 4,000 people employed here, the staple work being printing machines. The firm is the oldest printing machine makers in Germany (perhaps in the world), and have shops even larger than those at Augsburg situate at Nürnberg. Mr. Krantz proved to be quite an interesting personality, and a few lines may be appropriately devoted to him. A thick-set man of 50 or 55, with iron-grey beard, black shock head of hair, and boisterous manner, he put me in mind of Mr. Wm. Allan, of Sunderland. He wears loose trousers, a jacket of material something like felt, a peaked cap with flat top, and an immense leather strap round his right wrist. This latter may be a relic of other times, he having been an army officer and a huntsman, to which he was still partial, but for which, he said, he had now no time. He was most effusive in his welcome, and took me everywhere, being heartily in favour, he said, of all that I had advocated the night before, and of workmen's rights generally. Eight hours were, he thought, long enough for men to work, and he had been much interested in our struggle of two years ago, asking me for printed matter and full particulars, a request with which I afterwards complied. Altogether I found him a very fine type of man, combining a large flow of the milk of human kindness with, at the same time, disciplinary power. Smoking at work was here barred, and refreshments had been systematised. Prior to stopping times for refreshments, labourers went round to ascertain the men's wants, and then brought them beer, coffee, bread, sausages, &c., from a canteen. This latter place was visited, and we had beer, bread and sausage together. It was amusing to see, as we trotted about, the exchange of salutes between him and the men, most of whom touched their caps as he approached. He did not want it, he said, and, moreover, its discontinuance would be a saving on both sides, for he would not then have to salute them. But bowing and saluting in the district seems to be general, soldiers and priests coming in for special attention. The same day I had seen a little chap of about 10, meeting an old lady, put his little body at an angle of 30 with his legs.

As may be imagined, Mr. Krantz has very fine and large ideas as to

What an Engineers' Shop Ought to be,

and, as far as he can, he is getting these ideas put into concrete form. Some parts of the works are quite new, having been built right over the old parts before the latter were removed. But he is far from satisfied, and foundations are being got out for extensions which are, he said, to put everything there as yet into the shade. At present the works and yard cover an area of 600 yards by about 300 yards. The railway runs down the centre of the yard, the main shops being parallel with it, and skirted on the other side by a canal. Along the side of the shops there are wooden posts at intervals of about 15ft., with little wooden boxes on top, with holes for birds to enter and build their nests. Provision is made for the shops being all heated by piping, and, where there are two floors, there are interruptions in the ceilings for air outlet and lighting. There are also electric cranes, in some cases running one over the other, and the main turnery is 180 mètres (600ft.) long. Special shops are reserved for apprentices (who don't work piecework like the men), who are separated into gangs, each in charge of a man, for the first three years. After that, in the fourth and last year, the boys are placed with the men. All the shops are designed on strictly geometrical lines, the windows and bays being of a certain measurement, and the spans being multiplies of the same. The machine tools are good and also the work turned out. The tools are mostly of German make, some from Chemnitz, and some from Düsseldorf, but there is a little from America and from this country. The shop is full of work, and Mr. Krantz looks forward to continued prosperity, and is preparing for it. Some beautiful specimens of their work are being prepared for the Paris Exhibition.

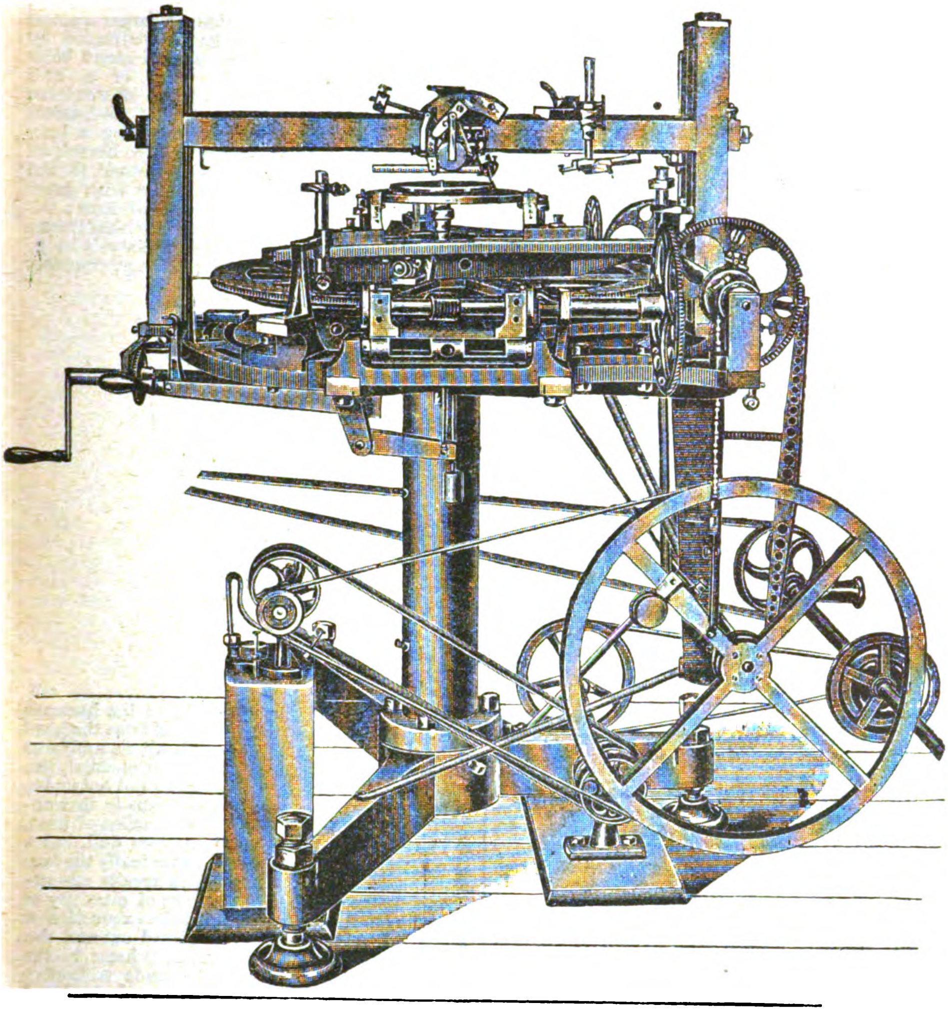
The adjuncts are arranged on a most generous scale. Five doctors attend the works daily (in addition to an eye specialist) and the men have the choice of the five. Of course, much of this is required under the Act, but the provision made goes much beyond the Act's requirements, and it had been so before the Act came into operation. I saw one of the forms which the governmental authorities required, giving particulars of accidents. It was brought for Mr. Krantz's signature as we sat in the canteen, and the particulars required were in respect to an accident that had happened three days before, when a man had had his thumb slightly injured. It required the man's name, occupation, wage, whether married or single, how long employed in the place, how the accident happened, the witnesses of it, if it necessitated the man ceasing work, and other details. After leaving the canteen we went into the baths, which are open to workpeople after working hours at any time, and during working hours to the boys or anyone on making application on the score of ill health. They include a small swimming-bath, as well as numerous shower-baths. Adjacent to the works there are blocks of dwellings for the workpeople who care to live in them, and I was told that the rents were about 3s. 6d. per week for three rooms. Altogether the whole place is conceived on a grand scale, and its manager brought to my mind Carlyle's figure of the "Captain of Industry." If the extensions are to be so much better, then, in the words of the poet of John Gilpin, "may I be there to see."

COAL AS A BACTERIOLOGICAL FILTERING MATERIAL.

MANY materials have been used as media in the filtration of sewage, and among these coal has given very good results. At the Wolverhampton sewage works there is, as we learn from a paper read before the Institute of Sanitary Engineers, by Mr. Ernest Berrington, a coal filter, 40ft. 6in. long by 20ft. wide by 5ft. deep, with an area of 90sq.yds., which is doing excellent work. It is constructed as follows:—A layer of 6in. of coal about ¾in. cubes in size is laid over the drain pipes. Above this comes a 3in. layer of ½in. cubes, and above this 3ft. 9in. of ⅜in. cubes. The top layer consists of 6in. of fine coal-dust. The sewage is applied by means of perforated pipes laid on the surface, and is allowed to percolate through the filter continuously. At the present time this filter is allowed to work for twelve hours, and is then allowed to aërate for a similar period. The rate of filtration is about 200gal. per square yard, equal to one million gallons per acre per day. The sewage is first precipitated in tanks, and the tank effluent passed through the filter. The analyses show the purification on organic ammonia effected by the tanks on the raw sewage to be 85 per cent., and 98·2 per cent. by the tanks and filter combined. On the "oxygen absorbed" test the purification of the tank effluent is 91 per cent., and on the "organic ammonia" the purification of the filter on the tank effluent is 88 per cent. These results show that coal makes a very effectual filtering effluent.—*Engineering.*

FLASHLIGHT PHOTOGRAPHY ON THE CHEAP.

I HAVE seen a great many hints on the taking of flashlight photographs, but very few on the way to make the necessary apparatus at a smal cost, so I hope this will prove useful to some. Firstly, get an ordinary clay pipe (½d. each) and a small piece of board about 9in. long by 2½in. to 3in. wide. Near one end of this make a hollow to roughly fit the bowl of the pipe, and from this a groove to take the pipe-stem; then, just on each side of this groove, bore two holes about 3in. apart, and by means of these tie the pipe firmly down with string. Next get some copper wire (1d. worth) and form it into a ring about 2½in. in diameter, and fix it about ¾in. above the pipe-bowl by twisting the remainder of the wire round the bowl of the pipe; then get an empty pound tobacco or soft-soap tin, and cut it in two from the top to the bottom, and nail it to the board about 2½in. behind the pipe-bowl, so as to form a reflector; then get a foot of india-rubber tubing (cost about 3d.), and fix this on to the end of the pipe-stem. This will complete a useful flash-lamp at the modest price of about 6d. For the screen get the lid of the largest cardboard box obtainable (for instance, a lady's dress box) and cut out the middle, leaving a margin of about 2in. all round, and gum a sheet of tissue-paper tightly over the opening; then make a hole in both top



corners, through each of which fasten a long piece of string. I will now explain how to use these. Take the screen and hang it from a picture or gas-bracket, or anything handy, so that it will come between the flashlight and the object to be photographed; then get the flash-lamp and wind some cotton-wool round the wire ring above the pipe-bowl and soak it in methylated spirits, and put the magnesium powder in the bowl of the pipe. When you have the sitter in the right position uncap the lens, light the cotton-wool, and give a sharp blow through the indiarubber tube, and "the deed is done."—A. M. B., in the *Photographic News.*

WURDEMANN'S DIVIDING ENGINE.*

SOME years ago Mr. William Wurdemann, of Washington, D.C., devised a novel dividing-engine now in the possession of Berger and Sons, of Boston, on which very accurate work has been done in graduating circles for astronomical instruments. As no account of this engine has ever been published, and but few persons are acquainted with its construction, a short description of it may be interesting to many readers of your valuable paper.

Engines of this kind as made by Troughton, of London, and others, consist principally of a circle or wheel supported upon a perpendicular axis and moved by a tangent screw gearing with teeth corresponding to the section of an internal screw cut in the edge of the circle. There are 2,160 of these teeth, so that one turn of the tangent screw moves the circle exactly ten minutes of arc. The circle to be graduated is secured upon the circle of the machine, and the cutting diamond or graver is moved in a radial line by means of a swinging frame attached to the framework of the machine.

The improvements invented by Mr. Wurdemann and embodied in his engine are many and of great importance, securing greater accuracy in results and requiring less attention from the operator, it being automatic in action and driven by a small motor.

The improved machine is shown in the engraving; in it two driving screws are employed, geared together so as to move in the same direction and at the same speed, and arranged on opposite sides of the circle. Driving the circle by two screws tends to divide and equalise any errors or differences arising from slight imperfections in the gear teeth or screws, and any wear of the parts has a tendency to eliminate the errors. Furthermore, in consequence of the greater contact surface between the moving screws and the engaging teeth of the circle, there is less pressure and friction on these parts and the bearing is relieved of side pressure.

The moving screw has a drum-head graduated to 120, so that the automatic movement may be arranged to five seconds of arc. There is also a second drum-head with 200 graduations arranged for dividing the circle according to the centesimal system.

The axis of the circle is of novel shape, it being a perfect cylinder where attached to the circle and ending below in a hard steel cone that bears the weight. The effect of this long cylindrical axis is that the circle turns with uniform ease under all conditions of temperature. The axis enters a cast-iron column, into which its upper end is perfectly fitted, so as to turn easily without any possible shake. The column is supported on a cast-iron tripod with three levelling screws that step into iron cups. On the upper part of the column is fixed a cast-iron frame, on which all the necessary moving parts are supported. The circle and its bearing are of hard cast iron; it will be seen that all the parts are made of a dense hard metal, having a small coefficient of expansion, consequently the working of the machine is not affected by slight changes in temperature.

The bars that carry the tracing works are placed on one side of the circle, so that these works stand out free and accessible in all their parts, while the tracing point is carried directly over the centre line of the circle, and is not interfered with in any adjustment that may be necessary during any one operation.

Although the circle of the engine is but 30in. in diameter, a meridian instrument circle of 45in. diameter has been graduated upon it to two-minute spaces, making 10,800 lines with a very satisfactory result, the probable error not reaching two seconds of arc, a degree of accuracy never before attained.

* By Capt. H. P. Sanders, in *Scientific American.*

UNUSUAL FOOD.

LION flesh is said to be very good eating, but tiger is tough and sinewy. Nevertheless, the latter is eaten in India, as there is a superstition that it imparts strength and cunning to the eater. Bear's flesh is a great favourite in Germany, and smoked tongues and hams are considered great delicacies. On account of the rarity of Bruin, they are expensive. Sausage—so dear to the Teutonic heart and stomach—is also made from bear liver; 25lb. of sausage can be made from a single liver.

There appears to be considerable diversity of opinion as to the merits of elephant's flesh. In India and Africa it is a favourite dish with the natives; but a European who has travelled much in Africa says: "I have tasted elephant over and over again. It is more like soft leather and glue than anything I can compare it to." Another traveller, however, declares that he cannot imagine how an animal so coarse and heavy can produce such delicate and tender flesh. All authorities, however, agree in commending elephant's foot. Even the traveller quoted above who compared elephant's flesh to leather and glue, admits that "baked elephant's foot is a dish fit for a king." When an elephant is shot in Africa the flesh is cut into strips and dried; it is then called "biltong." The elephant's foot is cut off from the knee joint, and a hole about 3ft. deep is dug in the earth, and the sides baked hard with burning wood. Most of these faggots are then removed, and the elephant's foot placed in the hole. It is filled up with earth tightly packed down, and a blazing fire built on top, which is kept burning for three hours. Thus cooked, the flesh is like a jelly, and can be eaten with a spoon. It is the greatest delicacy which can be given to a Kaffir.

Rhinoceros meat is something between pork and beef, and is not to be despised when no other flesh is to be obtained. In America a 'possum is esteemed a great delicacy. Kept in a barrel for a week and fed on sweet potatoes, and, when killed, stuffed and roasted, it forms a most delicate dish, resembling chicken in taste. A negro will spend all the night catching a 'possum for his Sunday dinner. Monkey meat is also good eating. Dr. Wallace, the well-known scientist, once breakfasted on monkey. "It was by no means bad," he wrote, "being something like rabbit." He also stated that: "Although the habits of the jaguar are filthy in the extreme, jaguar steaks are beautifully white, and remarkably like veal in taste." In the same way ducks, though feeding on grubs, worms, frogs, and mud, form, as everyone will admit, a delicious dish. Kangaroo steaks are splendid, and our Australian cousins assert that kangaroo soup is the finest in the world, and infinitely superior to ox-tail. Travellers are also unanimous in declaring that the flesh of the alligator and crocodile is extremely tender, white, and delightful to the palate. Seal flesh, though perfectly black, is matchless for flavour, tenderness, digestibility, and for heat-giving power. Squirrels are extensively eaten in some parts of rural England. Skewered nightingales is the great dish of Florence, and those who have conquered their sentiments and eaten the little songsters are loud in their praises. In Florida a stew of robins, jays, and bluebirds forms a most savoury and delicate dish, and if you did not know the names of the dishes, you could eat and enjoy rat pie, stewed cat, boiled horse-beef, fried snails, or any of the above dainties. As it is, the imagination is the autocrat of the stomach, and people will only eat what custom has made familiar. There is no reason—beyond that of custom—why man should not add some of the above dainties to his bill of fare.—*St. Louis Globe-Democrat.*

ARTIFICIAL PRODUCTION OF INDIARUBBER.

THE *Kew Gardens Bulletin* contains an article on Dr. Tilden's Artificial Production of Indiarubber, and quotes from his paper on the Spontaneous Conversion of Isoprene into Caoutchouc, read before the Birmingham Philosophical Society.

Indiarubber, or caoutchouc, is chemically a hydrocarbon. But what is called its molecular constitution is unknown. All that has been ascertained is that when decomposed by heat (distillation in closed vessels) it is broken up into simpler hydrocarbons, amongst which is isoprene. Isoprene is a hydrocarbon which was discovered by Greville Williams many years ago among the products of the destructive distillation of indiarubber. Later, in 1884, it was observed by Dr. Tilden among the more volatile compounds obtained by the action of a moderate heat upon oil of turpentine and other terpenes. It is a very volatile liquid, boiling at about 36°. Its molecular formula is C_5H_8, and it forms a tetrabromide, $C_5H_8Br_4$, but no methylic derivatives like the two homologues of acetylene.

Bouchardat observed that when isoprene is heated to a temperature near 300°, it gradually polymerises into a terpene, which he called diisoprene, but which is now called dipentene. This compound boils at 176°. A quantity of colophene, similar to that which is produced by the action of heat upon turpentine, is formed at the same time. When isoprene is brought into contact with strong acids, aqueous hydrochloric acid for example, a small portion of it is converted into a tough elastic solid, which has been examined by G. Bouchardat and by Dr. Tilden. It appears to be true indiarubber.

Specimens of isoprene were made from several

terpenes in the course of Dr. Tilden's work on those compounds, and some of them have been preserved. He was surprised at finding the contents of the bottle containing isoprene from turpentine entirely changed in appearance. In place of a limpid colourless liquid, the bottle contained a dense syrup in which was floating several large masses of a solid of a yellowish colour. Upon examination this turned out to be indiarubber.

The artificial indiarubber, like natural rubber, appears to consist of two substances, one of which is more soluble in benzene or carbon bisulphide than the other. A solution of the artificial rubber in benzene leaves on evaporation a residue which agrees in all characters with a similar preparation from Para rubber. The artificial rubber unites with sulphur in the same way as ordinary rubber, forming a tough elastic compound.

The constitutional formula of isoprene is now known to be:—

Methyl-crotonylene, $CH_2 = CCH_3 - CH = CH_2$.

In a recent letter, Prof. Tilden states:—"As you may imagine, I have tried everything I can think of as likely to promote this change, but without success. The polymerisation proceeds *very* slowly, occupying, according to my experience, several years, and all attempts to hurry it result in the production, not of rubber, but of 'colophene,' a thick sticky oil quite useless for all the purposes to which rubber is applied."

A 240-GEAR WHEEL.

ONE of the largest geared wheels ever built has just been completed, according to the New York *Sunday World*, by H. Fox, of 2,764, Boulevard, New York.

Its front sprocket contains 60 teeth and the rear sprocket seven; that is to say, the wheel is geared to 240. It is equivalent to an old-fashioned high bicycle equipped with a front wheel 20ft. high.

Assuming a running horse's stride to be 15ft., it must, in order to do a mile in 1·39, make over three and a half strides a second.

A man in doing a mile on the bicycle would only have to make a revolution of the pedals once in one and one-fifth seconds to beat the horse badly; or, to do a mile a minute, one revolution every three quarters of a second.

This wheel was built for Fisher, a Harvard man, who is engaged to ride it against some of the fastest horses on the French tracks at the Paris Exposition in 1900.

COMBINED DEVELOPMENT AND FIXATION.[*]

PUNNETT pointed out that chloro-bromide plates could be simultaneously developed and fixed. Hanneke has also written concerning similar experiments with bromide plates in the *Photographische Mittheilungen*, 1899, p. 141. The developing power of alkaline pyrocatechin upon bromide of silver is very little affected by hyposulphite of soda, and the quantity of the latter may be so far increased in relation to the former that development and fixation with a single solution may be effected in a few minutes. Theoretically, the matter is very interesting. But efforts are now being made, in Germany, I believe, to apply it practically, and under the name of "Elconal F." a strong, concentrated, fixing developer has been placed upon the market and sold in Vienna. Messrs. Elion and Co. have patented the process, but grant the right to use it to each purchaser of Ellon's pyrocatechin. The formula is as follows:—

No. 1.

Water	250 c.c.
Hyposulphite of soda	50 grammes

No. 2.

Water	75 c.c.
Sulphite of soda	30 grammes
Caustic potash (pure—in sticks)	7 ,,
Pyrocatechin	7 ,,

For developing and fixing a normal plate 13c. by 18c., take 12c.c. of developer No. 1, 20c.c. of fixing solution No. 2, and 30 c.c. of water. The process of development and fixation are simultaneous. We mention this novelty, as in some quarters it is spoken of as a great advance in photographic development.

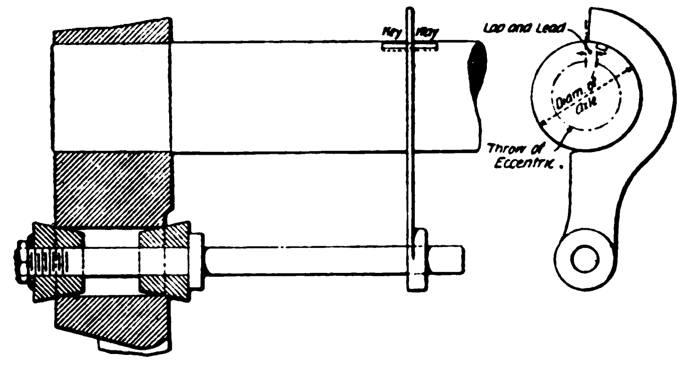
In our opinion the new method is very questionable. It is well known that the duration of development must depend upon the exposure, the lighting, and the nature of the subject; also that the temperature of the developer and many other subsidiary circumstances play a part. The fixing process proceeds independently, but the rapid interruption, or the prolongation of the development process, which are such important factors for the success of a fine negative in the hands of a competent photographer, become an impossibility.

It seems superfluous to demonstrate further to the professional photographer that combined development and fixation cannot be regarded as advance, and that it is not destined to replace the separate development and fixing processes in applied photography.

[*] By Dr. E. N. Eder, in the *Photographische Correspondenz*, translated in the *British Journal of Photography*.

LAYING OUT KEY-WAYS.

THE simple and convenient device illustrated by the accompanying engraving is used on the Baltimore and Ohio for laying out the key-ways on driving-axles, whereby the eccentrics are secured in position before the wheels are placed in position



under the engine. The drawing makes the method of operation clear with but little description. The spindle which carries the two conical plugs is self-centring in the crank pin-hole in the driving-wheel, and on the end of this spindle is an arm which partially encircles the axle. From this the key-ways are laid off with the proper angular advance. This device has been used for several years with very satisfactory results.—*American Engineer*, N.Y.

THE RELATIONS OF PHYSICS AND ASTRONOMY TO THE DEVELOPMENT OF THE MECHANIC ARTS.[*]

IT is but four months since, on January 18, you celebrated the seventy-fifth anniversary of the Franklin Institute. This is, therefore, an anniversary year, and it will not be long before January of the year 1906, when you will have an opportunity to celebrate the two hundredth anniversary of the birth of Benjamin Franklin, whose name is held in reverence and inscribed above your portals. You now propose to inaugurate a new branch of activity for the Franklin Institute. Not long since you added the Mechanical and Engineering Section to those already existing, and you have now added a fifth, to be entitled "The Section on Astronomy and Physics." The organisation of the Franklin Institute will, therefore, hereafter include, not merely a "Committee on Science and the Arts," and "Sections on Engineer and Mining and Metallurgy," but also special sections on important branches of science, such as astronomy, general physics, electricity, and chemistry. You have thus recognised the existence of certain relations between the advanced sciences and the practical arts. The Franklin Institute is devoted primarily to the promotion of the mechanic arts, but you have recognised that the sciences are so closely related to the mechanic arts that it is to your advantage to give them a distinct recognition in your organisation.

I.—The Mechanic Arts Closely Related to Physical Sciences.

This inaugural meeting of your new scientific section is, therefore, an appropriate occasion on which to consider with some detail the precise character of the relation between physics and the mechanic arts. I do not say astronomy and physics, because that branch of astronomy which we shall consider is itself known as celestial physics. We have celestial and terrestrial and molecular physics, three branches of knowledge that are all included under the comprehensive term physics, or the science that treats of force. Ages ago man recognised only those forces in which large masses of matter are involved. He studied projectiles, falling bodies, the equilibrium of forces, the buoyancy of vessels, the motions of waves and tides and winds, and even the motions of the heavenly bodies. But now he has learned that all chemical phenomena have to do with the motions and equilibrium of molecules; that heat and light and electricity and the photographic or chemical action of light are but the motions of individual molecules of ponderable matter, and of the imponderable ether atoms that drive the material molecules hither and thither; that sound is but the motion of larger groups of molecules. Everywhere he is confronted by the laws of force. If you strike a smart blow with a hammer upon the head of a cold chisel and make a cut into a piece of soft iron, you are doing one of the simplest mechanical operations, and yet you are awakening a long list of reactions that invade every branch of physical science:—1. The muscles respond to the eye and the will; the hammer moves with great acceleration, and strikes straight and hard; the energy of the blow comes from the chemical transformations going on within the workman's body, suggesting problems that belong to the profoundest depths of biology. 2. The stroke of the hammer calls forth a clear and cheerful sound from the head of the chisel—a musical ring with all its problems in acoustics. 3. The hammer, the steel chisel, the soft iron, and the chips become warm and hot under the repeated blows, suggesting problems in thermodynamics and the radiation and conduction of heat. 4. The edge of the hard chisel becomes dull, but a deep gash is cut in the soft iron; eventually the face of the chisel breaks; all of which results are explained by the study of the science of elasticity as applied to the flow of solids and the exhaustion of metals. 5. A better chisel is picked out and the hammering goes on all day without harm to the tool; such choice could not be made without a thorough knowledge of the chemisty and physics of steel. 6. If the anvil be a stone and both it and the hammer be properly insulated and connected with an electrometer, every stroke would be seen to produce electricity; this sets us to thinking about piezo-electric phenomena, and we perceive that as every change of pressure produces electrical phenomena, therefore the electrified condition of the whole earth, with its resulting atmospheric lightning, may be in part the result of the crunching of the geological strata that we call the earthquake, an idea that was first suggested by Clerk Maxwell. I need not weary you with illustrations of that which must be patent to every thoughtful mind; the general principle holds good everywhere and at all times that no invention can be made, no action taken, no great work accomplished on this earth, without involving many principles in nature that have already been recognised by scientists and others that still remain to be discovered. You, therefore, do well to combine both physical science and the mechanical arts into one institution. Your object must be, on the one hand, to apply physics to the proper construction of machines and the daily needs of the artisan. On the other hand, you may hope to add something —perhaps much—to our knowledge of physics, through your ingenious machinery, your abundant experience, and your keen thought. The manifold and intricate connection between the sciences and the arts may be treated from several points of view. Let us first glance at the historical development of this connection.

II.—Evolution of the Mechanic Arts.

The mechanic arts may be said to have existed before the dawn of history; they were coeval with the evolution of the Aryan language. We trace the art of weaving, as we now know it, back to the time, 3,000 years ago, when it was already well advanced in India, but the word *to weave* is far older than that. We trace the potter's wheel back to the earliest archæological potsherds, perhaps 5,000 years, and know nothing of its far earlier history. We trace the arts of cutting, sawing, and planing from our present magnificent machinery back to the first knives of jade used by the prehistoric Asiatic and American races. We trace our hoes, ploughs, and cultivators back to the sticks and the forked branches that were used to scratch the soil by the first tribes of men, but how many thousand years ago no one ventures to say. The modern railroad car, the elegant waggons and the fleet bicycles only became possible after the ancient architects had first learned to put rollers under the massive stone blocks and had put rude wheels to the carts drawn by oxen and to the wheel-

[*] By Prof. Cleveland Abbe, U.S. Weather Bureau, Washington, D.C., an address delivered before the Franklin Institute.

barrow pushed by man. The art of sewing leaves together, or that of spinning threads must have been an early suggestion after man had learned to twist grass and twigs together to form crude ropes. Our extravagant military engines, from the immense ironclads down to the Mauser rifles, go back step by step to the stones and slings, the bows and arrows, and the boomerangs of primitive man. I should say that the mechanic arts had no definite beginning; they have gone through a process of evolution so gradual and gentle that we can at no time say "this was the beginning." Mythology does, of course, tell us that Vulcan forged Jove's thunderbolts. To the mind of the child of to-day, just as to the childish minds of antiquity, everything on earth must have had a definite beginning—there must have been someone who first taught us how. Therefore the ancients demanded a cosmogony, a History of Beginnings, a Divine Creator, and a simple tangible method of procedure as to His inventions and creations. But the modern scholar who has studied carefully all the ways of nature among the plants, animals, and rocks of this earth and the stars of the universe beyond us, perceives that a series of changes, a gentle and gradual evolution, has prevailed everywhere. We are, therefore, prepared to recognise that this same principle applies to the industries and to the arts that have been developed through the agency of man. We are but the agents. The Creator is working, but through us, not for us. He moulds the world, not as the potter does the inert clay, but as the wise parent does the mind of the intelligent child.

III.—Evolution of Inventions.

The crude devices of primitive man were improved by successive inventions. In the history of invention, properly so-called, the simple collocation and juxtaposition of two ideas is often the critical matter. It is not science, or study, or art—it is simply the happy accident that brings someone's mind two thoughts that are suddenly seen by the inventor to have an important relation to each other hitherto unsuspected. For instance, someone is anxiously looking about for a pigment that will produce a special tint of colour. He is wandering along the roadside and sees the colour he needs in a piece of stone or discolouring a ledge of rock. If his mind is ready to receive the suggestion, it becomes seed sown in good ground. The idea of grinding that stone into pigment immediately occurs to him. He proceeds to experiment, and not only grinds, but oxidises and even roasts the stone. The invention was a matter of suggestions to the inquiring seeker, but the art was an application of physical and chemical science. Man's needs have stimulated him to discover and invent. Those who enjoyed the best surrounding have generally brought forth the best results. Those nations and individuals who were unfortunate as to climate, soil, vegetation, minerals, water-power, &c.—those who had neither stimuli nor opportunities, did little. In proportion as we to-day associate ourselves with the highest science, we bring forth the best inventions and manufactures. Someone asks why we cannot make a steamboat that will go fifty miles an hour by the use of the screw-propeller. The idea is good, but it is a mere matter of imagination, a dream, a useless suggestion until all the resources of physics and mechanics have been combined to evolve the modern high-speed vessel. Prof. S. F. B. Morse was an artist, but was also seeking to make some great invention. The idea of communication by means of electricity, with the speed of thought, early took possession of his mind, and he was always on the look-out for some method of realising the indefinite hope that haunted him. Ten years were spent in making every conceivable combination of electrical devices—but nothing came of them. At length Dr. L. D. Gale suggested that Joseph Henry's recent researches on the electro-magnet be put to use. That distinguished scientist was consulted at Princeton, and immediately it was found that the laws that he had discovered in relation to electricity and magnetism, and the apparatus that he had made, were those appropriate to the Morse telegraph, that, in fact, he had one already at work. Even if you do not agree that we ought to speak of the "Henry telegraph" and the "Morse alphabet," you will at least grant that every step in telegraphy, from its beginning to the modern perfection of the art, has only become possible by means of the knowledge resulting from investigations conducted by scientists, or by inventors who had to become scientific investigators before they could complete their work.

IV.—Invention Associates with Investigation.

We must be careful to recognise that the inventor is frequently also a scientist, and still more frequently is the scientist an inventor. The scientist cannot investigate without having instruments and apparatus, and must invent these to suit the needs of the case. The inventor frequently comes upon an obstacle that cannot easily be overcome until he has investigated some obscure point either in mechanics or physics. This principle is beautifully illustrated by the life and work of James Prescott Joule, who was the son of a brewer, and himself continued in that business for a long time. His scientific education under Dalton, in England, and Jacoby, in St. Petersburg, enabled him to fully appreciate the mutual relations of science and art. While others speculated on the use of the electricity from the galvanic battery as a motor, he, by studying the laws of thermo-dynamics, showed the exact connection between the amount of work that could be done by a pound of coal when burned in the furnace and a pound of zinc consumed—i.e., burned, in the galvanic battery. He then proceeded to the determination of the so-called "mechanical equivalent of heat"—viz., the fact that a unit of heat can only do 772ft.-lb. of work. He is justly considered one of the founders of the modern doctrine of the conservation of energy, whose principles must be obeyed by every mechanical device that man can invent. When anybody proposes to manufacture something out of nothing, no matter whether he calls it perpetual motion, or the Keely motor, or the liquid-air motor, you have only to show him that he proposes to violate Joule's law and he must subside. The changes of temperature produced by condensation and rarefaction of gases, especially of steam, are vital to the working of the steam-engine. These were early experimented upon by Espy, but more thoroughly by Joule and Kelvin; the arrangement of the cut-off of the steam-engine must be made in accordance with Joule's laws if the machine is to work efficiently, as indeed he, himself, first showed in his paper of June, 1844. At that time he said: "The principles I have established lead to a theory of the steam-engine very different from the one generally received. . . . Believing that the power to destroy belongs to the Creator alone, I entirely coincide in the opinion that any theory which, when carried out, demands the annihilation of force, is necessarily erroneous. . . . The theory here advanced demands that the heat given out in the condenser shall be less than that communicated to the boiler from the furnace in exact proportion to the equivalent of mechanical power developed."

V.—Mechanics, Experimental and Empirical, Associates with Science.

I choose the following case to illustrate this theorem:—In the *Philosophical Transactions* of the Royal Society of London for 1866 is a beautiful memoir on the theory or method of action of lubricating oils and other lubricators. This memoir, by Prof. Osborne Reynolds, seems to be the first satisfactory effort to unravel the physical actions involved in lubrication. There had been abundance of previous experimentation for 200 years past, and many empirical rules and tables had been formulated respectively applicable to each set of experiments, but the special experiments made by Mr. Tower gave Prof. Reynolds the first suggestion as to the truth concerning the method of action of the film of oil that we insert between a journal and its bearings in order to diminish the loss of power by friction. Reynolds had previously conducted a beautiful set of experiments on the flow of liquids in tubes and very small channels, and had shown that, although the resistance to flow is ordinarily proportional to the square of the velocity, yet there is a critical velocity at which it suddenly changes from the square over to the first power of the velocity. He was now able to show that lubrication is simply a case of the flow of a viscous liquid through a very narrow channel. When the journal presses upon its bearing, the intermediate space is perhaps the $\frac{1}{1000}$in., or more likely $\frac{1}{10000}$in. in thickness. This space, being filled with oil, constitutes the thin film that serves to convert the rubbing and tearing of the metals into the sliding and rolling of liquid molecules. It is as though we had inserted a myriad of minute steel friction balls between the journal and its bearings. You are all familiar with the thin films of the soap bubble. Perhaps you have observed that when the film is not too thin it may be said to consist of two surface films separated by a thicker layer of liquid. These two surface films may slide past each other. By careful watching you may see the beautiful spots of coloured light re-arranging themselves as the two surfaces draw nearer and nearer together and squeeze out the liquid between them. The thinnest part of the soap bubble is a film much thinner than that ordinarily dealt with in lubrication, while, again, the thicker parts are much thicker than lubricating films. By means of the apparatus invented by Plateau, the properties of these thin films have been abundantly studied. The motions of the viscous liquid particles must obey the laws of mechanics, as at first clearly expressed by Stokes, Kirchhoff, Helmholtz, Stefan, and other students of hydrodynamics. The results of these difficult researches in molecular physics have a direct application to the lubricating action of oils. Prof. Reynolds succeeded in elucidating the novel phenomena recorded by Mr. Tower, and established an important verification of the assumptions on which our modern theories of hydrodynamics and molecular physics are founded. I may be allowed to speak more fully on this subject, because these ideas have not yet found their way into many textbooks on machinery. Let us take up one simple phenomenon—viz., the heating of the journal and bearings. We have hitherto imagined that after the journal has worn a smooth bed in its bearings, and there is no objectionable and injurious heating or abrasion, that then its rapid revolutions proceed without the evolution of much heat. Now the fact is, that while the upper and lower surfaces of the lubricating film of oil remain in permanent contact with the steel journal and the brass box respectively, or at least change very slowly, and there is no abrasion of the metals, still, the thin layer of intermediate liquid is being rapidly torn away and renewed. The viscosity of the liquid resists this sliding of one layer of its molecules past the other, and thus gives rise to heat. The inner layer of the liquid film soon becomes a surface layer where the molecules are under great tension, and this change gives rise to more heat. As long as the journal is revolving heat is being evolved by the compression and internal friction or motion of the molecules composing the lubricator itself. Often we do not observe this heat because it is carried away by conduction through the metals and by the last breath of air almost as fast as it is generated. Everyone knows that the abrasion of dry metal surfaces evolves heat, but the abrasion of viscous films also does so. As the journal revolves rapidly, it carries its thin film of oil into the crevice between the journal and the bearing; it is a V-shaped or wedge-shaped crevice, and as the film crowds into the wedge, Reynolds speaks of it as going into the "on" side, because right above this crevice is the load bearing down upon the film. As the film squeezes through the crevice, being forced along by the rotating journal, it quickly approaches the off side of the load, where the pressure is taken off of it and it is again free to spread out over the journal: thus it is carried around until it again enters the "on" side and squeezes through a second time to the off side. You will see at a glance that the small area of film between the journal and the bearing on the "on" side must support the whole load, and this implies an enormous pressure, which, in the experimental work of Mr. Tower, was only 625lb. to the square inch, but must be far greater than this in many of the cases that occur in actual practice. Of course, the laws that hold good for perfect lubrication will not obtain for the case of imperfect and irregular supply of oil, or for cases where the lubricant has not the proper molecular and physical properties needed when very great pressures are involved. But when there is a full supply of oil and the pressures are not too excessive, then you will easily perceive that the film adhering to the journal and about to enter the "on" side of the crevice is not as yet under any pressure or constraint, except only that it is held to the surface of the journal by reason of some molecular attraction between the metal and the liquid. Ordinarily, we say that the particles of liquid cohere among themselves, while the liquid and the solid adhere together. Now, the liquid will not easily be forced from the free surface of the journal into that crevice between the journal and bearing where the pressure per square inch is so great, and yet it does both enter and pass through, and there is nothing to bring about this remarkable result, except the rapid motion of the journal and the adherence of the film to its surface. We must think of the liquid film as a small mass of matter thrown into the "on" side of the crevice with considerable velocity and, also, as dragged in by the journal. Its viscosity and its inertia combine to force it into the wedge-shaped space. It must be very considerably compressed therein. It must, also, have its molecules forcibly squeezed past each other as it passes through the narrowest part of the wedge, and slips onward to the large space in the rear. Of course, also, its forward movement with the journal is slightly retarded in front and accelerated in the rear. But the most interesting feature is the pressure—the static pressure within every part of the film. There must be a resultant pressure against the surface of the bearing, and another against the surface of the journal. These would be normal to the surfaces, and equal in intensity and opposite in direction if the journal were not in rotation; but when rotating the pressure keeping the two surfaces apart is greatest in the front half of the lubricating film, while in the rear half it becomes negative—that is to say, it tends to bring the two surfaces together. This surprising result may, perhaps, be easily reconciled with our current ideas if we remember that the same powerful adherence which carries the oil with the journal forward into the funnel must also, in the rear of the latter, carry it away from the funnel. As much oil must leave the funnel in the rear as approaches it in front. There is a push in front, but an attraction in the rear. It is evident, therefore, that the force that keeps the journal from absolute welding contact with its bearing is the adherence of the oil to the journal and the coherence of its own particles.

The resistance that we call friction in a smooth-running journal is an exaggerated case of that which we call viscosity in hydrodynamics. It is the force required to make one layer of liquid glide past another. The other friction that occurs when no lubricant is used, or when the supply of the lubricant is too limited, of course, involves the tearing asunder of the particles or molecules of the metals themselves. This abrasion is not considered in the theory of lubrication. Prof. Reynolds' hydrodynamic theory, as checked by Mr. Tower's experiments, seems to give us a complete statement of the relation between the frictional resistance, the load and the speed for any lubricant that is supplied in abundance, and he has given us a general formula applicable to all cases that can occur. When there is but a limited amount of oil available, an increase in the load—i.e., the pressure—will diminish the thickness of the film around the journal in general: but will increase the length of the pad of oil that bears the weight, thereby increasing the area of the surface films, whose sliding past each other produces the frictional resistance, and, therefore, increasing the friction. The relation between the increase in friction and the increase in load for this case is more complicated than for the case in which an unlimited amount of oil is available, which latter case is experimentally realised by wholly immersing the journal and its bearings in a bath of oil. The result of the whole research is to show that, not only in case of intentional lubrication, but whenever hard surfaces under pressure slide over each other without abrasion, they are separated by a film of some foreign matter, whether perceivable or not; that the action of the revolving journal is to maintain the film between the surfaces at the point of pressure; that if there is any abrasion when the surfaces are well lubricated and well filled, it must be due to the foreign particles in the oil—particles introduced at the first grinding or subsequently as dust.

I may add that when the lubricant has thickened or is entirely absent, we have a condition analogous to that of the swiftly revolving wheel of soft lead, which is used to cut into the harder metals, to which I will refer later.

I give this long review of Reynolds' work as but one among many illustrations of the advantages that accrue to empirical mechanics when illuminated by sound science.

(*To be continued.*)

WHITWORTH SCHOLARSHIPS.

THE following is the list of candidates successful in the competition for the Whitworth Scholarships and Exhibitions, 1899:—

1. Scholarships (tenable for three years; £125 a year each):—

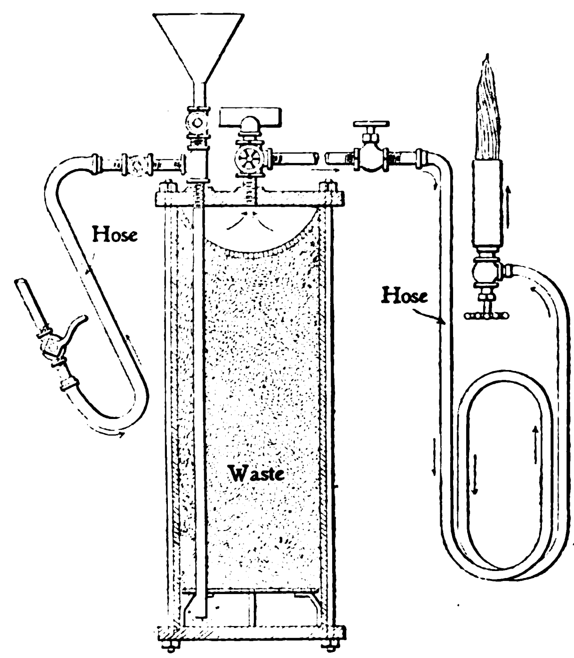
Name.	Age.	Occupation.	Address.
1. Quennell, A. W.	21	Engineer........	London
2. Topham, H.......	22	Engineer.........	Gt. Horton, Bradford
3. Shearer, W. V. .	21	Eng. Student...	Langside, Glasgow
4. Wall, G.	25	Student	Oldham

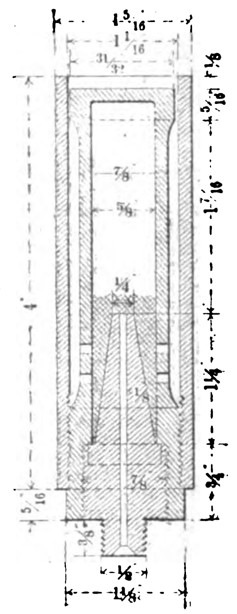
2. Exhibitions (tenable for one year; £50 each):—

1. Spencer, A. J. ...	20	App. Fitter......	Portsmouth
2. Turner, G. F. ...	23	Engineer.........	Sheffield
3. Philpot, H. P. ...	23	Draughtsman .	London
4. Adams, W. H....	19	App. Fitter......	Devonport
5. Moyle, E. C.......	19	App. Fitter......	Devonport
6. Scoble, W. A. ...	18	App. Fitter......	E. Stonehouse, Devon
7. Alexander, A. D.	18	App. Fitter......	Portsmouth
8. Edmonds, S. A..	18	App. Fitter......	Devonport
9. Cowley, G. F. A.	20	App. Fitter......	Portsmouth
10. Wilson, A..........	21	Draughtsman .	Leeds
11. Britton, E. J. ...	19	App. Fitter......	Portsmouth
12. Duncan, H.	20	Engineer.........	Plumstead
13. Rhodes, S. C. ...	20	Engineer.........	Morley, Leeds
14. Andrew, H. M....	22	Fitter	Manchester
15. Traill, A. P.......	21	Draughtsman .	North Shields
16. Bairstow, L.......	18	Student	Halifax
17. Butlin, W. T. S.	23	Student	Bristol
18. Dodridge, A. E. .	19	App. Fitter......	Devonport
19. Lowe, J.	22	Draughtsman .	Alloa
20. Rodd, W. J.	20	Mech. Engineer	Plumstead
21. Rendle, F. C. ...	23	Fitter	Plymouth
22. Heywood, T. E. .	21	Eng. Student...	Cardiff
23. Paul, J.	23	Engineer.........	Woolwich
24. Raitt, C. P.	20	App. Fitter......	Portsmouth
25. Booth, C. H.......	18	App. Engineer .	Bolton
26. Howarth, E.......	20	Fitter	Oldham
27. Down, P.	22	Draughtsman .	London
28. Straw, M. H. ...	25	Draughtsman .	Sneinton, Nottingham
29. Matthews, R. B..	21	Engineer.........	Swansea
30. Crossley, S.	23	Mechanic	Oldham

PAINT BURNER.

THE annexed illustration shows a very successful form of paint burner which is used by the Southern Railway. The reservoir is 36in. long by 12in. in diameter. It is completely filled with clean waste, packed as tightly as possible. The reservoir has a false bottom and top, both of which are perforated. The air pipe extends into the space between the false and true bottom, and the air becomes thoroughly saturated with gasoline, with which the waste is saturated, before it reaches the corresponding space at the top into which the discharge pipe enters. An interesting feature here is the use of a pressure gauge upon the discharge pipe, and a valve at this point for controlling the supply.





The burner is of peculiar construction, and is designed with a view to still further mingle the air and gasoline. The supply enters the burner through a nipple, having an aperture $\frac{1}{8}$in. in diameter. This nipple is inclosed in a cap, having its outer extremity closed, but with a series of perforations below the tip of the nipple. There are 35 of these perforations, $\frac{1}{8}$in. in diameter, in four rows staggered. The inside of the cap is lined with a fine-mesh brass-wire netting, covering the perforations. Outside of all is a shell 4in. in length and extending $\frac{1}{8}$in. beyond the end of the cap described. The outer circumference of the cap is flared near the end, so that the only place for the escape of the gas is an annular space $\frac{1}{32}$in. wide between the cap and the shell.

The course of the mingled air and gas in the burner is from the nipple to the closed end of the cap, back through the netting and perforations, and through the narrow space inside the shell to the end of the burner. The gas and air become so thoroughly mingled that the combustion is nearly perfect, and the flame is almost entirely blue.—Frank Johnson, in *Locomotive Engineering*, N.Y.

MILK PRESERVATIVES.

OUT in Omaha it has been found that dairymen are using a "patent fluid" to prevent milk spoiling. A spoonful of the antiseptic, which is sold for three dollars a gallon, keeps a can of milk for several days. Children are dying from the use of this milk—so it is reported.

Among the milk preservatives, which include salicylic acid, borax, and boric acid, the disinfectant formaldehyde is the newest, and it is probable that the Omaha "preservaline" is a preparation of formaldehyde. Not long ago the New Jersey State Health Department prosecuted some thirty or more dairymen for using formaldehyde.

Very little of this antiseptic or any other has been used by dairymen who send milk to this market, undoubtedly because the farmers fear the New York Health Department. The Sanitary Code says that nothing must be added to or taken away from the pure milk as it comes from the cow.

Dr. Ernst J. Lederle, consulting chemist to the Health Department, has found some use of antiseptics in New York milk. Their use in milk, he says, should be absolutely prohibited. They interfere with digestion, and may do great injury to infants and invalids.—*Practical Druggist.*

DEATH OF PROF. BUNSEN.

BY the death of Robert Wilhelm Eberhard Bunsen, F.R.S., &c., science has lost one of the most famous chemists the world has known, and Germany one of her most illustrious sons. His father was a distinguished theologian of Göttingen, in which city Bunsen was born in 1811, and graduated at the University (which, by the way, was founded by George II. of England) as Ph.D. at the age of twenty. After spending a few years in study at Paris, Berlin, and Vienna, in 1836 he succeeded Wöhler as Professor of Chemistry in the Polytechnic School at Cassel. Two years later he went to Marburg; then, in 1852, after a short interval at Breslau, he was appointed to the chair of experimental chemistry at Heidelberg, where he remained, in spite of a tempting invitation to Berlin University, until his resignation in 1889. Many academical distinctions, of course, fell to his share, both in this country and abroad. In England the Royal Society—which in 1858 elected him one of its foreign members—awarded him the Copley medal in 1860, and seventeen years afterwards chose him and his fellow-worker Kirchhoff to be jointly the first recipients of the Davy medal.

He first showed his ability in the prosecution of a difficult and dangerous investigation upon a series of poisonous and explosive organic compounds of arsenic, and in the course of these experiments he met with an accident which nearly cost him his life; but, undaunted, he pursued his work until he succeeded in placing the chemistry of the whole subject in a clear light. The discoveries in almost every branch of chemistry made by his unwearied assiduity would fill a treatise. The Bunsen voltaic battery, which supplanted the more expensive form bearing the name of Grove, was generally used as the cheapest and most effective mode of generating electricity until the dynamo displaced all forms of batteries. Then came the Bunsen gas-burner, which, it is not too much to say, is now not only a necessity in the laboratory, but in every household and every manufactory where a clean flame is wanted. About his discovery of this simple and effective apparatus an interesting tale could be told, says the *Times*. No one before Bunsen had thought it possible that a mixture of coal-gas and air could be made to burn without explosion from a simple tube burner. His clear conception of the laws which apply to the inflammation of such a mixture showed him that it was possible to arrange the dimensions in such a way that a steady, smokeless, and highly combustible mixture could be obtained; but a long series of delicate experiments was needed before the perfect burner which now bears his name resulted. Of other investigations carried out by Bunsen may be mentioned those on the chemistry of blast-furnace gases, in conjunction with the late Lord Playfair, on actinometry and the chemical action of light with Sir Henry Roscoe, and on the geological conditions of Iceland and the theory of the geysers, the result of a visit to that island in 1847.

The research, however, by which, perhaps, more than any other the name of Bunsen will go down to posterity, linked with that of his colleague Kirchhoff, is the discovery of spectrum analysis, for this opened out a field of experiment so new and so vast that it may well be said to be the most important scientific result accomplished during the latter half of the century—a time pregnant with work of a truly marvellous character. To have added a new branch to chemical science which throws a clear and wholly unexpected light upon the constitution of terrestrial matter, which has been the means of discovering many new chemical elements, and of proving the widespread distribution of others hitherto considered as rare, would in itself have been a work of primary significance; but when to that is added the fact that by means of this far-reaching method the bounds of our planet are outstepped and a knowledge not only of the chemical composition of the sun and of the far-distant stars but even of their rates of motion have thus been

obtained, an idea may be formed of the debt of gratitude which all interested in human progress must feel to the two great twin brethren who, in their quiet laboratory at Heidelberg, revealed such hidden secrets. But these, though the best-known and most popular of the achievements of the Heidelberg master, are not more important from a scientific point of view than many others all known and valued by the chemist and physicist. To have first instituted methods of almost astronomical precision in the measurement and separation of gases, and thus to have laid on a firm foundation the branch science of gas analysis, is in itself sufficient to have marked him as one of the first experimentalists of the age. Add to that his numerous memoirs on purely chemical subjects, all marked by the same accurate work; add, again, his researches in physical chemistry; on the measurement of the chemical action of light—carried on in conjunction with one of his pupils—and, again, one on a new and improved method of determining specific heat, not forgetting his chemico-geological researches, which constitute what may well be termed an epoch-making discovery as to the composition of the volcanic rocks of our planet, and it is not much to say that for variety and importance the theoretical and experimental work proceeding from his brain and hands has rarely, if ever, been exceeded.

This work, although great, is by no means the only or even the greatest work achieved by Bunsen. He has built up a vast and enduring reputation by his labours as a teacher and as a master craftsman.

USEFUL AND SCIENTIFIC NOTES.

A NEW form of caisson for executing work under water, the invention of the Russian engineer, L. Astarchoff, is about to be tried in the Neva by a committee of technical experts. The caisson in question has a conical form, and its inventor claims that, by its use, work can be carried on on the bed of a river at a lower atmospheric pressure than is now the case with the present caissons.

Royal Exhibitions, National Scholarships, and Free Studentships (Science), 1899.—The following is the list of successful candidates:—Royal Exhibitions: William M. Selvey, 18, apprentice fitter, Devonport; Edward C. Moyle, 19, apprentice fitter, Devonport; Archibald D. Alexander, 18, apprentice fitter, Portsmouth; Charles W. Price, 18, apprentice fitter, Devonport; George F. A. Cowley, 20, apprentice fitter, Portsmouth; Edgar Sutcliffe, 16, student, Blackley, Manchester; Sydney A. Edmonds, 18, apprentice fitter, Devonport. National Scholarships for Mechanics (Group A): Francis P. Johns, 20, apprentice fitter, Devonport; George F. Turner, 23, engineer, Sheffield; Walter A. Scoble, 18, apprentice fitter, East Stonehouse, Devon; Arthur J. Spencer, 20, apprentice fitter, Portsmouth; William H. Adams, 19, apprentice fitter, Devonport. Free Studentships for Mechanics (Group A): R. Borlase Matthews, 21, engineer, Swansea; William H. Outfin, 19, apprentice fitter, Devonport. National Scholarships for Physics (Group B): William R. Daniel, 16, student, Levenshulme, Manchester; William J. Lyons, 21, science teacher, Cork; James Lord, 20, student, Chadderton, Oldham; William M. Varley, 20, student, Slaithwaite, Huddersfield; Wilfred H. Clarke, 21, science teacher, Kidderminster. Free Studentships for Physics (Group B): John H. Shaxby, 19, Aberystwyth; †Gerald Henniker, 17, student, London. National Scholarships for *Chemistry* (Group C): William D. Rogers, 17, assistant science teacher, Smethwick; John H. Crabtree, 24, cotton weaver, Todmorden; Howard E. Goodson, 18, laboratory assistant, Armley, Leeds; Arthur H. Higgins, 18, student, Bradford; Montague W. Stevens, 17, student, Plymouth. Free Studentships for Chemistry (Group C): John R. Horsley, 16, student, Canterbury; †Arthur C. Nicholson, 20, student, Newark. National Scholarships for Biology (Group D): Eric Drabble, 22, student, Chesterfield; Louis E. Robinson, 17, student, Bradford; Ernest A. Wraight, 20, London; Reginald F. G. Bayley, 19, Eltham; *Harold B. Fantham, 22, teacher, Birmingham. National Scholarships for Geology (Group E): William H. Goodchild, 19, analytical chemist, London; Thomas Thornton, 22, cloth looker, Briercliffe, Burnley.—(* Extra Scholarships transferred from Group E. † Extra Free Studentships transferred from Groups D and E.)

SCIENTIFIC NEWS.

THE programme of the British Association, which meets at Dover on Sept. 13, under the presidency of Sir Michael Foster, Sec. R.S., has been issued, and to a certain extent is of special interest, as the meeting this year partakes of an international character. The members of the French Association will visit Dover on Sept. 16, and the members of the British Association are invited to visit Boulogne on the following Thursday. It is anticipated that the gathering will be memorable by the large attendance of the most eminent men of science in America and on the Continent. The Mayors and Corporations of Dover and Canterbury, the military authorities of the South-Eastern District, and the leading scientific and educational institutions, will take part in the entertainment of the Association. The Castle at Dover and National Harbour Works will be open for inspection during the meeting. The first general meeting will be held at the Connaught Hall on Wednesday, Sept. 13, when Sir Michael Foster will assume the presidency in succession to Sir William Crookes, and deliver his Presidential address. On the following evening there will be a soirée in the School of Art, and on the Friday evening Prof. Charles Ritchet will deliver an address on "La Vibration Nerveuse." The professor next evening will discourse on "The Centenary of the Electric Current." In the Mathematical and Physical Science Section Prof. J. H. Poynting will preside; in the Chemistry Section the president will be Mr. Horace T. Brown; and the presidents in the other sections will be: Geology, Sir Archibald Geikie; Zoology, Mr. Adam Sedgwick; Geography, Sir John Murray; Economic Science and Statistics, Prof. Henry Higgs; Mechanical Science, Sir W. H. White, Chief Constructor of her Majesty's Navy; Anthropology, Mr. C. H. Read; Physiology, Mr. J. N. Langley; Botany, Sir George King; conference of delegates and corresponding societies, Rev. T. R. R. Stebbing. A special feature of the Association will be demonstrations of Signor Marconi's wireless telegraphy, and the Rev. Mr. Bacon, it is anticipated, will give an address on his recent balloon experiments.

Observations of the Perseids seem to have been fairly successful this year, and it is probable that when all the notes come in some useful data will be obtained.

Dr. Frank Schlesinger, of Columbia University, New York, is to take charge of the observations on variation of latitude at Ukiah, California, under the scheme of the International Geodetic Association.

In France the finance minister has granted to MM. Hermite, of Besançon, the sum of £50 towards the expenses of making experiments with free balloons. Some of these experiments will be made at Boulogne during the meeting of the French Association for the Advancement of Science.

Dr. Daniel G. Brinton, the distinguished American anthropologist is dead, in his sixty-third year. He was for many years Professor of American Archæology and Linguistics in the University of Pennsylvania, and has bequeathed his valuable library to that institution. Dr. Brinton had very little work to do in connection with his professorial duties, and had therefore so much time to devote to research that he became the most accomplished man in America in connection with the many languages of that vast continent.

The death is announced of Mr. Thomas Francis Rivers, of Sawbridgeworth, Herts, who was well known throughout the civilised world as one of the most successful of the modern professors of fruit culture.

According to a Reuter's telegram which deals with other matters, Capt. Welby has made an important expedition in Abyssinia and the regions to the south-west. After some preliminary excursions, it appears that Capt. Welby collected a "caravan" and then struck south, skirting the western shores of the Abyssinian lakes. The last of these, Lake Obai, is surrounded by mountains over 10,000ft. in height. The country from this point was practically unexplored. Capt. Welby found it very fertile and thickly populated by Gallas, who are tributary to the Abyssinians. It is purely agricultural, and the natives, many of whom had never seen a white man before, were everywhere friendly. Leaving this region, the party continued their journey to the north end of Lake Rudolph, Capt. Welby being able to satisfy himself that the River Womo runs into that body of water. The east shore of the lake, which was next visited, was found to be practically uninhabited. Here the great majority of the caravan animals died of anthrax. One tribe met with—the Tirkana—were of immense stature, most of the men being 7ft. in height. They had long hair extending to the waist, and matted like felt. This they generally wear turned up in such a manner as to form a receptacle for small articles and nick-nacks, the ends being finally twisted into a tail with a thin stick, about which they are very particular. Abundance of game was met with, and elephants were numerous. The chief articles of commerce in the new region explored are camels, donkeys, sheep, and agricultural produce, brass, iron, copper, and amber. No precious metals were seen, but there is a large supply of white marble. Payments are made in beads, salt, and iron bars.

It is announced that Mr. Weld Blundell and Lord Lovat have presented to the British Museum the fine collection of birds made by them during their recent expedition through Southern Abyssinia to the Blue Nile. They travelled through nearly 300 miles of country which had never been previously explored. The collection is said to be one of the most interesting that has ever been obtained in Abyssinia, and is remarkable for the number of species it contains new to science. A detailed examination has not yet been made, but at least twenty new birds have been discovered by the ornithologists of the Museum.

The neighbourhood of London has been infested with mosquitoes during the hot weather, as have most ports to which ships from the Tropics come; but the sting of these mosquitoes is not so bad as that of the malarial mosquito, which it is announced that Dr. Ronald Ross has found. He was sent out by the Liverpool School of Tropical Diseases to study the subject, and to determine which species of mosquito is the disseminator of malaria.

Some rather extraordinary statements are made as to Marconi's system of wireless telegraphy, and it is said that the possibility of communicating with the United States has been almost demonstrated. It appears that messages have been sent and received from stations between which some miles of cliff 400ft. high intervened, and it is considered settled that messages can be sent from Paris to London, and that it is probable they can be sent from England to America. When the British Association meets in Dover next month experiments are to be made, and attempts will be made to signal over very great distances.

It is stated that Signor d'Azar's maritime telephone consists of two sections, or "sound collectors," one of which is lowered into the water on each side of the vessel, both being connected by a special mechanism to a microphone provided with a vibrating membrane. A movable hand indicates the direction of the sound-waves upon a quadrant, which is placed on the deck, so that it is quite possible to learn the approach of a vessel and its course at a distance of five miles in the darkest night or thickest fog. Should two vessels wish to communicate with one another, they need only make use of a special clapper-apparatus, the strokes against the side of one vessel being registered on a Morse machine in the other. All semaphores along the coast can also communicate with ships at sea by means of specially-constructed buoys. Apparently it is an important invention, but further details will be awaited with interest.

At the meeting of the Iron and Steel Institute the important question of carburised iron was brought up by Dr. A. Stansfield, who said that metallic alloys behaved as saline solutions did, and bringing carburised iron into line with alloys was rendering a good service to industrial and theoretical chemistry. A solution need not be a liquid, but in certain solids, especially when they were at a high temperature, an added element tended to diffuse itself uniformly through the mass, from which, however, as from the liquid solution, it might be crystallised out on cooling. Such a solution was white-hot steel. The solution theory of carburised iron affirmed that this substance was, when fluid, a solution of carbon in iron, and that under certain conditions the solidified mass also formed a solid solution. It

further affirmed that these liquid and solid solutions obeyed the ordinary laws of solution, which had been fully studied in the case of aqueous, saline, and organic solutions. The solution theory could, therefore, be invoked to explain both the mode of solidification of carburised iron, and the molecular changes that took place after solidification. The president expressed himself as being quite in accord with the author, who, he thought, had advanced the subject by his elaborate paper.

The autumn meeting of the Iron and Steel Institute appears to have been very satisfactory from all points of view, but the papers read were necessarily too technical for prolonged discussion. The question of the utility of microscopic analysis in the steel industries was introduced by Mr. C. H. Ridsdale, who pointed out that, valuable and interesting as many of the communications and discussions had been, they had been so chiefly either from a general or else from a purely scientific point of view. He then explained in detail how he had systematised the microscopic study of steel, and rendered it available for every-day use in a busy laboratory, where commercial objects must ever predominate, so that it might be carried on with minimum demands on time or of specially expensive appliances, or other serious cost, while it should be of such value as to really have a *raison d'être*. He also gave some of the results of his study of soft steel up to the present time. The President observed that he had given a great deal of attention to the subject of the paper, which was a very important one; and the only doubt in his mind was as to whether the method of examination adopted by Mr. Ridsdale was the best one for the purpose. In expressing that doubt he wished it to be distinctly understood that he in no way decried the labours of the author, or of the principle involved; he simply questioned one or two points of practice. M. Greiner, of Seraing, said he highly appreciated the principle of microscopical analysis, and suggested that the Institute as a body should set to work to formulate a systematic method of procedure, by means of which uniformity of results might always be obtained. Prof. Porter, of Montreal, stated that the importance of the subject under discussion was fully recognised in the United States and Canada, and he was engaged in equipping an expensive micro-laboratory in his college at Montreal.

The Wellmann expedition has been brought back to Tromso from Franz Josef's Land. It is reported that the explorers reached the 82nd parallel of north latitude. A member of the expedition named Bentzen, who wintered with one companion in a stone hut on the island of Wilzienland in intense cold, died. In February Mr. Wellmann had his foot crushed in an ice-squeeze, and is still obliged to use crutches. The expedition killed 103 walruses and eight bears. No trace of the Andrée Expedition was found. The *Capella* picked up the expedition on the 27th July, and sailed homeward on the 10th August. On the 6th inst. the *Stella Polare*, with the party of explorers, headed by the Italian Prince, the Duke of the Abruzzi, on board, was sighted in Broejens Sound 80° 20′ N. latitude. The full report will be received shortly, and with interest, as it appears some important observation have been made.

At the Zoological Gardens the new zebras deposited by the Queen are much better for their rest in roomy quarters, and thrive on the improved rations served to them. A Burchell's zebra has been born, and attracted nearly as much attention as the far rarer animals deposited by her Majesty. This species does well at the Gardens; and, with so magnificent a collection of wild asses—self-coloured and striped—as there is at the Zoo, it is suggested that they should be utilised for experiments on similar lines to those carried out by Prof. Cossar Ewart at Penycuik, for these would be sure to throw considerable light on questions of hybridisation, reversion, and telegony. There is also an economic side to the question, to which the society in its early days gave some attention; nearly seventy years ago a pair of quagga mules drew one of their carts about London. A puma cub has been born in the lion house, but will not be shown for some days. Then visitors will have an opportunity of seeing how these New World cats, which are of a uniform colour when adult, are spotted and have the tails ringed in their cubhood. To the aviaries have been added, by purchase, three pink-headed ducks from India. Though nowhere common, they are most plentiful in Bengal. A pair were imported in 1874, and secured for the Gardens, but they did not breed. In 1887, when the late Mr. Jamrach secured several pairs, he found ready purchasers, chiefly on the Continent, at from £40 to £60 a pair. They should make fine birds for ornamental water, the clear rose pink of the head and neck showing up well against the chocolate and brown of the back. Since 1874 only one other specimen has been exhibited in the Regent's Park aviaries.

In reference to the colliery explosion in South Wales, it is probable that there will be an inquiry into the conditions, which may help to elucidate the fact such explosions should not occur unless the circumstances are exceptional. It is doubtful whether it is ever really safe to work a mine with naked lights.

According to a news par. from New York, the movement started at Chicago to obtain a national petition to Congress to suppress copper money has reached New York. Experiments made by Chicago bacteriologists showed that there were many cases of communication of disease to children through coppers. No copper coin examined by them was free from disease germs.

Similarly from Coney Island, the news comes that the lemonade has been made of "citric acid by unscrupulous dealers," owing to the scarcity of lemons, and "there are many cases in the hospital." The reporter does not apparently suspect the ice, and he evidently does not know that citric acid is made from lemons.

A new regulation on Russian weights and measures is officially published. The Russian pound, which is fixed as the standard of weight, and declared to be equal to 409·512 grammes, a pail or vedro should hold 30lb. of distilled water at 16 2-3 (Celsius), and a garnez 8lb. of water. The unit of length is the Arshin, equal to 71·12 centimètres. The metric system is to be optional, and may be used on a par with the Russian in commerce in dealing with contracts, accounts, &c., and after mutual agreement by State and municipal authorities. Private persons are, however, to be under no compulsion to use the metrical system when dealing with the above-named authorities. Apparently there are some signs of progress in Russia.

The latest remarkable news from America is sent by the New York correspondent of the *Morning Leader*, who writes:—"A powerful electro-magnet, the invention of Dr. Haab, a German professor, recently added to the equipment of the Manhattan Eye and Ear Hospital, was tested with great success a few days ago, when an operation was performed on a patient, who was brought to that institution almost blinded from a sliver of steel which had been hurled into his eye from a rapidly-revolving lathe. The steel had cut almost through the entire eye into the posterior chamber in the vitreous fluid, where it was impossible to reach it with an instrument. The consequence of its remaining, however, would result in blindness possibly of both eyes. The giant magnet, which is so powerful that it will seize a large bunch of keys thrown at it with a vice-like grip (*sic*) was brought on the scene. The patient was moved gradually toward the magnet, and as the eye came nearer and nearer it was drawn far out from the socket. The pain was almost unbearable, but as the piece of steel came slowly through the opening it had made going in, and flew like a flash to the magnet, the socket fell back in its place. The eye would have had to come out entirely were it not for the magnet, and it is believed that the patient will soon recover. The magnet is shaped at each end like a torpedo; it is 22in. long and 14in. in diameter, and is strong enough to draw a nail from a board."

Further and most decisive trials of the submarine boat *Holland* took place in Picnic Bay, New York, last week. She was submerged when proceeding at a speed of 7½ knots, and disappeared in less than five seconds. She remained submerged on an even keel throughout the distance of a mile, and she discharged a dummy torpedo without any disturbance of the surface water.

The important scheme for making a canal between Marseilles and the Rhone is being pushed forward with much energy, the promoters having succeeded in obtaining a promise of a large Government subsidy. The course of the canal will be from the northern end of Marseilles Harbour, through the mountain chain of Rove by means of a tunnel four and a half miles long to Lake Solmon. Thence, by way of Berre and Martigne, it would effect a junction with the existing Canal Maritime, the course of which would be followed as far as Port de Bouc, where a short connecting water-way would open into the Arles Canal. From that point to the Rhone is only a short distance.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

⁂ *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

REPORT OF THE PARIS OBSERVATORY FOR 1898—THE HUYGHENIAN EYEPIECE—REDUCING INTENSITY OF SUNLIGHT—OPTICAL DEALERS—TRADITIONS OF THE DELUGE—STELLAR PHOTOMETER—"THE STORY OF OUR PLANET"—INCLINATION OF THE PLANETARY POLES, &c.—ABSOLUTE TEMPERATURE.

[42712.]—THE Annual Report of the Director of the Paris Observatory for the year 1898 scarcely yields to any of its predecessors in interest, showing as it does how M. Lœwy, its gifted head, has contrived to overcome difficulties before which many men might well have stood helpless. One of the principal works in which he has been engaged is in a successful attempt to insure and preserve the stability of the meridian instruments, a work the importance of which it would be difficult to over-estimate. Beginning with the Meridian Circle in the Garden, whose piers were originally erected on made earth, they are now carried down on to a solid bed of concrete, some 40ft. thick, which rests upon the limestone rock beneath. Furthermore, the circle was read by six microscopes affixed to the east pier, with which anomalous results were obtained. Now, a second series of six microscopes has been attached to the west pier, so that both circles are read, and the improvement is notable, *inter alia*, in the determination of the Nadir point. The revolving hut of the small equatorial coudé has been covered with cork, thus protecting the instrument from variations of temperature. But M. Lœwy has been met with a new and unexpected difficulty, and one which, it seems to me, must perforce involve the removal of the observatory from the familiar site which it has occupied for the last 230 years. As all visitors to Paris know, the extensive grounds to the south of the observatory face on the Rue Cassini, and although the vibration of the tram running down the Rue Denfert-Rocherau close by sometimes renders the use of the mercury collimator difficult or impossible, yet until last year the east part of the Rue Cassini, adjoining the garden of the Observatory, was always closed to traffic. But in Paris, as in London, nothing is sacred to the builder, and an important building has been erected in that part closest to the meridian instruments, and the City of Paris has entered into an agreement with Madame André, its proprietor, to open the street for carriages for its entire length. The Minister of Education has, at the instance of the council and directors of the Observatory, tried in vain to get this latter order cancelled. The utmost he has succeeded in obtaining is a promise that the pavement shall be asphalte and the roadway wood. The effect of this upon the precision of meridian observations must be only too apparent. Turning from this to the actual work achieved, the section of the photographic map of the Heavens confided to the Observatory may be considered as complete, a very few lacunæ, caused by the bad weather of certain seasons of the year, alone remaining to be filled. Hereafter, the principal object of photographic work will be the obtaining of the image of stars up to the 14th magnitude. The splendid atlas of the moon of MM. Lœwy and Puiseux progresses apace, and one of their exquisite clichées of our satellite when between 20 and 21 days old forms a frontispiece to the present Report. Some interesting

results, pointing to the mode of origin of certain familiar lunar formations, have been deduced by the authors from their photographs. M. Bigourdan has used the western equatorial for the observation of the physical and chemical structure of nebulæ, while M. Hamy, on the nights when the great equatorial coudé was not employed in photographing the moon, has employed it in the determination of the diameters of small stars by the method of interference. He has thus successfully measured the diameters of Vesta and of Jupiter's satellites. That of Vesta he finds to be about 0·4″. Of the general meridian work, the reduction of the stellar photographs, &c., &c., it is needless to speak at length. Anyone and everyone interested will find ample evidence of the energy and its concomitant success, alike of the director and his staff in the perusal of the "Rapport" itself.

Among much that is interesting in the August number of the *Journal* of the British Astronomical Association, I would call attention to a paper by Mr. E. M. Nelson on the Huyghenian Eyepiece, which will well repay perusal. The particular form of it devised by Mr. Nelson has a field of 33°, which is ample for all practical purposes; and further possesses an advantage which will be appreciated by all observers—viz., that the annoying secondary image, known as a "ghost," which is visible in some eyepieces, is wholly eliminated.

In connection with what Mr. Ellison says (in letter 42662) on p. 576, of Vol. LXIX., concerning the reduction of the intensity of the sun's light and heat in the telescope, I may mention that more years ago than I care to count, the late Andrew Ross fitted some of my eyepieces with tubes which carried coloured glasses within the solar focus of the instrument, and so intercepted the rays from the objective before they arrived at their point of highest concentration. The late Mr. C. L. Prince, F.R.A.S., produced the same effect by the aid of a piece of smoked glass placed in the diaphragm of an eyepiece. The first of these devices is that, as he will see, which your correspondent has reinvented. That of Mr. Prince pretty quickly got unpleasantly hot.

"Hear Both Sides" (letter 42664, p. 577, Vol. LXIX.) quotes more than one case in which it seems to me the aggrieved party had a legal remedy. It has been decided in the High Court of Justice that: If a tradesman sell an article for a particular use or purpose, he thereby impliedly warrants that it is fit for that particular use and purpose (vide "Jones v. Bright," "Brown v. Edgington," &c.), and can be made responsible in damages. It seems, then, to me that to take a single instance, in that case of the £50 6in. achromatic, so far from the purchaser having "no redress," he could have sued the vendor, and certainly got a verdict against him.

I am at a loss to imagine upon what grounds Mr. Rouse (letter 42665, Vol. LXIX., p. 577) asserts that *I* "incline to the belief that this tradition (of the Flood), which seems otherwise to have spread all over the globe, had originated in an extraordinary overflow of the Nile." I stated, in letter 42529, on p. 442 of that volume, that Sir George Airy expressed that opinion, but most certainly not that I held it. My own idea is that the legend of the Deluge had its origin in the finding of fossil shells in mountains at a great altitude above the sea-level by people whose knowledge of geology was, *ex necessitate*, nil. That great and devastating local inundations may have given rise in the regions in which they occurred to legends of a Flood originally, is quite possible; but the belief in the universality of such a cataclysm would be most materially strengthened by the finding, as I have just said, of shells in rocks elevated many thousand of feet above the sea. Mr. Rouse's peroration is really delightful. The derivation of Cucumber from King Jeremiah seems almost a poverty-stricken conception beside it.

The most simple photometer that I can recommend to "X Y Z" (query 96432, Vol. LXIX. p. 584) would take the form of a series of diaphragms to fit over his object-glass. The first thing is to procure one of exactly 1in. in aperture, and determine from Argelander the smallest of his magnitudes *just* discernible on a clear moonless night with this. Call this L, or the limit of vision for 1in., then the limit l for any other aperture will be $l = L + 5 \times \log.$ aperture. This is known as Pogson's formula. Now suppose that "X Y Z" finds, as he probably will, that the 9th magnitude is the *minimum visibile* with his inch diaphragm, what is the magnitude of a star he can just perceive with an aperture of 0·2in.? Here we have $l = 9 + 5 \log. 0{\cdot}2$, and as $\log. 2 = \bar{1}{\cdot}301030$, five times this is $\bar{4}{\cdot}505150$. Finally—

$$\begin{array}{r} 9 \\ \bar{4}{\cdot}50 \\ \hline 5{\cdot}50 \end{array}$$

gives us 5·50 as the smallest star visible. Or, what is the limit of vision for 3in. of aperture? Here we have log. 3 = 0·47712, and this × 5 = 2·38560. If to this, then, we add 9, we get 11·39 as the *minimum visibile* with the aperture specified. Another form of photometer consists of a graduated wedge of coloured glass sliding before the eyepiece. The value of different parts of this must be obtained by comparison with some such catalogue as that of Pickering's Harvard Photometry. Wesley and Son, 28, Essex-street, Strand, London, would be the people to obtain this from.

I recommended Prof. Bonney's "Story of Our Planet" to "Glatton" (in letter 42659, p. 576 of your last volume) as a most interesting and readable book at a moderate price; but as this seems to have raised the ire of "E. L. G." (letter 42694, p. 15), I would say that Lyell's "Students' Elements of Geology," Geikie's "Textbook of Geology"; or, in short, any standard work on the subject will answer just as well.

The following data, derived from Young's "General Astronomy," will probably answer the purpose of "J. R. J." (query 96467, p. 22)—

Planet.	Inclination of Orbit to Ecliptic.			Inclination of Planet's Equation to its Orbit.		
	°	′	″	°	′	″
Mercury........	7	0	8		?	
Venus..........	3	23	35		?	
Earth	0	0	0	23	27	12
Mars	1	51	2	24	50	0
Jupiter	1	18	41	3	5	0
Saturn	2	29	40	26	49	0
Uranus	0	46	20		?	
Neptune........	1	47	2		?	

Satellites.	Inclination of Orbit to Ecliptic.			Inclination to Plane of Planet's Orbit.		
	°	′	″	°	′	″
Moon	5	8	40			
Of Mars—						
Phobos	26	17	12	28		
Deimos........	25	47	12	28	±	
Of Jupiter—						
I.	2	8	3			
II.............	1	38	57			
III.	1	59	53			
IV.	1	57	0			
	Inclination of five inner satellites to plane of Celestial Equator.*					
Of Saturn—						
Mimas	28	10	10	27 (about).		
Enceladus	,,		,,	,,	,,	
Tethys	,,		,,	,,	,,	
Dione	,,		,,	,,	,,	
Rhea	,,		,,	,,	,,	
Titan..........	27	38	49	6	57	43
Hyperion	27	4	48			
Iapetus........	18	31	30			
Of Uranus—				Inclination to Celestial Equator.		
Ariel	97	51	0			
Umbriel						
Titania				75	18	0
Oberon........						
Of Neptune	145	12	0	120	5	0

* The planes of the five inner orbits sensibly correspond with the plane of the Ring.

I must absolutely refuse to touch the monkey puzzle, the discussion whereon is the veriest logomachy.

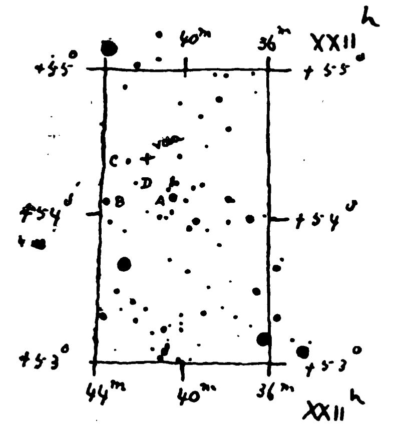
If, as is presumably the case, by "absolute temperature" "B. L." (query 96476, p. 22) means the absolute zero of temperature, this was found by Joule and Lord Kelvin to be −461° Fahr. (Olszewski has actually measured −373° Fahr.!) There is no satisfactory determination of the temperature of space, for temperature can only exist where there is matter. The boiling point of liquid hydrogen is that at which it passes from the vaporous to the liquid form, or vice versâ.

A Fellow of the Royal Astronomical Society.

THE VARIABLE STAR ES-BIRM. 735—A NEW NEBULA—THE CLUSTER H. VI. 30 CASSIOPEIÆ, AND A POSSIBLE VARIABLE STAR.

[42713.]—(1) Es-Birm. 735, R.A. 22h. 43·7m., N. Decl. + 54° 38′ (1900). This star was found in sweeping on Oct. 20, 1887, and a circle reading led me to identify it with B.D. + 54° 2865. It was only in 1893 that I found it was really to be identified with B.D. + 54° 2863, whose magnitude in Argelander is 9·5. As it was a whole magnitude; brighter, suspicion of variability was at once aroused. The telescope being employed in sweeping for stars of type III. and IV. makes it impossible to follow up the variable stars accidentally detected, but occasional observations are made of suspected variables when the telescope is in use in that part of the sky. The following are all the observations I have of this star:—1887, Oct. 20, 8·5; Dec. 4, 8·2; Dec. 7, 8·5; mean = 8·4. 1893, Oct. 8, 8·5; Oct. 11, 16, Dec. 1, 1894 Jan. 9, 8.3; mean = 8·3. 1894, Sept. 10, 7·9; Oct. 21, 7·4; Oct. 29, 8·0; Nov. 29, 7·6; mean = 7·7.

These results are interesting, as showing that the variation is very slow. In 1887, 1893 the variation was inappreciable; in 1894 there seems to have been fluctuation, and the mean shows the star considerably brighter. It will be noticed that it has never been seen so faint as given by Argelander. Can the star have slowly brightened since his time? The variation has been confirmed by Parkhurst and Backhouse, and it would be of interest to see their observations. I inclose a tracing from Argelander, showing the position of the star. The magnitudes



Es-Birm 735

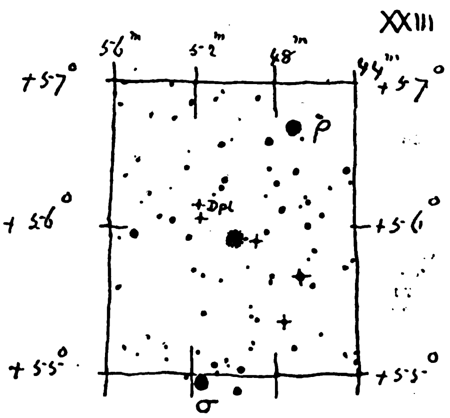
of the stars A, B, C, D are respectively 7·1, 8·0, 8·5, 9·0. The four large stars are in Argelander all 6·0 mag. For those who have not equatorials, it may be helpful to state that a line from Alpha Lacertæ to 9 Lacertæ projected to twice the distance between these stars will find the 6-mag. star south of the variable. The other bright star N is B.A.C. 7961, and its magnitude 5·4 in the Harvard Photometry.

(2) In the sweeps with the 17¼in. it is customary to note any nebulæ that are come across, and on Aug. 13 I found a large diffused nebulosity not a difficult object, the centre of which is—

R.A. 21h. 47m. 54s., N.Dec. 46° 34′ (1855).

It is fairly circular, and fades away on all sides, and some 10′ in diameter. Much to my astonishment I found next morning that it is hitherto unrecorded. I should think it is not more difficult than the Merope nebula, but like it, it requires a low power.

(3) Between ρ and σ Cassiopeiæ lies the cluster H. VI. 30, R.A. 23h. 52m., Decl. N. 56° 9′. Celestial



Cluster H. VI. 30 Cassiopeia
Coloured stars marked +

Objects, p. 75. With a low power a lovely object, and with a higher one quite resolved stars 10 to 14 mag. on Aug. 13. I examined it for red stars. P is an orange red (Es. 1249), mag. 8·7, showing a well-developed III. type spectrum. F is a 9·0 mag. orange red, with apparently similar spectrum. About 6′ N. of this star a pair caught my attention, the *comes* being a dull-looking object. With a higher power it turned out to be deep red. The neighbouring star prevented any satisfactory observation with the spectroscope. I estimated the pair as—

P = 230° ± D. 15″ ± mag. 9·3, 9·8.

The star is B.D. 56° 3126 R.A. 23h. 51m. 45·8s.,

No.	1899.	G.M.T.	From.	To.	Mag.	Dur.	Description.
		h. m.	° °	° °		s.	
87	Aug. 11	9 55	270 + 52	235 + 70	4	—	Swift.
88	,, 11	10 6	15 + 67½	332½ + 69	2	—	Swift; streak.
89	,, 11	10 9	288½ + 54½	277 + 38½	2	—	Swift; streak.
90	,, 11	10 11	5 + 38	346½ + 17½	1	—	Swift; streak.
91	,, 11	10 14	305 + 79	300 + 44	4	—	Swift.
92	,, 11	10 22	55 + 62	65 + 65	♀	0·3	Swift; streak.
93	,, 11	10 34	10 + 73	30 + 85	3	0 2	Very swift.
94	,, 11	10 39	329 + 54½	355 + 45	3	—	Very swift.
95	,, 11	10 43½	67½ + 73	110 + 79	2	—	Swift; streak.
96	,, 11	10 46½	33 + 55	25 + 53	4	—	Swift; streak.
97	,, 11	10 49	20 + 57½	26 + 47½	3	0·3	Swift.
98	,, 11	10 51½	350 + 35	332 + 13½	1	0·3	Very swift: streak.
99	,, 11	11 1	355 + 62½	340 + 71½	4	0·2	Very swift.
100	,, 11	11 4½	16 + 35	4 + 17½	2	—	Swift; streak.
101	,, 11	11 6	2 + 62	0½ + 69	4	0·2	Very swift.
102	,, 11	11 12½	290 + 87	200 + 75½	4	0·2	Very swift.
103	,, 12	10 34	353 + 60	345 + 65	4	0·2	Very swift.
104	,, 12	10 35	37½ + 51½	33 + 47½	4	0·3	Swift.
105	,, 12	10 38	30 + 75	53½ + 69	4	0·3	Swift.
106	,, 12	10 39½	7½ + 40	350 + 20	2	0·4	Swift; streak.
107	,, 12	10 41½	15 + 70	326 + 72	2	0·4	Swift; streak.
108	,, 12	10 42	6 + 47	343½ + 30	3	0·3	Swift; streak.
109	,, 12	10 43½	0 + 45	331½ + 43	4	0·2	Very swift.
110	,, 12	10 48½	350 + 75	37½ + 65½	4	0·4	Rather swift.
111	,, 12	10 52	53½ + 58	57 + 58½	2	0·2	Swift; streak.
112	,, 12	10 53	39 + 65	51½ + 58½	3	0·2	Very swift.
113	,, 12	10 59½	41 + 61	35 + 63½	3	0 3	Swift; streak.
114	,, 12	11 5	330 + 30	322 + 15	2	0·2	Very swift.
115	,, 12	11 8	338 + 30	327½ + 67½	4	0·3	Very swift.
116	,, 12	11 9	345 + 37	327½ + 16	2	0·3	Swift; streak.
117	,, 12	11 10	10 + 36½	356 + 16½	2	0·3	Swift; streak.
118	,, 12	11 13½	4 + 35½	348½ + 17	3	0 3	Swift; streak.
119	,, 12	11 14½	71 + 70	310½ + 83	4	0·2	Very swift.
120	,, 12	11 20½	5 + 45	343½ + 26	2	0·3	Swift; streak
121	,, 12	11 21½	15 + 57	350 + 60	4	0·3	Swift.
122	,, 12	11 23	54½ + 65	60 + 70½	3	0·3	Swift; streak.
123	,, 12	11 23	84 + 60½	100 + 59	3	0·3	Swift; streak.
124	,, 12	11 29½	38½ + 53½	35 + 52	4	0·2	Swift; streak.
125	,, 12	11 31½	305 + 33½	320 + 39	1	0 4	Rather slow.
126	,, 12	11 40½	10 + 47½	20 + 40	4	0·2	Very swift.
127	,, 12	11 50	313 + 45	298½ + 35½	3	0·2	Very swift.
128	,, 12	11 55½	44 + 62½	23 + 68	4	0·2	Very swift.
129	,, 12	12 2	40 + 61	30 + 64	4	0·3	Swift; streak.
130	,, 12	12 4½	305 + 55	0 + 79½	1	0·4	Rather slow.
131	,, 12	12 6½	340 + 65	300 + 48	♃	0·2	Very swift; streak.
132	,, 12	12 12	17½ + 52½	355 + 0½	4	0·2	Very swift.
133	,, 14	10 50	3 + 33	22½ + 46½	4	0·3	Swift.
134	,, 14	10 56½	322 + 65	350 + 80	3	0·3	Swift.
135	,, 14	11 2	33 + 53½	23 + 48	2	0 3	Swift; streak.
136	,, 14	11 5½	336½ + 52	331½ + 51½	4	0·2	Swift.
137	,, 14	11 11	18 + 41	28 + 55	2	0·2	Very swift.
138	,, 14	11 14	348½ + 48½	355 + 46½	4	0·2	Swift.
139	,, 14	11 16½	340 + 47½	337½ + 45	4	0·2	Swift.
140	,, 14	11 23	25 + 63½	70 + 70	3	0·2	Very swift.
141	,, 14	11 29	343½ + 47½	342½ + 43½	4	0·2	Swift.
142	,, 14	11 31	22 + 48½	15 + 48	3	0·3	Rather slow.
143	,, 14	11 33	350 + 20	12 + 12½	1	0·3	Swift.
144	,, 14	11 47½	45 + 54	41 + 50	4	0·2	Swift; streak.
145	,, 14	11 52½	20 + 50	32½ + 46½	2	0·3	Swift.
146	,, 14	11 58½	145 + 33½	340 + 15	4	0·3	Swift.
147	,, 14	12 1½	352 + 37½	346½ + 24½	4	0 2	Very swift.
148	,, 14	12 4	72 + 61½	90 + 61½	3	0·3	Swift; streak.
149	,, 14	12 6½	5 + 29	338 + 31	2	0·3	Swift.
150	,, 14	12 8	345 + 55	50 + 85	4	0·2	Very swift.
151	,, 14	12 24	355 + 27	25 + 20	3	0·3	Swift.
152	,, 14	12 26	325 + 77½	318½ + 63	3	0·3	Swift.
153	,, 14	12 30	58 + 60	65 + 61½	3	0·2	Swift; streak.
154	,, 14	12 35	17 + 12½	5 + 1½	2	0·2	Very swift.
155	,, 14	12 35	17½ + 48½	30 + 44	2	0·3	Swift.
156	,, 14	12 50½	30 + 40	21½ ± 41½	2	0·3	Swift; streak.

Decl. + 56° 9·5′. Now on turning to the Hels.-Gotha zones, I find this star is mentioned as a double in zone 109 (1870, Oct. 12), mag. 9·2 "dupl. 16″ sq. *comes* 9·5." It would thus appear that the preceding or red star was then the brightest. The pair is very like U Cygni, and the red will probably turn out to be a variable. A tracing from Argelander showing the cluster, and ρ and σ Cassiopeiæ, with the coloured stars marked, may be helpful.

T. E. Espin.

Tow Law, Co. Durham, Aug. 15.

THE PERSEIDS, 1899.—II.

[42714.]—In continuation of my former letter (42690, p. 14), I subjoin an account of watches recently kept for meteors. These were as follows:—Aug. 11, 10h. 5m. to 11h. 13m. (16 meteors, including one seen during a momentary glance at the sky at 9h. 55m.); Aug. 12, 10h. 25m. to 12h. 15m. (30 meteors); Aug. 14, 10h. 50m. to 13h. 0m. (24 meteors). Total, 5h. 8m. (70 meteors). All were determined by clouds. The hourly rates of meteors during the period of observation on the several nights were 14, 16, and 11 respectively.

Another meteor as bright as Jupiter was observed by my brother at 10h. 35m. on Aug. 14. It travelled swiftly from 2° + 55° to 357½° + 10°, and left a streak.

The times, &c., of the 70 meteors are set out in the annexed table.

Date.		Radiants.	Meteors.
F.	Aug. 11	4° + 50°	(93, 99, 101, 102).
G.	,, 11	45 + 57	(88-90, 92, 95, 96, 98, 100).
H.	,, 12	0½ + 54	(103, 114, 126, 127).
I.	,, 12	48 + 58	(104, 106-8, 111, 113, 116-118, 120, 122-124, 129, 131).
J.	,, 14	5 + 52½	(137, 140, 145, 147, 155).
K.	,, 14	50 + 58	(135, 144, 146, 148, 153).
L.	,, 14	343½ + 52½	(136, 138, 139, 141).

MAGNITUDES.

Radiants.	= ♀	= ♃	1st.	2nd.	3rd.	4th.	Totals.
F.	—	—	—	—	1	3	4
G.	1	—	2	4	—	1	8
H.	—	—	—	1	1	2	4
I.	—	1	—	6	5	3	15
J.	—	—	—	3	1	1	5
K.	—	—	—	1	2	2	5
L.	—	—	—	—	—	4	4
— (Aug. 11)	—	—	—	—	2	2	4
— (Aug. 12)	—	—	2	—	1	8	11
— (Aug. 14)	—	—	1	3	4	2	10
Totals	1	1	5	18	17	28	70

In my letter above referred to in last week's issue, for "4" as the magnitude of meteor of No. 11, read "♃."

Walter. E. Besley.

The Chase, Clapham Common, Aug 19.

OBSERVATORY LIGHT.

[42715.]—Has anyone devised a really satisfactory light for the amateur observer yet? After trying many different lamps, I have now a 2½c.p. 8-volt incandescent lamp, worked by a small four-cell Pitkin accumulator, with variable resistance to adjust light for micrometer illumination, &c. The lampholder has flexible wire attached, and finding eyepieces, reading circles, looking at star maps, &c., are all easily performed. The trouble lies with the accumulator. No charging station within easy reach, heavy to carry, constant loss by local action when not in use, and life of plates not interminable. That I have put up with these objections, however, for two or three years speaks well for the battery and general convenience and cleanliness of the light when once obtained. Still, I should much like to hear whether Mr. Bottone or some other kind friend can improve upon it.

Would it be practically possible to drive a small dynamo by a falling weight? I mean something that could be wound up by hand with a windlass, and, if allowed to fall continuously, say 6ft. or 8ft., keep a small lamp going for perhaps a couple of hours. Of course, the light would not often be wanted for many minutes consecutively, and no doubt the weight could be controlled by some form of brake. Would such a plan be feasible?—and if so, what would be the most suitable design for the driving apparatus, to be erected outside observatory? I understand the armature of a small dynamo requires to be driven at between 2,000 and 3,000 revolutions per minute? If this could be accomplished, it seems to me that the plan would have the double merit of durability and that complete independence of gas and electric companies needful in out-of-the-way places.

F. D. C. Baly.

SOLAR EYE-SHADES FOR TELESCOPES.

[42716.]—I have never tried placing a coloured-glass shade between the eyepiece and the object-glass, so cannot speak from experience; but it seems to me that unless the quality of the glass of the coloured shade was of the finest, it would seriously affect the definition, as any imperfection in the glass, and consequent distortion of the image, would be magnified when in that position; though I see that Mr. Ryle (letter 42688) says that he has found the definition under these conditions to be excellent.

I have used coloured eye-shades for direct vision with both a 2¼in. and a 5in. refractor; but with neither of them were the shades of any use. With the 2¼in. fusion took place after three or four short observations (in mid-winter); with the 5in. they fused almost instantly, and in one case, with a low power (75), the glass was shivered the moment I turned the instrument on to the sun; fortunately before I had time to apply my eye to the eyepiece. Since this accident I never attempt to observe sun by direct vision with the 5in., but always use an ordinary stellar prism, which, with the shades that were supplied for direct vision, gives most satisfactory and most comfortable views, much superior to those given by Sir Howard Grubb's "combined polarising and Dawe's solar eyepiece." It is only fair, however, to say that the inferiority of this latter eyepiece is due to its coloured shade not being deep enough, and too yellow. Slate-blue I find by far the most comfortable shades to use.

N. Maclachlan.

Rontenburn, Largs, N.B., Aug. 20.

TO "H."—DIVIDING POWER OF AN OLD GREGORIAN.

[42717.]—My humble appeal in letter 42576 has failed to elicit any fellow-sufferer's London experiences with small telescopes, but had the good fortune to be noticed by so eminent a contributor to your valuable journal as "H.," in his interesting letter 42668. This encourages me to give some further experiences with my old 3¾in. Gregorian, hoping that they may be of interest, at least from an historical point of view, in the matter of instrument-making.

Since writing the above-mentioned letter some tolerably favourable observing nights occurred in West London. On one of these—July 19, about 10 o'clock—I succeeded, to my great pleasure, in unmistakably dividing Epsilon Böotis (distance 2·6″, according to Webb), with my highest power—about 180 or 200. It was not easy; but required the utmost strain and perseverance in seeing; yet once caught, I succeeded more easily in seeing it again. The appearance was that of a faint point of light glimmering close upon, but clearly separate from, the principal star, being, however, immersed in the latter's interference rings. This dim, ghostly little light seemed an infinite distance behind the bright principal, thus presenting a very weird and fascin-

ating picture. But no colours were caught, nor were the discs as clean and round as I saw those of γ Leonis, as mentioned in my letter No. 42576.

I guarded myself against possible deception, first by moving eyepiece and head without any effect on P.A.; secondly, by frequent comparisons with α Coronæ, which showed no ghostly points of light whatever; and thirdly, by estimating the P.A. correctly to within about 20 degrees, without any previous knowledge of it.

This may be no special feat for a 3¾in. Gregorian, as the late Prebendary Webb divided ε Boötis "perfectly" with 2¼in. achromatic; but, considering that my eyes are quite untrained, and that the speculum doubtlessly has an imperfect spherical figure, not to speak of beginning signs of old age, it bears good testimony, I think, to the skill of its maker, and proves that even old Gregorians need not be quite worthless. Perhaps "H." can kindly furnish nearer data of its origin if I mention the inscription on its back-plate. It is, "James Short, London—$\frac{11}{503}$ = 18." The small specula have no adjustment for centring, and the focussing screw is carried right along outside the tube. Also terrestrially it performs well. At the seaside it showed distinctly, with p. 45 or 50, the whole network of ropes on vessels at least 12 to 14 miles away, judging by the known distance of a lightship.

C. H. Stielow.

GREGORIANS, &c.

[42718.]—I SHOULD indeed be wanting in courtesy if I did not thank and *heartily* thank "H." for his kind expressions in letter 42689; but at my age and with my many ailings I can but recognise that the time must soon come when the correspondent through 70 vols. of the "E.M." will correspond no more. Till then, however, I shall do what little lies in my power to help others as "H." and others have so often helped me.

One thing more. I can truly say that, though (as "H." remarks) we may have occasionally differed, I have derived more information from "H.'s" masterly letters than from all the textbooks I ever read, and their number is not small.

Apologising for this long "personal" preface, I will take up the several points in his letter. I do not think "H." and I really differ about the relative aberration in Gregorians and Cassegrains. I said in my former letter (p. 557) "The total amount of aberration *to be dealt with*, &c." If the mirrors were theoretically perfect the aberration would *have been*, and not "*to be*," dealt with, and both telescopes would be (apart from "Schaeberle error") equally perfect. If, however, the mirrors are *not* "theoretically perfect" (and they never are, for even Short had to "match" them by trial), I certainly think the remaining aberration would be more in the Gregorian than in the Cassegrain, assuming the actual amount of error in the mirrors to be the same in both.

In this connection I confess to having doubts as to the accuracy of figure of modern Newtonian mirrors whose performance is said to be "improved" by using a Barlow lens! "Ell Hay's" comparison between the Gregorian and Newtonian form of his telescope is interesting, but would have been far more so if he had told us how he managed to secure a correct curve for his small mirror, or whether he found it necessary to make several, and select the best by trial.

As regards a comparison with *old* Gregorians, the latter would have had a focal length of only two-thirds that of this "Newtonian-Gregorian."

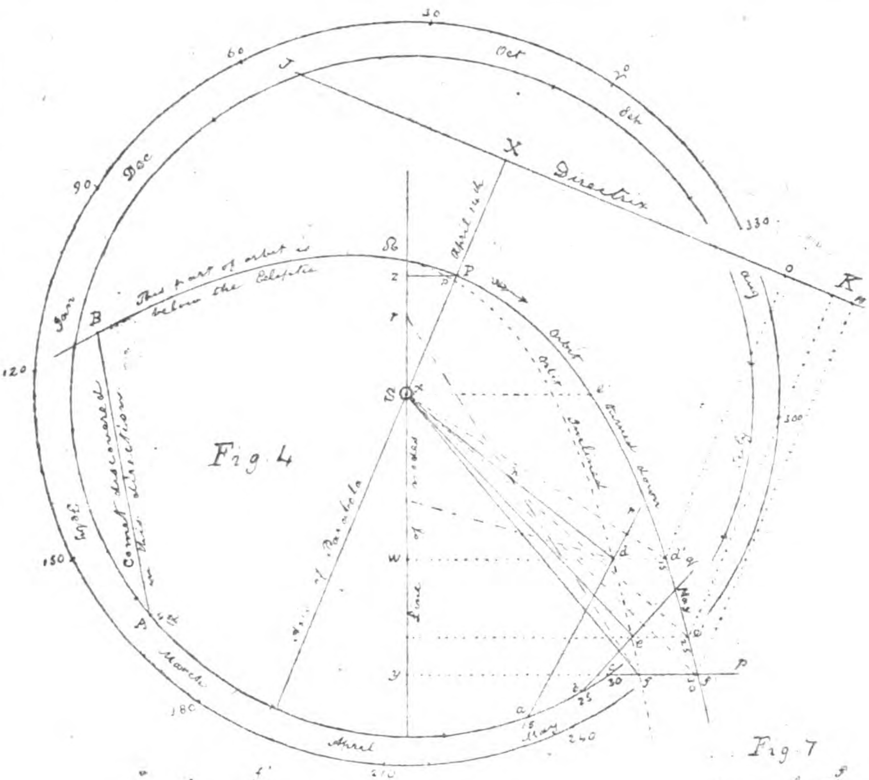
In using the term "aplanatic," I did so with some hesitation; but I thought "H." would understand thereby a secondary image lying wholly in one plane, of which the straight line V L in his diagram represented a section. From his original diagram of a Gregorian, it is evident "H." is as handy with drawing instruments as he is with his (mental) calculating machine. I wish he would draw a large mirror of short focus (say three times its diameter, as used by Kitchiner), and a corresponding small mirror, using any curves (conic sections) that he pleases, and assuming a *straight* line (as V L) to represent the secondary image; then, selecting a few points in V L, let him draw the rays, proceeding backwards till he obtains the directions of the incident rays; then, if these are found to be parallel to the axis, it proves that the curves required *are* conic sections, and vice versâ. I think they will *not* be parallel to the axis.

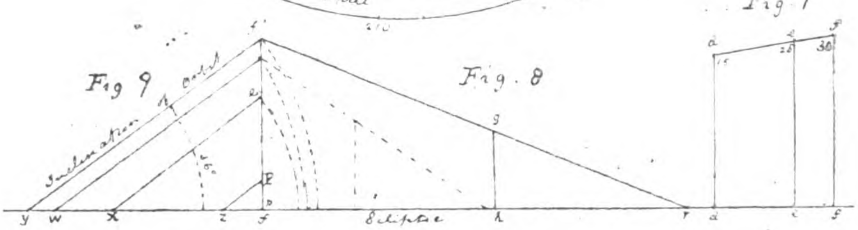
I quite agree with "Balolo's" remarks as to "H.'s" ingenious method of finding size of eye-hole and its correct position.

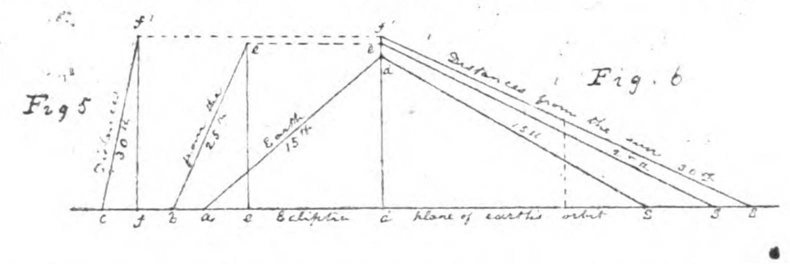
A. S. L.

ORBIT OF SWIFT'S COMET BY PROJECTION.

[42719.]—THE accompanying diagram will further illustrate the method for finding the orbit of a comet by projection, described in letters (42555, p. 464) and (42581, p. 488). In those letters the orbits found were for fictitious comets for the purpose of clearness in description. The present illustration of the orbit of Swift's comet was projected by the method described in the above letters, the figuring and lettering being the same as in the previous diagrams, as near as may be, so that description can be used in this case.







The projection of this orbit was not undertaken with a view to its publication, so no special care was taken with that end in view; but I have thought since the above letters were inserted that it might be desirable to present the solution of a real orbit, and so the original drawing has been reduced for that purpose, and sent to our obliging Editor.

It was not until May 15th that any first observation of position of the comet was obtained, and the other positions used were at intervals from that date, of ten and five days respectively, my last observation being on the 30th; but my positions having been obtained by home-made apparatus, can only be roughly approximate it would be a great convenience if observed positions were published.

The following were the positions used in finding the orbit:—

Time.	Longitude.	Latitude.
May 15	4·7°	41·25
,, 25	350·5	66 6
,, 30	309 0	79·35

And the elements of the orbit came out. Time, April 14·4th:—

Longitude of Perihelion	11·0°
Longitude of ascending node	33·6
Inclination of orbit	36·0
Perihelion distance	·376

Motion retrograde.

Do not know how these elements compare with those given by professionals, as I have not seen any other list of elements for this comet.

The general observer may find it interesting to notice that at the time of discovery the comet and earth were moving from one another until near the time of perihelion passage; after that event they were approaching one another until the end of May, when the comet was distant from the earth a trifle more than half the earth's distance from the sun; it will also be seen that about the beginning of April the comet was in the direction of, and beyond, the sun, so that when at its brightest it was impossible to see it from the earth.

With reference to suggestions in letter 42582, p. 490, upon this subject—(1) the scale, Fig. 2, was not intended to be used to check the correctness of the diagram. (2) When working by trial and error, it would be inconvenient to have to find the velocity for each different distance between each trial; but when the points are found by the scale, the work can then be checked, and, if needful, corrected by calculation. This remark will also apply to other parts of the problem.

Wimbish, August 12. J. Lane.

THE DELUGE AND ITS BLESSINGS.

[42720.]—IT is very astonishing that nobody can be induced to examine Nouri's diluvial relics. "Do we advance much?" asks "J. W." Seven years after the discovery, nobody can explore the few miles.

The Rev. Samuel Graham Wilson, M.A., fifteen years a missionary in Persia, writes a book on "Persian Life and Customs," living at Tabriz, about 100 miles from the alleged ruins. He says, "In 1883, the *Levant Herald* published a detailed account of an alleged discovery of the Ark on Mount Ararat. In 1893, Dr. Honri, a Chaldean archdeacon, claimed to have seen the ancient 'house boat.' It would be interesting to know what it is that has apparently deceived these worthy, and no doubt veracious, chroniclers?"

What has *deceived* them? Why on earth must they have been deceived at all? In Heaven's name, what is a missionary for, if not to investigate such discoveries?

Mr. Dormer says, "I do not mention why extinct animals alive in 3102 B.C. were not preserved in the

Ark? Where is the promise that all then living were to be preserved? God promised to bring to Noah those that were to save seed alive; not all that were living. We may thank Him we have no woolly rhinoceroses, mastodons, and especially no salve-toothed tigers. A great destruction of flesh was threatened because the earth was filled with violence through them. Partly by human violence, but also that of other flesh that had corrupted its way. We may take it as pretty certain that the Deluge was necessary to preserve our species even another century. Without it, there may have been children to Shem and Japhet, but hardly grand-children. E. L. Garbett.

THE DELUGE.

[42721.]—May I venture to inquire what would happen if the South magnetic Pole was moved, say, a thousand miles or so nearer north. I have an idea that before the Flood the South Pole did occupy such a place, and that the movement into its present position cause the Flood, by throwing the seas upon the land. The long-promised millennium may be a restoration of the South Pole to its former position, and movements of the magnetic Pole may have caused the return of the shadow on Ahaz's dial.

I believe my idea to be perfectly original. But it may be stale. Little Bookham.

[42722.]—I hope before the propounders of the Mount Ararat in Armenia and the cometary theory of the deluge retire that you will permit me to state, as a student of all theories, that I think the most reasonable and pleasing explanation of this Biblical mystery is that of the Allegorists. Fraser, in his "Golden Bough," and Prof. Max Müller, in his "Science of Religion," touch upon this subject, and show clearly that as an allegory it is undoubtedly founded upon a universal system of mythology and the religious system of allegorising astronomical facts and natural phenomena, which is found as the common stock property of all religions—Pagan, Jewish, and Christian.

The recent hot spell of weather in London has, however, somewhat shaken my faith, and I have panted for the snow-clad summit of Ararat, where, in the company of the genial "E. L. G.," one might camp out, and boil their pot with some of the remains of the Ark, which your correspondent assures us is to be found there.

40, Spondon-road, Tottenham. T. May.

[42723.]—The paralysis of common sense seems indissolubly connected with this subject. There has been clearly a continuity of land-life at least since the coal-measures were formed. One regrets, therefore, to see "J. W." (letter 42692) advocating universal deluges every 22,000 years. Similar opinions were prevalent in the early years of this century, and Darwin was inclined to explain the extinction of certain species of animals in South America catastrophically in consequence. But with a fuller acquaintance with facts accumulated later, he acknowledges in the "Origin" that his astonishment was groundless, and cataclysms superfluous. Has "J. W." imbibed the idea by reading some geological literature of half a century ago? J. Dormer.

[42724.]—The question of a universal deluge is one of considerable interest, though our conclusions will largely depend on the amount of trust which we place in early traditions. Mr. Garbett's theory, however, is that this Deluge took place at a different date from that usually assigned to it, and that it was caused by a comet composed of water. He seems to me to have done nothing towards proving that a great comet actually visited us at the date mentioned by him, and still less, if possible, towards proving that this or any other comet consisted of water, whether solid, fluid, or gaseous. But it would be interesting to know how he came to fix upon the date which he assigns to the Deluge. As to the geological evidence to which he appeals, I do not suppose that any geologist could fix the date of what he regards as diluvial deposits without a possible error of 1,000 years. On the other hand, the Bible, if the existing text can be relied on, gives a date differing considerably from Mr. Garbett's, and if, as that writer holds, the Book of Genesis was written as late as the time of Samuel, its authority is not thereby strengthened, especially in the matter of dates.

I hope Mr. Garbett will try his hand at solving Mr. Ellison's problem of the fly. He holds that large quantities of water may be suspended in the air without increasing the atmospheric pressure at the earth's surface. The fly would, I presume, be in the same position, as, indeed, would the largest eagle when in flight. It reminds me of the old question why a live fish did not add to the weight of the water, while a dead fish did so. W. H. S. Monck.

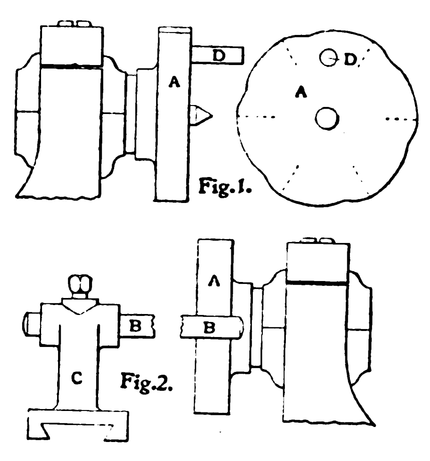
"PROF. BONNEY'S STORY."

[42725.]—I have received a copy of your paper in which a Mr. E. L. Garbett (p. 15) is making free with my name. He asserts, if I understand him aright, that I get "£1,000 a year indisputably" for teaching on Sundays a doctrine about the Flood, or, if he likes, maintaining certain views on theological questions which are not generally held by scientific men. So far is this statement about my income from being indisputable, that I beg leave to inform him it is grossly false. T. G. Bonney.

[42726.]—Your correspondent, E. L. Garbett, evidently knows nothing of Prof. Bonney. Had he been a listener at Great St. Mary's Church one memorable Sunday in the late seventies, he could never have made such a blunder as to allege that the learned gentleman's Sunday story differed from his story of any other day. One thing Bonney never preached on Sunday or any other day of the week, and that is E. L. Garbett's story of our planet. C. P.

BACKING OFF CUTTERS.

[42727.]—The following note by Mr. C. H. Whipple, of Chicago, which I found in the *American Machinist*, may be of use to your readers. He says:—We back off our cutter in a simple way. We have a face-plate, A, which on its edges is a



cam with as many teeth as the cutter, and with the proper amount of rise and fall for the clearance. The casting C, Fig. 2, is fitted to the carriage at the back of the lathe, and can be set at any point on the carriage cross slide. The bar B is of tool steel, hardened, which will draw the cross-slide forward as every tooth in the cam passes, and a suitable spring can be applied, or weights, to draw it back, or rather to keep the bar B always in contact with the cam A. This device is applied to a Pratt and Whitney lathe, with a rise and fall rest, which allows of the cross-slide being moved back and forth. The arbor with the cutter is driven by a straight-tail dog and a driver pin on the face of the cam. The dog must, of course, be tied to the driver-pin, to prevent its getting away when the tool finishes its work on each tooth.

Cleveland, O. J. M.

WHO MADE THE SCREW PROPELLER A SUCCESS?

[42728.]—Having my attention called to a letter in your journal of July 28 (42627, page 534), in reference to "Who Made the Screw Propeller a Success?" wherein it states that experiments had been carried on by "Dowson and Pilgrim, and that both had unsuccessfully experimented with the screw," as regards screw propulsion, I cannot allow it to go before the world at large without contradiction. Being the son of the Thomas Pilgrim referred to, I may say, without any fear of contradiction, it was through his engineering abilities and indomitable perseverence, after he had joined Francis Pettit Smith (who had conceived the idea in 1834) in 1836, in the uphill fight to produce a method of propelling vessels other than by paddles. They both at that time had no knowledge whatever that any other people had been trying the same method of propulsion. Smith has often told me that if it had not been for my father's great perseverance, he would have given up the attempt. In 1836 they converted a canal-boat on the Grand Junction Canal at Paddington, which was a success. The screw at first was two entire turns of a single thread, and soon after reduced to one turn. She was the first vessel, other than models, that was propelled by a screw, and from that vessel has sprung all the screw vessels afloat at the present day. Therefore how can "Justice," in any fairness, say that my father, as an engineer, failed in the attempt to perfect the screw as a propeller for ship propulsion?

"Justice," again, says at that stage of failure Henry Wimshurst obtained permission to repair and test the capabilities of that converted canal-boat, after she had gone through her successful trials, which is erroneous, as he had nothing whatever to do with her or her method of propulsion. And again, in the same paragraph, one would imagine that Wimshurst was the ruling genius in the construction of the *Archimedes*. "Justice" must mean the parlour business at his bankers had reference to the *Novelty*, not to the *Archimedes*. It is true he built her from designs handed to him by Smith's Screw Propeller Company; that was his only share in her construction. Although I am fully aware he wanted to claim all the credit, he had nothing to do with the *Archimedes* after he had finished building her, and as to his advice in regard to experiments with her were *nil*. They rested entirely with Smith and my father. Early in 1839 the vessel went to sea with a screw of one turn, and before the year was over the one turn of a single thread was altered to one-half turn of a double thread, at my father's proposition (which was three or four years before Wimshurst built the *Novelty*). Therefore, how could he have been the introducer of the shorter length of aperture in the deadwood of the run of the ship for the propeller. The *Archimedes* in 1839 and 1840 went to all the principal ports of Great Britain and the Continent with well-known success. In 1841 she went to Bristol to experiment for the best form and length of screw for the *Great Britain*, building there by the Great Western Steam Ship Company, which had been laid down as a paddle ship, and when that company knew of the success of the *Archimedes*, they determined to alter her for the screw. The experiments were carried out by my father, who advised the shortening of the screw, and the various pitches and number of threads, and the result was, after a series of trials, that one-sixth of a turn of a double thread was the best, though with a triple thread there was less vibration. The screw at the present day remains the same with very trivial difference. All this took place before Wimshurst had built the *Novelty*; therefore, how can it possibly be said it was by him that the screw was shortened and perfected? Justice is a virtue; therefore let it fall on those to whom it is due.

In regard to the portrait of Wimshurst with his hand on the model of the stern of a screw vessel, in the Patent Office Museum, South Kensington, that was taken in 1856, to form a collection of men who had been in any way connected with the screw. Had "Justice" looked round the museum, he would have noticed an oil painting of Smith pointing to the offspring of his fertile brain, which was painted in the middle forties.

In conclusion, I can inform "Justice" where they failed—and that was in not reaping a competency to procure for them the comforts of life in their old age. Unlike Stephenson with the locomotive, who amassed a large fortune, they were comparatively penniless, and not a long distance from poverty; and myself, the last of the two families, is in anything but affluent circumstances. Which idea has been of most importance to the nation I most humbly say the screw. The nation's magnificent fleet, for the protection of our homes, colonies, and commerce, could not possibly have been so effective without it, or some other better method of propulsion; and in justice to the two men who wrought out the screw to a practical result for the benefit of the nation, it is a disgrace to that nation that those men were so ill provided for.

Apologising for troubling you on this subject, and the length of this communication.

King's Lynn, August 18. C. F. Pilgrim.

REDUCING THE INTENSITY OF LIGHT.

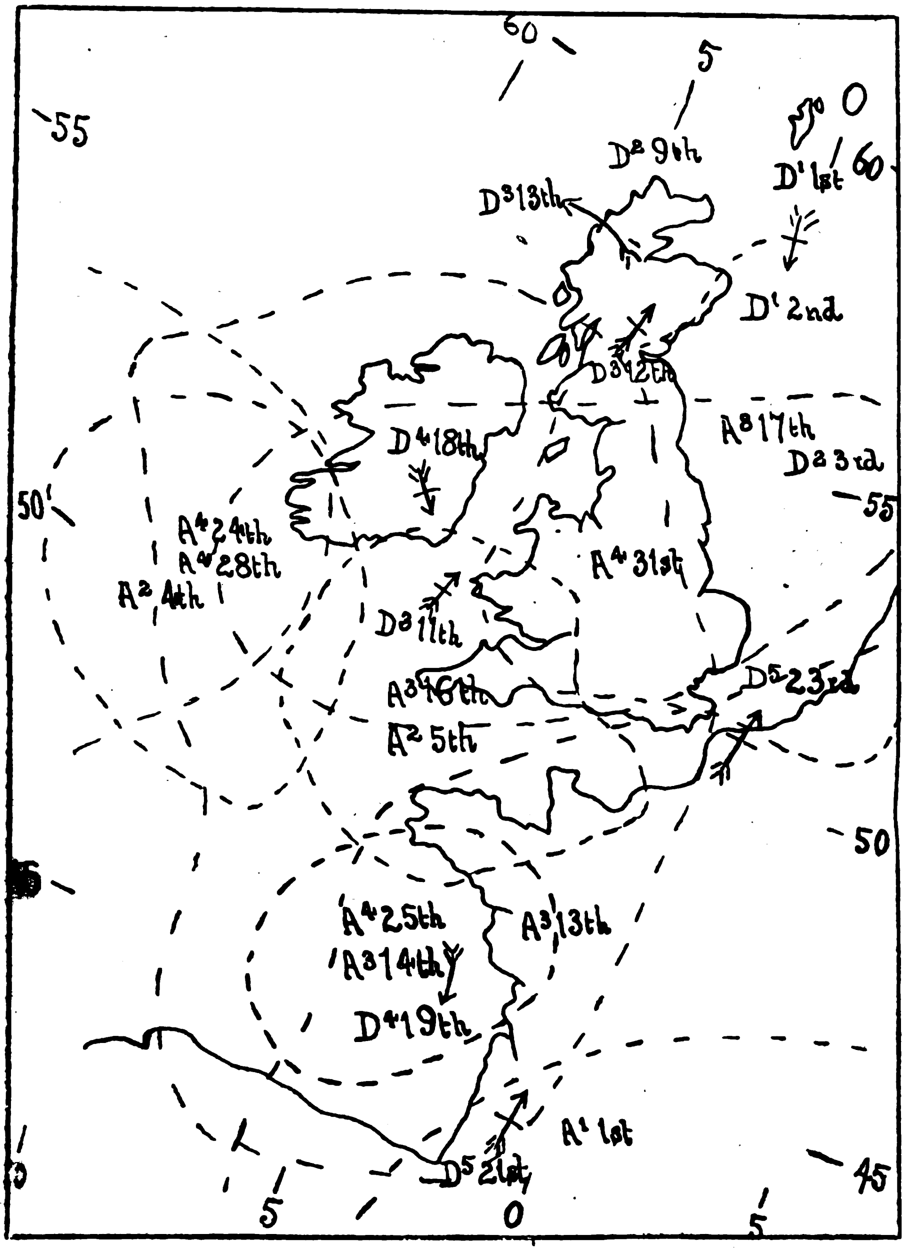
[42729.]—I have also been trying the effect of a stop, perforated with numerous medium-sized holes placed in front of the object-glass of my telescope, a 3·1in. refractor, although my eye-screens of coloured glass push into the tubes of the several eye-pieces in front of the field-lens. Even in this position they crack when the full aperture is employed. My experience coincides with that of Messrs. Ellison and Graythorp in every respect. While the light was greatly reduced, definition was ruined; but why this should be so, I cannot at present see, especially as the holes in the stop were large—⅜in. in diameter.

Perhaps "A. S. L." (who, I hope, may soon be quite recovered) or "H." would come to our assistance.

Trin. Coll., Oxon. J. M. W.

THE WEATHER OF THE BRITISH ISLES IN JULY—THE DROUGHT.

[42730.]—The writer has to commence by thanking "No. 7" for his appreciative remarks with regard to the chart and attempted elucidation of the mysteries of British weather, and the Editor for the admirable way in which it was set out. He has also to reply to a question (letter 42603) as to



whether it is not unusual for a halo and "mock-sun" to be observed with an anti-cyclone to the westward. In answer to this query, it may be said that halos and mock-suns frequently occur on the "edges" of anti-cyclones, and it may be as well to add that such phenomena are by no means an infallible sign of rain—i.e., of the approach of a depression.

Returning to the weather of July, and retaining the tabular form of "cause" and "effect," we arrive at the following conclusions:—

Date.	Cause.	Effect.
July. 1 to 3	Depression off the N.E. of Scotland. High pressure over the Iberian Peninsula.	Unsettled generally, especially in the north and east.
3 to 5	Atlantic Anti-cyclone. Low pressure over the North Sea.	Generally fair.
6 to 10	Anticyclone covering the whole of our islands.	Fine, warm weather throughout.
11 to 13	Depression to westward. High pressure area on the S.E.	Very hot, fair generally, but sudden heavy local falls of rains.
14 to 18	Anticyclone almost central.	Very fine and hot.
18 to 23	Small shallow depressions to W. and S.W., moving N.E. up the English Channel.	Heavy local thunderstorms on our S.W., S., and S.E. coasts, also in London and district on the 22nd. Generally fine.
24 to 31	Atlantic anticyclone.	Very fine and warm.

It is difficult in a month such as the one under consideration, which literally *teemed* with anti-cyclones, to preserve their individuality on the small chart at our disposal, but a careful examination will discover their centres, and the dotted lines around will show the areas. For a full explanation of the chart readers must refer to letter 42595, page 492.

Before finishing these remarks a word about the drought will not perhaps be out of place. July was the third consecutive month with a rainfall much below the average over the whole of England, though Scotland has generally benefited in the way of rainfall from depressions which have, until lately, constantly skirted our northern and north-western coasts. Should this state of affairs continue, as it did last year till mid-October, the question of water-supply will become an ever more serious matter than hitherto. **Meteor.**

TURN THE TOES OUT.

[42731.]—"S. R.," in letter 42708 (p. 18), seems to me to be so completely on a wrong line, that I am induced to make a few remarks on the point.

Perhaps I may claim to write with some authority, since I have charge of the orthopœdic department in a London hospital of repute, and make the study of orthopedics as part of orthopœdics my special professional work. (N.B.—Orthopædics, from *orthos* and *pais*—child, means childhood's symmetry; not pes, a foot merely.)

On my return from my present summer holiday, I intend to submit to our Editor a full article, with illustrations, on the main points in the mechanical structure of the human foot, and I will at present only remark that, "S. R." is quite in the right in saying that the posture in walking of the turned-out toes is taught in "drill" both in military and in dancing academies, and also that many town-dwelling educated people walk in this manner on the level, rigid surface of our pavements.

I must differ from "S. R." in his statement that "acrobats" and "ballet dancers" habitually assume the position of everted feet—the weak and unnatural position, except as a momentary action in some special movement or exercise.

The military and school drill, with the faulty, rigid nature of most of our modern boots (rigid I mean at the waist or instep of boot), are some of the most prolific causes of that result of civilisation, *flat foot*;—this I state from ample experience.

The British army will not enlist a flat-footed man; but men with good feet enter the ranks and often acquire flat-foot as a result, whilst it is only by virtue of the active habits and objection to artificial bodily postures which healthy children show, that the stupid teaching of the "dancing academies" fails to produce more cases of flat-foot than we see.

Nations conquer by their brains, not by their feet; and the higher the civilisation, and the more advanced the education, the more artificial is the physical environment; bringing with it many evils in the form of the sacrifice of natural gifts and powers of the body, and the acquiring of many faulty habits in physical movements; this everted foot being one of the worst of that class of habit.

"S. R." will, perhaps, understand my reasons for thus differing from him after he has read the paper which I hope to contribute later, in the course of a fortnight or so.

Gerard Smith, M.R.C.S., &c.
8, Nottingham-place, W.

MULTIPLYING WITH THE FINGERS.

[42732.]—In the "E.M." for 4th inst. (p. 551) there is an interesting account of the invention by a Polish mathematician of a system of multiplying numbers together by certain arrangements of the fingers. There is a very lucid explanation of details; but for my present purpose it must suffice to say that the fingers of both hands are used in three ways to represent as many series of numbers—namely, 6 to 10, 11 to 15, and 16 to 20 respectively. The method of what may be called visual multiplication together of any two of the five numbers included within any one of the sethree series is made perfectly clear; but, in the absence of further information, there appears to be a radical difficulty which would prevent application of the system to the requirements of everyday arithmetic calculation. Probably I shall best make my meaning plain by asking the question. Is this finger method capable of providing for the multiplication together of numbers *which are not in the same series?* Taking a few numbers at random, for the sake of illustration, I may instance 9 by 14, 12 by 17, and 19 by 8.

C. B.

MOTOR CYCLE: INFRINGEMENT OF PATENT.

[42733.]—With reference to long bolts of cylinder, in the year 1883 I made a double-cylinder horizontal engine for a stern-wheel steamer in that way. It was for Africa, and so made to save weight in single pieces on account of land transport.

G. W. H.

[42734.]—Regarding the point raised as to the advisability of using gunmetal cylinders by letter 42710, p. 18, I am told that cast-iron cylinders automatically harden themselves by the treatment they undergo. If this is so, it is presumably owing to their exposure to a high temperature in a carbonaceous atmosphere. But will cast iron harden under these conditions? It is an interesting point. I have it on good authority that the cylinders and covers become too hard to be touched with the file.

G. E. O.

[42735.]—Owing to pressure of business, several letters on this subject have escaped my attention. My reason for putting flanges to the brake-drum is to keep the brake-band in position sideways. I do not see any objection to these flanges. Will "Faber" (42657) let me know why he dislikes them?

In reply to "Monty" (42672), I should be glad if he would put the first paragraph into plainer wording. The way it reads at present seems to me to imply that I "followed" some of his suggestions in my drawings. The only reply needed is that both drawings and M.S. for the whole of the motor were in the Editor's hands before his letter appeared,* and I never saw them again until published, which precludes the possibility of their having been altered. The next point raised is the valve in crank chamber. This is shown in Fig. 11, and described in the text. With regard to size of inlet and exhaust, the dimensions I give are in excess of gas-engine practice, and with the speed of motor not exceeding 1,800 revs. per minute, will be found of sufficient size. In any case, they do not fall below the Dion. I agree in condemning elbows. That used for the exhaust of the Dion must check the flow of burnt gases, besides getting very hot.

* That is so.—Ed.

I am obliged to "R. J. V." (42710) for so graphically pointing out the difference between the Dion contact-breaker and the one I describe. I also believe there is a direct anticipation of the "master patent" claimed for the long cylinder bolts, and will spare no trouble to find it. Perhaps if "R. J. V." will write me, c/o the Editor, we may be able to join forces. As I am in the South (London) and he in the North, it will have to be by correspondence only, unfortunately.

The Writer of the Articles.

MOTOR CYCLES.

[42736.]—WOULD the writer of the article on "Motor Cycles" give an opinion on the possibility of motor bicycles taking the place of motor tricycles? If a satisfactory motor can be produced for a bicycle such as the one by "Armand Gancan," which was illustrated in the ENGLISH MECHANIC a few weeks ago, I think they would prove as much superior to the tricycle just as the ordinary pedal-driven bicycle is to the pedal-driven tricycle. I would like to build a tricyle, but if their place is to be taken by bicycles when a satisfactory motor is produced, is it worth while building one? Could "H. H. S." inform me where full particulars, details, &c., can be had of the motor bicycle illustrated in the "E.M." of June 30.

Glasgow. J. W.

THE FUTURE OF AERIAL LOCOMOTION.

[42737.]—I so fully endorse our Editor's remarks on p. 16, Aug. 18, that I have been disinclined to write again on the subject of mechanical flight until something effective is really accomplished. Mere correspondence without facts calls forth obnoxious criticisms from unknown persons who have done nothing in the way of any definite experiments.

I was one of the promoters of the Aëronautical Society of Great Britain, inaugurated on Jan. 6, 1866, and for many years served on the council. We received a number of communications, some of them of such a fantastic and grotesque character as to be beyond the pale of public notice. Some proposed complicated arrangements of levers and cords and internal movements, by which the effects of gravity were to be neutralised or inverted by creating a persistent unbalanced force which even these schemers themselves could not verify.

A few attempted to demonstrate the problem by mathematical deductions. Sheets were fitted with symbols, starting from a mere assumption, the end culminating in the position of "as you were," showing that mathematics in such cases is an artificial reasoning, that forms no substitute for the inventive brain of practical mechanics. There appears to be a lamentable ignorance of previous experiments with flying machines which have before been found to fail. If such had been studied, with the causes of failure, many abortive schemes would not have been attempted, and so have spared the loss of time and money of inventors. If Mr. Maxim, who has built the largest and most costly steam flying-machine, consisting of an immense and nearly square *flat* plane driven by screw vane, had looked up and carefully noted precedents, he could have foreseen causes for failure, as similar arrangements had been tried long before. He may have obtained a lifting effect of the whole contrivance; but what of that? For in a brief free flight the machine would have come to grief by reason of improper stability, and the first voyage of any foolhardy persons who ventured out in it would certainly be their last.

It may be asked, What right or reason have I for criticising? I first noticed the question of flight, and began to experiment on the subject in the year 1858. At the first meeting of the Aëronautical Society in January, 1866, I gave a *résumé* of these experiments, and the deductions derived therefrom. These appeared in their *Transactions*. I find them also published as an essay in book form by Messrs. Cassell and Co., of which I possess one copy, under the title of "Aërial Locomotion." I did not assume any fanciful movements or actions to explain bird flight, which I accounted for on tangible dynamic experiments and reasoning. To acquire flight with a machine constructed in imitation of a bird's mechanism is utterly impracticable, for such an arrangement can never meet with success. Flapping wings as a means of support for a flying-machine is an impossibility; like arrangements were first tried a century ago, and they have all ended in failure. The only feat of bird-flight that approaches the condition of an aërial machine is when birds soar at a level for nearly a mile at a time, with outstretched and motionless pinions. This occurs with the largest and heaviest species, such as vultures, pelicans, the albatross, &c. Yet in the face of all previous knowledge we still have proposers of machines to be supported by vibrating wings; I have stated that the lifting effect of the down-stroke of a surface is almost nil. Try at first with a lady's fan, say not surface enough, increase this till all your strength is used up in waving it up and down, still no considerable supporting effect. Do not try to imitate nature as in animal progression. If the first pioneers of locomotion, such as Murdoch or Trevithick, had done so, they would have produced a hideous multipod affair resembling a huge centipede! Whether the flap of a wing is directly downward, figure of eight, or any other delineation of stroke, no marvellous difference of effect will result. Flight is most likely to be obtained by a *continuous* force.

Of all the numerous models that I have seen during my lifetime, I have observed nothing to surpass in performance the screw-bands rotated by a spring, or wound string, and set free in air. At one time, I tried many of these, made of tin-plate, for the convenience of altering the pitch and beating the surface into form. These usually flew round with circling movements with bird-like performance, and sometimes went away fairly straight to a distance of more than one hundred yards so far out of sight that I lost several. These screw vanes, made out of stamped sheet iron, all to one form, for flying shot practice, are now sold, with a coiled spring projector, by the leading gun-makers in lieu of the hollow glass balls thrown up from a catapult. These screws are remarkable for their stability. From this position they do not deviate till struck by a charge of small shot, when they will sometimes turn a somersault. In my papers of 1866 I gave an estimate of the approximate force required to prolong the flight of such a screw, and found it to be 3H.P. per 100th raised; but this power consumed is far in excess of the reality, as the maximum of economy is at the time of the first start. Towards the end of the flight, when the velocity ceases, there is a waste of lifting power on the ever-yielding air, accompanied by a pitch unsuitable for a decreased velocity. Screw vanes are destined to play a most important part in aërial machines as propellers, and probably in part as lifters; but no model that I have seen has a form of surface adapted for obtaining the maximum of abutment on elastic air. The surface should have an expanding pitch—that is, an increasing angle in a highly progressive ratio. There is also loss from centrifugal force, tending to drive the air outwards. This must be counteracted by curving the surface of the blade downward, the curvature increasing rapidly towards the extremity. The component of these curves will produce a very hollow surface of what has been termed a "conchoidal" form. I intend to test this by making a screw in accordance with these conditions. The principle of aërial flight is not a very abstruse one. In this we have the problem of supporting a heavy inelastic body on a medium of light weight and great elasticity. We can only do this by quickly grasping at a large body or wide stratum of the light element before it has time to yield; bringing the law of first impact or undisturbed inertia into action, to serve as a substantial support. A rapid forward movement in still air appears to me to be the only way of successfully effecting this.

All arrangements acting continuously, with no forward progress, set the air in gradual movement without lifting the weight. In fact, as the speed of "drift" is increased, so is the "lift" increased by reason of the yield of the stratum of air for support becoming less. All this I demonstrated by experiment near forty years ago. I carried my experiments to the verge of personal safety. The constructions were deficient in lateral stability, swerving from side to side like an inverted pendulum. I would willingly have continued to experiment, but then had to engage in more substantial business as a mechanical engineer, from which I could spare neither time nor capital. Mr. Chanute, who has experimented on a large scale, says the condition of stability is one of the most difficult problems in the construction of a flying-machine. It was, no doubt, a deficiency in this respect that caused the death of Lilienthal at one of his celebrated soaring flights. F. H. Wenham.

LOCOMOTION PAST.

[42738.]—IN my present communication I raised the question as to whether any of the first pioneers of land locomotion had taken ideas from the action of animal leg propulsion. I find that some did so, as they could not realise the possibility of propelling a vehicle by road wheels rotated by internal power.

At the beginning of this century Mr. W. Brunton constructed a steam vehicle propelled by two jointed stern legs lifted alternately, just in the way that a man pushes a truck; he named it a "mechanical traveller." Though the engine was 6H.P., the machine only progressed at the rate of two and a half miles per hour.

Another, on a similar plan, was patented by Mr. F. Baynes in 1819.

In 1824 Mr. D. Gordon patented a steam-road vehicle propelled by six legs beneath, having knee joints and elastic soles on the feet, which lifted consecutively. This carriage was made and run on the road. It has been a comical sight with these six legs scampering below, like the Irishman that was thrust in and run through the puddles with a sedan-chair without seat or floor.

In 1825 Mr. G. Gurney patented a similar device acting the same way with legs beneath.

Another grotesque affair was patented by Mr. T. S. Hollander, 1827. This was a vehicle of inordinate length. The method of progress was similar to that of some species of caterpillars known as "Land Measurers," which have a few legs only at the extremities, by which they attach themselves and get along by drawing and throwing their long bodies alternately.

Moral: Don't attempt to imitate nature in terrestrial or aërial machines.

F. H. Wenham.

E. WILSON'S AERIAL SHIP.

[42739.]—WOULD it not be useful if Mr. Wilson would give some explanation of the singular figure you have printed on page 17 of August 18? What are the 14 two-bladed screws (I suppose that is what they are meant to represent) intended for? The stern screw will be a poor propeller. Might I suggest a centrifugal fan, drawing in air from the front, and blowing it out at a great velocity at the stern, would be more effective? G. A. Haig.

BALLOONS IN SECTIONS—ERRATA—ARTIFICIAL WINGS.

[42740.]—BALLOONS constructed in sections—the theory advanced by Mr. G. Parker—is, I regret to say, impracticable when reduced to practice. For instance, when a balloon ascends into the rarefied atmosphere, the gas expands in volume owing to decrease of pressure, thus necessitating the opening of the neck to allow for the escape of the expansion of gas. What would result, then, if, say, "one or more independently controlled sections" remained closed? Of what practical utility would be the other independent section? Not the slightest, I assure Mr. Parker. Again, if it were practicable to open simultaneously all of the sections, this would be tantamount to opening the proper one—to wit, the neck, and with this practical disadvantage that the increase of weight (a great drawback) would be totally useless in extremity.

Errata: Inadvertently, owing to being very much occupied at present, I should be glad if one or two errors may be pointed out in my last two letters. In describing the oblique fall of the eagle (letter 42704), I wrote "vertical" tail for "horizontal" tail; also in letter 42705, helicop*teral* was misprinted for helicop*heral*, whilst in the same letter, *re* the artificial bird system, should be "whatever power is employed to raise the wings, *re-acted* in a downward," &c.; not *reached*. I also, in letter 42704, inadvertently put "fallacy" of this reasoning (page 17, first column), instead of "correctness."

Although I have retired from any further discussion respecting systems of artificial or individual flight, permit me to point out to Mr. Challis that he takes an erroneous interpretation of the flexure and extension of the wing. Gravitation does not do all the work in progression through the air, as the bird's pinions when in action is essentially a forward motion, gravitation largely assisting, of course—an opinion endorsed by the more advanced investigators in the ENGLISH MECHANIC. And that is why, without attacking Mr. Challis, I have found by experiment to be more efficient for my purpose the artificial wing marked Fig. 1, letter 42704, than Dr. Pettigrew's, to form when in action *alternately at will* a kite, screw with reversing planes, or parachute or propeller, precisely similar to the action of bird's pinions in my minor experiments in individual flight. E. Wilson.

EXTREMES.

[42741.]—I PERUSE your useful weekly paper with considerable interest. I, however, differ with a writer of an article you quoted from the *Photographic News* (in your issue of 18th inst., p. 8). Amongst other directions for beginners in the art of photography, they are advised to either aim at under- or over-exposure. My own idea, Sir, is *correct* exposure. How would it do to advise a man to paint—telling him to use too much colour, or not enough; or to tell a man about his diet, that he must eat too much or too little? The wisest plan I have found by my own observation and experience is to obtain a good make of plate (and I agree there is nothing better than Mawson's), it is advisable to have a first-class lens (giving such definition as Wray's secure), and, after such exposure as seems suited to the plate, development according to the plate-maker's directions will give the best possible results. Detail, according to my idea (more especially in photographing landscape, seascape, and architecture), cannot be too clearly shown. A lens should supply for our picture all that the keenest-sighted eyes behold. What do people do when there is a dimness in their natural sight? Why, of course, they obtain the best glasses they can afford to see detail; and so it is with regard to objects at a distance: people are not satisfied to see events without detail, but use opera or field-glasses and telescopes, so that every procurable detail may be observed. I have no sym-

pathy with the hazy photographers, although their pictures obtain prizes occasionally. I am not a prize-winner; but having supplied photographic illustrations for several of the leading London journals, I hope, without egotism, I have gained a position which qualifies me to give an opinion concerning photography.

It is not only in the photographic world we find people going to ridiculous extremes; but if we look at cycling we see some strange absurdities. The man who designed a "bone-shaker" had good common-sense, and saw that a bicycle must be made with a brake for safety, and that a machine must be made of sufficient strength to carry a man safely. Further wisdom was manifested by later manufacturers, who secured strength and reduced weight too. Then the ingenuity of makers introduced mudguards, and the air tire was, of course, forthcoming; then silly faddists began to lead makers, insisting upon having machines too light for safety, casting aside brakes and mudguards, and dropping handle-bars into absurd shapes. Results —of extreme lightness, fatal accidents; casting aside brakes, hundreds of accidents, serious and fatal; dropping of handles, a rider's position about the most absurd in which humanity can be seen to-day—one at which even apes must surely smile. The discarding of mudguards was another fad of "the knowing"; and who has not viewed with pity and disgust the bespattered cyclist returning from a country ride after a shower?

It seems to me, Sir, that extremes are undesirable, and that when writers try to teach people to work against material-makers' directions, or when clerks and others ignorant of mechanical skill try to lead cycle makers, the results are not for improvement of matters, but the reverse.

William H. Morris.

STEREOSCOPES.

[42742.]—The original stereoscope was invented by Prof. Wheatstone about 1840. At that time photography was in its infancy, and the first stereos were such objects as cubes, cones, prisms, &c., drawn as they would be seen with either eye. The spectroscope was a reflecting one, consisting of two mirrors set about at right angles to each other, so that the images of the pictures placed at some distance on each side appeared to unite behind the mirrors. The angle at which the mirrors were placed could be adjusted for pictures of various sizes.

About 1855 or 1856 I made some stereoscopic pictures of Indian temples with an ordinary camera, taking pairs of pictures, shifting the camera about a foot between the pair. Some of the prints were sent to Negretti and Zambra to mount, and they requested me to do them a set, sending me a very perfect stereoscopic camera for the purpose. It had twin lenses like an ordinary binocular camera; the dark slides being square, so that two sets of pictures were made on one plate. The camera could also be set upright, fitting on to a system of parallel bars, an arrangement devised by Mr. Latimer Clark. The photos. were taken so that the right-hand picture was taken on the left-hand side of the plate, and so did not require to be shifted after printing. The camera, with slides, fitted into a box, on the top of which the shifting bars were fixed, the bottom of the box screwing on to the tripod stand. I have lately done some very satisfactory stereos. with a hand-camera, making the exposures first from my right hip, and then from the left.

I do not think that it is very generally known that stereoscopic pictures can, with a very little practice, be seen without a stereoscope. Perhaps the simplest plan of educating the eye is to place two coloured wafers on a sheet of white paper about 2in. or rather less apart. On looking towards them the eyes will tend to converge and form one image. The distance between the wafers can be gradually increased till the eyes can unite them at 2½in. to 3in. apart.

On first trying to unite stereoscopic slides, it is as well to select some with a marked feature, which facilitates the uniting the picture. After a short time, however, there is no difficulty, even if the slides are less marked. The magnifying power of the lenses of the stereoscope is a great advantage if the prints have much delicate detail.

L. Paxton.

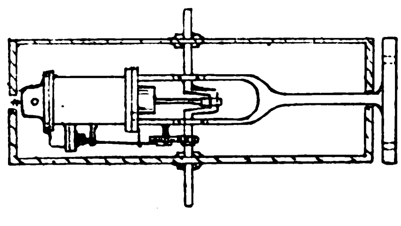
TREATMENT OF DISEASE.

[42743.]—The very able address recently delivered in Portsmouth by Dr. Geo. Wilson, and published in last week's issue of the *British Medical Journal*, ought to give pause of those members of the profession who are doing their level best to persuade the municipalities of the country into endowing researchers in bacteriology. The germ theory of disease is nowhere universally accepted by the closest investigators. It has its opponents in America and on the Continent. English authorities on the subject declare that it is a gigantic mistake. The theory regarding the "police corpuscles" of the blood is now discredited. It is a fable. Many eminent bacteriological experts are strongly opposed to certain forms of inoculatory treatment for so-called microbean diseases. Pasteur's anthrax vaccine is so dangerous to animals and men that it has been prohibited in Hungary, and is condemned by our Board of Agriculture; his rabic virus has actually increased the mortality from hydrophobia. In the English edition of Dr. Lutaud's lecture on Hydrophobia and Serotherapy (published by the Anti-Vivisection Society, 32, Sackville-street, London) it is conclusively proved that the treatment has given what is called laboratory-hydrophobia to many persons not affected with the true disorder. Dr. Wilson has tried the newer methods of preventing disease, and found them wanting. He says boldly that there should be some pause. "The more I have studied them the more firmly I feel convinced that they are based on errors," and he enumerates, with their appropriate epitaphs, the exploded "cures" invented by Koch and Pasteur and their imitators. It would, indeed, be a great mistake to accept unquestionably all the magnificent theories and speculations which nowadays emanate from the laboratories. Joseph Collinson.

53, Chancery-lane, London.

SMALL ENGINE.

[42744.]—Inclosed is a sketch of an idea of mine for a small gas or steam-engine. The feature of it is that the flywheels, instead of being of the usual



size, are very large, the rims of each extending inwards to within 1in. of one another, which is sufficient to admit gas or steam-pipes, also the standard which forms the bedplate of engine. The flywheels are, of course, very light, and have solid webs instead of spokes. This arrangement makes the engine look very compact, and there is plenty of room for an exhaust silencer inside. The engine may, of course, be either horizontal or vertical.

90, Ferry-road, Leith. W. Ewart Gibson.

USEFUL AND SCIENTIFIC NOTES.

Two-thirds of the beef consumed by Englishmen comes from America.

The Hamburg-American line is continuing its experiment with carrier pigeons for the purpose of conveying news from the vessels at sea either to New York or Hamburg. The *Augusta Victoria* recently set several pigeons free during a voyage to New York; one of these homed from mid-ocean, 1,500 miles to Hamburg, within two days(!)

A German patent has, according to the *Journal* of the Franklin Institute, been granted for the treatment of articles of plaster of Paris with an aqueous solution of ammonium borate, for the purpose of hardening them and rendering them insoluble in water. This is said to give results superior to anything that has heretofore been proposed. The solution is prepared by dissolving boracic acid in warm water, and adding thereto sufficient ammonia to form the borate which remains in the solution.

Poultry and Egg Culture.—We continue to talk about the importance of poultry-breeding, and we likewise continue to import eggs to the tune of many millions per annum. We are certainly exceedingly slow, says the *Estates Gazette*, to learn that we could, without difficulty, and with great advantage to the country, provide for our own needs in the matter of eggs and poultry, and Mr. Long seems to think that if he gave a little grant in aid the process would be hastened. Perhaps; but the only true way to encourage the industry is to show that it can be carried on at a real profit. The poultry-crammers make, we believe, a very good thing of it. The breeding and rearing of fowls is, however, a more ticklish business, and it seems probable that, if we are to keep our 14 millions a year at home, instead of sending more and more money abroad, every farmer and miller will have to make the growth of fowls and the production of eggs a well-recognised and properly-managed part of his business. It is obvious that a few millions a year added to the resources of the rural districts would make all the difference in the world. From particulars gathered at the recent Royal Agricultural Society's show we were much impressed with the advance in modern poultry culture, and believe the matter well worth the attention of many country millers.—*The Miller.*

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96304.]—**American Organ.**—Might I ask what is the object of this funny arrangement of bellows for an American organ, p. 496, and also for some few particulars of that organ, which, according to Mr. H. Bevan Swift (p. 514) was patented in America "some years back"? It seems to be a cranky idea; but there may be something in it, and as we have a sketch on p. 496 of an extraordinary bellows, it would be interesting to learn how it is supposed to work—that is, if it does work.

Organon.

[96305.]—**Motor Cycles.**—The querist has no doubt seen the articles on the subject which have been published recently; but if he wants a general book there is Farman's (Whittaker and Co.), which covers the ground. I do not know of any book which gives details, but the articles on motor cycles, the eighth of which appears in the same number as the query, are about as full as possible. It is not unlikely that the querist has never seen them. No doubt if he sends a specific query he will obtain an answer. N. F. J.

[96315.]—**Fish Tank.**—What does this querist mean? He must have a pump, or some other means of raising the water, so as to get sufficient head to form the jet. As he wants that "without the aid of a pump," he can manage by carrying the water up to a sufficient height, or by having the water supply laid on to the requisite height. There must be something not explained in the query, for that as it stands is simply idiotic. W. M.

[96333.]—**A Monkey Puzzle.**—"Scorpio," on p. 538, says that the moon goes round the earth in 28 days. I think not. I would say it goes round the earth's axis in 28 days. If it moved 28 times faster, it would certainly move round the earth's axis 28 times as fast; but for all that it would not move round the earth. I think S. Bottone and D. J. Carnegie, on p. 538, are quite right: this problem is not easily answered. At least, I think so. Now about those on p. 581. Mr. Bottone is right here again. "Lyttle Booke" is right also. The man could only go round such objects as were in his plane. Further, such objects would have to be stationary; or, if revolving in the same direction, they must revolve at a different and slower rate. I ask this: Suppose the monkey went round faster than the man, or in the opposite direction, what would be the result? I have puzzled myself over this, but can find no satisfactory answer to my liking. To resume, however: A man walks round St. Paul's. Has he been round the cross? No; the cross is on a plane above him, therefore he cannot have been round it, although he may have seen opposite sides of it. He, in order to have been round any object, must not only see opposite sides of it, but he must also be successively at all points of a circuit, being at one time at a place diametrically opposite to where he was at another time. In the case of the cross this is impossible, unless he could walk in air without any support, which nobody can do. The same in respect to the balloon. As for the wheel, if the rim and spokes were to revolve round the hub, the wheel would break. "Lyttle Booke" and "J. H. S." are both right here on p. 581. The rim, spokes, and hub all revolve round the axle, and when the axle is fixed immovably to the wheel, then both wheel and axle revolve round their axis. This axis is a line, and a line has length, but no breadth or thickness. If "Jec" cannot manipulate his house as suggested, let him try the same thing with the turntables found at railway stations. We don't go round the earth in 24 hours, but we go round the earth's axis. "W. J. G. F." is not quite right in thinking that the man goes round if the centre lies within the monkey. If the monkey were the centre, then the case were different; but as "Lyttle Booke" says, this is not possible. "J. H. S." (p. 581) is quite right, I think. The two boxers do not revolve round one another, but revolve round an axis common to both, and being situated either between them or in one of their bodies. I agree with "J. H. S." in regard to the earwig. I also agree with him in regard to the ring. If he held firm hold on it he would not get round it, although he tried for a year. I don't agree with "C. P." (p. 19.) I don't see through his reply as I should like to. As "F. C. S." (p. 19) says, "If the monkey were a geometrical point in the centre of the pole," then it would be possible to go round it. That is just what the monkey cannot be. The centre of the pole is a point, and a point has only position, but no magnitude (or size). Now to "Low Fell" (p. 19) I say, Suppose you did as you suggested with the string, then the string would encircle the pole, but not the monkey. I suggest "Low Fell" to do as follows:—Tie another string to the monkey's arm, both strings being the same length. Now go round a few times. What is the result? The string fixed

in the ground certainly encircles the pole, but not the monkey. The other string does not encircle either monkey or pole. Let "Low Fell" try and see. As the string does not encircle the monkey, he has not been round it. Let him try for himself with a friend instead of the monkey. I mean no disrespect here. I only try to explain as well as I can. To "Scorpio" (page 19) I would say that the man cannot "go" round unless he himself is in motion. The question has aroused a lot of interest, and I would like to see settled what is right.

A. Drysdale.

[96333.]—**A Monkey Puzzle.**—I have been asked to express my opinion on the monkey puzzle, and in order that there may be somewhat less ambiguity of the terms of the question, I would take this opportunity to reply to Mr. Bottone. He says the real question is, "Do we see the other side of the monkey?" Mr. Bottone will pardon me, but the original question did not stand so; if it did, it would not have had any sense in it, so that that reading is out of court, and only the question of real motion remains. If the monkey is in the centre, and rotates on his axis in similar time to the man's obital revolution, then the man has by real motion gone round the monkey in one revolution. If the man turns on his axis in similar time, he will know it by being permitted to see the monkey during the whole time while the different Signs of the Zodiac are marshalled past him, assuming him suspended in space, for it has become an exploded idea that they can go round the man in say, 24 hours, although I begin to think that the Ptolemaic system has still some adherents, and that some believe we don't go round the sun. The monkey, too, will know that the man has been round him by referring to the same signs, but he will deny that the man has rotated. Now take the monkey and place him revolving and rotating, but in an orbit inferior to that of the man. The man will still revolve round the monkey by virtue of his superior velocity in equal time, whilst the monkey will appear to revolve round the man; but it will only be apparent motion. Now place them both revolving in orbits exactly equal, and they will revolve around one another; and if anyone has a difficulty in believing this, let him sit for a little while twiddling his thumbs, and let the thumbs touch as they twiddle, and for once this noble recreation may have proved not a waste of time. The same real motion will exist if they (the man and monkey) are made to rotate as well as revolve, only it will not be so easily seen, the one motion concealing but not cancelling the other.

J. R. J.

[96348.]—**Eczema.**—Querist will find considerable relief in occasionally bathing the affected parts in a cold solution of borax. He must not take too much sugar, on account of its heating properties. Fish is also highly objectionable, especially salmon and mackerel. Ripe, uncooked fruit should be taken daily. If querist can take cocoa he will find it more beneficial than either tea or coffee.

Alpha.

[96372.]—**String and Key Experiment.**—I tried the experiment with the help of my wife and door-key and piece of ordinary string, which I surmise is correct. First I held the string at arm's length and noticed the swinging motion of the key, and at the same time noticed something else. Then I asked my wife to place her hand on mine and stand at right angles to me, and I found that the key made a direct circle. "Please stand this way, about half the distance." She did so, and the key made an egg-shaped circle, so to speak. "Now stand right opposite to me"—and I find the key goes in a direct line again. "Now please breathe at the same time as I do"—and I find the key nearly stops. "Now breathe in opposition to me"—and I find that the key swings with greater vigour.

P. C.

[96379.]—**Motor Car.**—Has "Petrol" noted if his Daimler has lost compression, which might be caused by either the exhaust or induction valves not closing? Has he at any time removed the ignition tubes? If so, in replacing them he may have failed to notice the small steel loose collar which is at the inner end of tube. These may have dropped down and closed the ignition port sufficiently to prevent ignition of the charge. If he will advertise his address, and lives in or near my district (Croydon), I will give him what help I can, as I know the Daimler motor extremely well.

The Writer of the Articles.

[96385.]—**Electric Fishing.**—The so-called electric fishing is nothing but a blind. It is a plain tank, 1ft. deep, 4ft. diam., with a false bottom, which is revolved by an electric motor. The fish are made of tin, with a few hooks soldered to the head and tail. When the false bottom is revolved it carries the fish round with it. The water is mixed with common washing blue, so that you cannot see the fish. Ordinary hook and line are used to catch the fish. A prize is generally given to the person who catches the first three.

R. S.

[96390.]—**Motor Cycle.**—As "Monty" has apparently overlooked this query, I venture to reply. The vaporiser, as shown in querist's sketch, will not work satisfactorily, if at all. The part of wick through which air is drawn is too far from surface of petrol. Follow the design given in the articles on Motor Cycles now running in "Ours."

The Writer of the Articles.

[96426.]—**Magnetism.**—There is no substance known which will prevent the passage of magnetic force in the same sense that an opaque body will prevent the passage of light. The only method is to interpose a screen of iron, as stated by Mr. Bottone. Owing to the great magnetic permeability of the iron in contradistinction to the magnetic reluctance of the air, the lines of magnetic force are diverted along the readier path through the substance of the metal. The best effect will be obtained when the screen takes the form of a hollow sphere surrounding the magnet. The reply by "Regent's Park" is quite incorrect.

W. J. G. F.

[96426.]—**Magnetism.**—No substance is absolutely impervious to magnetism. Some substances permit the lines of force to pass easier than others do. If somebody were to find a substance that would absolutely stop the lines of force, he (or she) would discover "a boon and a blessing to electrical men" in many cases. The best thing to prevent lines of force is to interpose a sheet of soft iron, as, on account of its great permeability, the lines of force select it for their path, and thus it acts as a shield to other objects.

A. Drysdale.

[96427.]—**Boot Polish.**—Yellow wax 4oz., oil turpentine, 8oz. Melt in water bath, strain, stir occasionally until paste turns creamy, then add the following solution: Nankin brown 15gr., phosphin 5gr., water 4dr.; stir constantly until the mixture is perfect. Brown's tan polish and Oxford and Cambridge ditto are two other mixtures, sold by stores and oilmen at 6d. bottle upwards.

Regent's Park.

[96428.]—**Motor Cycles.**—"Worried" can reduce the width of the machine; but it is not advisable. With the width he proposes there would not be so much stability when turning a corner. The bridge-tube, being shorter, would necessitate the exhaust silencer and coil being slung at right angles to the positions given in my drawings, and this would look bad, besides making the connections of the pipes awkward.

The Writer of the Articles.

[96429.]—**Steam Pump.**—"Old Reader" does not give a full enough description of his pump for one to say with certainty what is wrong with it. His description would apply to a Tangye's "Special" pump, but that firm is not dead. If he will send a drawing of valve I will be pleased to help him. What might a "shooting hole" be.

Mabel.

[96436.]—**Motor Cars.**—You must have a differential gear on the driving axle or first-motion shaft. Starley's "Jack-in-the-Box" is the most common. If you have ever attempted to turn an old "Cheylesmore" tricycle to "starboard" with the back-pedalling gear in, as I did once (only), you would have no doubt in the matter.

Mabel.

[96437.]—**Cold in the Head from Bathing.**—Bathing after cycling is one of the worst things querist could do. The best time for a bath is early in the morning before taking any food. If the shore is far distant, it is advisable to walk there slowly, taking a short rest before entering the water. People who bathe in the early morning seldom take chills from so doing.

Aqua.

[96439.]—**Quadratic.**—Both exp. on left must be arithmetically rational, or we should get either a surd = difference between surd and rational, or a surd = a rational. Therefore it follows—

$$\sqrt{(x+3)} = \text{a rational} \ldots\ldots\ldots\ldots (1)$$

$$\sqrt{(x-2)} = \text{a rational} \ldots\ldots\ldots\ldots (2)$$

$$\therefore (x+3) \text{ and } (x-2)$$

are exact squares, and their difference is 5. We find by trial that these squares must be 9 and 4, or—

$$\sqrt{(x+3)} = 3,$$

$$\sqrt{(x-2)} = 2,$$

which gives $x = 6$. If one wished to waste half an hour one might solve by quadratics by taking an assumed value in equation marked (1) thus—

$$\sqrt{(x+3)} = \text{a rational} = a \text{ (say)}$$

$$\therefore x + 3 = a^2.$$

Substituting in (2) squared—

$$x - 2 = a^2 - 5,$$

or—

$$a^2 - x - 3 = 0,$$

when one could find a by quadratics and thus find $x + 3$.

H. C. Donnithorne.

[96439.]—**Quadratic.**—"Inductorium" (p. 20) is not quite accurate in saying that the equation—

$$\sqrt{x+3} + \sqrt{\frac{x-2}{x+3}} = \frac{11}{3}$$

is one "which cannot be solved in any of the ordinary direct methods." It is interesting from the circumstance that *one* value only will satisfy, it being, as already stated, of *one* dimension. It may be put under a simpler form by writing $\frac{x-2}{x+3}$ in its equivalent form $1 - \frac{5}{x+3}$, and by putting $x + 3 = y^2$, whence we have—

$$y + \sqrt{\left(1 - \frac{5}{y^2}\right)} = \frac{11}{3}$$

or—

$$1 - \frac{5}{y^2} = \frac{121}{9} y^2 - \frac{22}{3} y^3 + y^4$$

or—

$$0 = 5 + \frac{112}{9} y^2 - \frac{22}{3} y^3 + y^4.$$

This may be solved by any of the direct methods in use, and gives us $y = 3$—i.e., $x = 6$. Dividing this equation by $y - 3$, we obtain the cubic—

$$0 = y^3 - 4\tfrac{1}{3} y^2 - \tfrac{5}{9} y - 1\tfrac{2}{3},$$

which gives $y = 4{\cdot}546$, or $x = 17{\cdot}665$. Again reducing this cubic by dividing by $y - 4{\cdot}546$, we obtain the quadratic—

$$0 = y^2 + {\cdot}213 y + {\cdot}4132,$$

which gives $y = \pm {\cdot}634 \sqrt{-1} - {\cdot}1065,$

and— $\therefore x = \pm {\cdot}135 \sqrt{-1} - 3{\cdot}623.$

Of these four values, $x = 6$ is the only perfect solution, and the only one which can satisfy the original equation.

West Norwood. Henry T. Burgess.

[96440.]—**Engine Power.**—I suppose you mean resistance in pounds per ton. If so, W. S. Hutton gives: Divide 2,240 by rate of gradient. This is due to gravity. Resistance due to velocity: Rule, square speed in miles per hour, and divide by 171, add 8 to quotient. Add 50 per cent. to quotient for curves, road imperfection, and wind. Tractive power of engine: Rule, multiply square of diameter in inches of one cylinder, by length of stroke in inches, and divide product by diameter in inches of driving wheel. The quotient will be the tractive force in pounds for each pound of effective pressure per square inch on piston, and the quotient multiplied by the effective mean pressure in cylinder gives full tractive force in pounds. Effective mean pressure in piston equivalent to a given tractive force at rails found thus. Multiply diameter of driving wheel in inches by total equivalent tractive force at rails in pounds, and divide the product by product of square of diameter of cylinder in inches by length of stroke in inches. Prof. Rankine gives formula:—Let W = weight to be dragged up; f = proportion of resistance to load on a level; i = sine of angle of inclination of ascent. Then—$(f + i)$ W should not be greater than P, or i should not be greater than $\frac{P}{W} - f$.

Lineham gives in tractive force total mean pressure in both cylinders multiplied by stroke equals tractive force multiplied by half wheel circumference. Or—

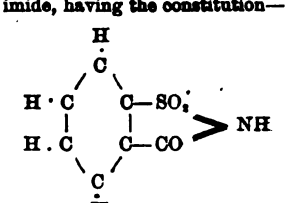
$$2 \times \frac{p \pi d^2}{4} \times l = T \times \pi r$$

$$\therefore T = \frac{p d^2 l}{2r}$$

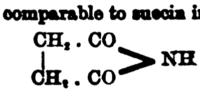
He also gives adhesion per ton on driving wheels: very dry, 600lb. per ton; very wet, 550lb. per ton; average, 450lb. per ton. Greasy, 300lb. per ton; frosty, 200lb. per ton. Prof. Perry gives on pull thus:—The weight multiplied by the coefficient of friction between wheels and rails represents the greatest pull of engine. Suppose weight on driving-wheels to be 15 tons, and the coefficient of friction of wrought iron is about 0 2, the greatest pull is 15 × 0·2 or 3 tons. Coefficient: ·33 for very slow; ·19 for 29ft. per second; ·127 for 66ft. per second. John Goodman, of the Yorkshire College, has much (with formulæ) to say on subject of friction in "Mechanics Applied to Engineering, 1899," of Longmans and Co.

Regent's Park.

[96446.]—**Saccharine as a Food.**—I should like to know what earthly bearing "Regent's Park" considers his more or less incorrect information has on this query. "Saccharine" (so called) is a derivative of benzene — viz., ortho-benzoyle, sulphonic imide, having the constitution—



and therefore comparable to succin imide—



It has a remarkably sweet, though somewhat peculiar, taste. Whether it has a deleterious effect

on the human organism I do not know; but it is sometimes allowed to be used (in cases of gout and rheumatism) when ordinary cane sugar is forbidden. Of course, not being one of the "sugars," which are carbohydrates, it cannot undergo fermentation by means of yeast. I remember some little time ago a query appeared in these columns about it under the erroneous name of "benzole sulf-imide."

Trin. Col. Oxon. J. M. W.

[96446.] — **Saccharine.** — When one reads "Regent's Park's" wonderful reply (p. 584) one feels that saccharine ought, for decency's sake, to turn itself into a sugar as quickly as possible. The habitual use of saccharine is considered harmful. I fancy the particular lesion it induces is renal; but, perhaps, some other correspondent can give a more definite reply. J. DORMER.

[96455.]—**Shoes without Heels.**—I wish to say the idea is behind the times, as the Americans have worn them for years, if I remember rightly, under the name of "common-sense" shoes. P. C.

[96460.]—**Dissolving Amber.**—Much obliged to Mr. Bottone for his reply on p. 21; but, unfortunately, it does not touch my question. I am quite aware that amber can be dissolved, but what I want to know is exactly what I stated in my question—how is it dissolved according to the recipe given on p. 494, reply 96271. The directions seem full and clear enough for the other ingredients, but there is not a word about how to dissolve the amber. That is the crux. I asked distinctly (p. 535) whether any reader would look at the recipe and tell me how the amber is treated to make it mix with the other ingredients. T. I. A.

[96461.]—**German Baths.**—I suppose I ought to be much obliged to "Regent's Park" for his reply on p. 21; but, as a matter of fact, I am not. The correspondent has simply misunderstood my query, and has given an extract from some book which I could, no doubt, have found myself. What does he suppose the analyses he gives have to do with my question? And there is no answer at all to the real question. No doubt the correspondent means well, but good intentions pave the way, &c. LITHIA.

[96462.] — **Wimshurst.** — Paraffin varies very much in resistance, and also in hardness. It has the disagreeable property of absorbing freely the acid perspiration of the hands, when it becomes a very poor insulator. Add to this that the brushes sweeping along the paraffin get their lips greased—you quite understand the machine won't work. It may also be that you are using hollow glass tubes instead of solid glass rods or Leyden jars. Then the machine will certainly not work. S. BOTTONE.

[96464.]—**Great Laxey Waterwheel.**—Replying to "C. C.," I beg to say that the wheel and all the gear attached to it were designed by the (at that time) village millwright, a Mr. Casement, father of one of the present chief engineers in the employ of the Isle of Man Steam Packet Co. For more than forty years this wheel was the largest in the world, and has always been regarded by the best professional engineers as the best-designed wheel for its work extant. It says much for the ability and courage of a plain country mechanic. I am personally acquainted with the son of the builder, and can vouch for the above remarks being accurate. J. J. KERMODE.

[96465.]—**Telephone.**—If you will refer to my little book, "Electrical Instrument Making for Amateurs," you will find a full description of the way of making a pair of telephones suitable for your purpose. S. BOTTONE.

[96466.]—**Length of Link.**—The principal distance you require is distance between eccentric-rod eyes. To the travel of the valve add the lead × 3; this will give centres; then, by measuring off length of half-block from centre, to which add ¼in. longer at suspended end for play in working, ½in. at far end. The go-astern is usually placed at the farthest end from suspension on account of wear, which is greater. Strike out radius of link from centre shaft, allowing sufficient in valve-rod for eye to clear the gland-nuts when highest; also the link. MONTY.

[96468.]—**Filling for Wood.**—In the Continental system of French polishing, the rubbers are made of old worsted stockings. After papering work all right, take rag, shake some plain polish on the work, rub in, which opens grain clogged by papering, polish acting also as a binder. Then oil in well to bring out colour of wood requiring it. Next fill worsted rubber with spirits, and rub in well ground pumice into grain of wood. With this exception use coarser rag in bodying in. Keep on rubbing, and supply rubber with spirit as required. Do not commence using polish or oil until a hard cold surface free from gloss, with grain that looks well filled, is observed. Allow work to stand some time · the longer the better. You may notice cavities of a minute character perhaps. If there is any accumulation of powder, put job aside, and when hard paper down before starting again. To judge of job it may seem as if primary filling-in had sunk deeply into wood, but when surface is touched with a little paper it will be found otherwise. When ready to proceed further, take spirits and pumice powder, but less in quantity, working firmly and steadily. When necessary add a few drops of polish, but no oil. If rubber drags, a little drop more spirit until the time comes for bodying up. Proceed gradually if job is worth it; take it up five or six times before spiriting off. If only dry polished—i.e., polish without oil being used in first or second stage—grain has tendency to rise. If so (often with maple), then level down with fine paper; but after preliminary coats are applied, the round felt rubber with oil and pumice-powder to fit for forwarding. Woods of open grain are sometimes filled by rubbing polish and pumice-powder, using colouring matter according to wood used. The American employs silica process for filling in, and the Continental workman fills up with two or three coats, confining himself to use of polish and spirit instead of hard drying oils. REGENT'S PARK.

[96469.]—**Rubber Stamp.**—The mixed rubber must be bought ready for use, as it requires machinery to mix it. Curing temp. about 290° Fahr., but varies with different mixings of rubber. See my advert.

West Didsbury. M. COLE.

[96470.]—**Friction of Water in Pipes.**—To calculate friction of bends $h = v^2 \times \text{sine}^2 \times$ number of bends × ·0003, where v = velocity of water in pipe or stream in inches per second. Or, multiply square of v by sine of angle of bends (of which the resistance is to be estimated), and the product by the constant ·0003, the result expresses resistance; h = head in inches necessary to overcome angular friction, which varies as square of velocity, and of sine of angle of bend with the straight line of direction. When the angle is reversed, or more than 90°, the square of the sine of the complementary angle + 1 must be used. The velocity for computation is, of course, that theoretically due to fall, and loss by bends must be deducted from head, discharge being calculated from reduced slope. Loss of head varies, not only according to size of angle, but also to volume to be carried; perhaps best expressed by square root of hydraulic mean depth in feet; loss of head being divided by this quantity to give final resistance. When hydraulic mean depth falls below unity, tabular numbers are increased as square of such depth. With pipes, this is quarter of diameter. Increase of resistance h will be $= v^2 \times \text{sine}^2 \times$ number of bends × ·0003, divided by $\sqrt{\frac{d}{4}}$, or friction against sides may be found by Prony's rule: Multiply 2·25 times length of pipe in miles by the square of the velocity of water in pipe in feet per second, and divide product by dia. of pipe in feet equal head of water in feet required to balance the friction. Friction increases nearly as the square of its velocity for bends in pipes. These diminish velocity by ·0039 times the sum of the sines of the several angles of inflection, sharp turns to be avoided. Blackwell's rules for pipes:—To find velocity in feet per second multiply dia. of pipe in feet by the inclination of pipe in feet per mile, divided by 2·3, and extract the square root. To find dia. of pipe in feet multiply square of velocity in feet per second by 2·3, and divide by the inclination of pipe in feet per mile. To find inclination of pipe in feet per mile, to be given to overcome friction, multiply square of the velocity in feet per second by 2·3, and divide product by dia. of pipe in feet. REGENT'S PARK.

[96474.] — **Colouring Rubber.** — Rubber, like other substances, loses its new look with usage. You can do a little to improve by rubbing with fine powdered French chalk. Vulcanite, polish with rouge or putty-powder.

West Didsbury. M. COLE.

[96476.]—**Absolute Temperature.**—For every degree Centigrade of rise in temperature a gas increases $\frac{1}{273}$ of its volume. One cubic foot of a gas, measured at 0° Cent., will, therefore, at 273° Cent., measure 2c.ft. Similarly, if the temperature were lowered to − 273° Cent., the contraction would be equal to the volume, therefore the gas would cease to exist, and consequently the motion of the molecules would cease, and the temperature will, therefore, have reached the absolute zero. It is from this zero that absolute temperatures are measured, and are clearly degrees Centigrade + 273, i.e., 0° Cent. = 273° absolute, 10° cent. = 283° absolute, − 10° cent = 263° absolute, and so on. The boiling-point of liquid hydrogen is about − 220° Cent. Correctly speaking, there is no such thing as the "temperature of space," as temperature cannot exist apart from matter. A thermometer placed in space would receive radiations from all sides, and the temperature indicated would depend on the number of radiations received and transmitted into heat motion within the substance of the thermometer. W. J. G. F.

[96476.]—**Absolute Temperature.**—A theoretically perfect gas contracts $\frac{1}{273}$ of its volume for every decrease of 1° C., and expands $\frac{1}{273}$ for every increase of 1° C. in its temperature. Hence it is assumed that 273c.c. of such a gas at 0° C. and 760mm. would occupy no space at all at − 273° C. Therefore when such a gas has contracted to nothing at all it is assumed that the lowest possible temperature has been reached, or, in other words, complete absence of heat. Therefore, − 273° C. is called the "zero of temperature." True temperature or "absolute temperature" should therefore be measured from − 273° C., which should be called 0° A (A = absolute). That is, the melting point of ice (only an arbitrary starting point when called 0° C.) should be 273° A, and the boiling point of water at 760mm. pressure, 373° A. Interstellar space is surmised to be suffering from complete absence of heat, and therefore its temperature should be 0° A, or − 273° C. The boiling point of liquid hydrogen is about − 212° C. or 61° A. TRYTOAID.

[96479.]—**Bunsen Burner.**—A Bunsen gives more heat and burns less gas, besides giving a clear, unsmoky flame, than an ordinary burner. The one which you describe constitutes the ordinary Bunsen with rose top. W. EWART GIBSON.

[96479.]—**Bunsen Burner.**—The advantage of the Bunsen burner is that the gas is first mixed with air, and this insures perfect combustion. In an ordinary burner only the gas on the exterior of the flame is burning. The luminous portions consists of incandescent carbon giving light but little heat. The carbon burns when it arrives at the outside, and is in contact with air, and therefore oxygen. In the Bunsen the admixture of air insures combustion taking place all through the flame. Further, the flame is non-luminous and smokeless. Vessels heated over it are not blackened with soot. Of the two burners mentioned the Bunsen would give the most heat for the same quantity of gas. A. DRYSDALE.

[96481.]—**Defective Dynamo.**—To MR. BOTTONE.—In all probability there is a leakage between iron and wire, either on the armature or field-magnets. Supposing this not to be the case, you can easily find out in which way the machine ought to be driven by connecting it up to a battery, and noting in which may it runs as a motor. When, if you have arranged it in series, it must be driven in the opposite direction to which it runs as a motor. But if you arrange it in shunt, it must be driven in the same direction as it runs as a motor. One point is very essential: the brushes must be arranged so as to rest on the slits when the iron portions of the armature face the iron portions of the tunnel. S. BOTTONE.

[96482.]—**Insects in Floor.**—Open all your windows in your dark-room, remove therefrom lights, candles, &c., so as not to have an explosion. Now procure a quart or two of benzoline, and about 2oz. of naphthaline (also called albo-carbon). Dissolve this in the benzoline, and go carefully over the floor with a clean, dry whitewash brush, and soak the floor thoroughly all over with this mixture. Now close all windows and doors of the room, and let no one go near the room for 12 hours; then, avoiding all candles, lights, or fires, throw open all the windows and doors so as to ventilate the room thoroughly. There won't be an insect left. S. BOTTONE.

[96482.]—**Insects in Floor.**—Try chloride of lime, as solution or dry powder. Pennyroyal oil sprinkled about clears of fleas, and it may have some effect on your pests. Benzine 10 parts, soap (soft, convenient) 5 parts, water 85 parts, sprinkled about. Avoid lights. REGENT'S PARK.

[96483.]—**Speed of Water-Wheels.**—General rule for H.P.: Multiply weight of cubic foot of water, 62·4lb., by number of cubic feet falling per second; multiply product by height of fall in feet, and divide by 550, quotient equal available theoretical H.P. of that fall. Overshot: Diam. of wheel from 1 to 1¼ height of fall, speed of circumference 4ft. to 5ft. per second, efficiency 60 to 70 per cent. High breast: Diam. of wheel 1¼ times height of fall, speed of circumference 5ft. per second, efficiency 75 per cent. Breast-wheel: Diam. of wheel twice the height of fall, speed of circumference 5ft. to 6ft. per second, 55 to 60 per cent. Undershot-wheel: Where fall is under 5ft., diam. of wheel 12ft. to 20ft.; speed of circumference = ·50 of velocity of water, efficiency 25 to 33 per cent. Paddle-wheels: Diam. of wheels 14ft. to 20ft., speed of circumference = ·50 of velocity of water, efficiency 25 to 33 per cent. Poncelet's undershot-wheel: Curved floats for falls under 6ft., diam. of wheel 10ft. to 20ft., speed of circumference 8ft. to 12ft. per second, 55 per cent., &c. See W. S. Hutton further for diam. of journals or necks; also formulæ for turbines. REGENT'S PARK.

[96484.]—**Cubical Contents.**—Draw a cross-section of the embankment, and from the tops of the slopes let fall two perpendiculars to the base. The cross-sections will then be divided into a central rectangle, 17ft. by 10ft., and at each side a right-angled triangle, of which the sides containing the right angle are 30ft. and 10ft.—since the slope is 3 to 1. These two triangles are, therefore, together

equal to a rectangle 30ft. by 10ft. The total square area of the cross-section is, therefore, 170sq.ft., + 300sq.ft. = 470sq.ft., and the cubical contents of the bank 470 × 300 = 141,000c.ft. Were the ground not level, the problem becomes more complicated, as each slope is then the frustum of a prism.

W. J. G. F.

[96489.]—**Wimshurst Experiments.**—You must drill some holes in the main balls of the prime conductor, and having procured the sufficiency of 7/20 stranded cable covered with good insulation up to at least 750 megohms resistance, you connect these to the holes in the balls, having bared them of covering where they have to enter the holes, and take them to your jars, or other things you wish to charge. To get pith balls to dance, you must see that one wire is connected to lower plate, and one to upper ball. You must put the ball and plate as far apart as you possibly can, and you must turn the machine very slowly, otherwise you get sparks instead of attraction.

S. Bottone.

[96492.]—**Two-Speed Gear for Motor Tricycles.**—The simplest arrangement for this is in form of old sun-and-planet gear, now better known as Crypto gear among cyclists. It consists of an external-geared wheel, which contains an internal geared ring, into which four small pinions, placed equidistant, work, these in turn gearing into spindle, which in some has a hollow sleeve fitted over it, cut with gear inside and out. By means of sliding this sleeve or bush in and out, it is possible to obtain a two-speed gear, and also a free wheel or pedal. The Crypto gear works well and silently, and works far better when gearing down than it did in form first applied to cycles as hub for the geared Ordinary bicycle. I regret having no time to make drawings of same. The sliding bush is a Manchester firm's patent; don't waste time trying to reinvent it, being fully covered. The Crypto gear, with its many forms, can readily be obtained from makers, for whose address look up advts., either in this or any cycling paper.

Monty.

[96494.]—**Wireless Telegraphy.**—Yes; but very slowly indeed.

S. Bottone.

[96499.]—**English Lever.**—In your issue of the 18th inst., Mr. P. Dewar asks some reader to let him know if Swiss made watches are good time-keepers. I would inform him that he will find in my reply 94949, which appeared in your issue of February 3rd, p. 589, an example of Swiss watch performance. It shows excellent timekeeping, considering that the price of the watch, in silver cases, was only 45s. If Mr. Dewar wants to purchase a watch of very high quality, he should also read my reply, 95279, February 24th, as it will give him some useful hints on the purchase of watches. The Swiss, of course, make far better watches than the one I referred to, as that was only a very cheap one which I bought simply for an experiment, having been told what a marvellous timekeeper this class of watch was at the price it would be sold at. But as an example of what the Swiss can turn out in high-class watches, I would mention that Mr. Montandon-Roberts, of Geneva, has been for some time past sending watches of his manufacture to Kew Observatory, and that in the years 1896, 1897, 1898 he received no less than 85·7 A marks on the average for the *twenty* watches he has sent up for those annual competitions. I consider this shows a fine example of clever and accurate workmanship, seeing that this average is for a fair number of watches, and not simply a solitary example. I am glad to see that several of the Coventry watch manufacturers also compete at the Kew Observatory trials, and gain high results.

Kingswood.

[96501]—**Oil and Gas-Engines.**—The design in the articles on "Motor Cycles" is entirely unsuited for a stationary engine. In the first case lightness is aimed at, and economy and durability are necessarily subordinate, while in the stationary type all consideration should be for steadiness, efficiency, and durability.

Trytoaid.

[96502.]—**Cement for Cork.**—See reply No. 96352.

S. Bottone.

[96502.]—**Cement for Cork.**—Nothing better than rubber solution as used by waterproof-garment makers; that sold for tire repairs is too thin. Smear the surfaces, allow to dry, then put together and hammer slightly. The cork must be cut so as to fit together to form a solid lump.

West Didsbury. M. Cole.

The Machinery and Electric Lighting Committee of the Glasgow International Exhibition, 1901, have agreed to accept as exhibits for producing steam for electric lighting and motive power the following:—Lancashire boilers from Messrs. Penman and Co., Glasgow; water-tube boilers from Messrs. Babcock and Wilcox, Limited, Glasgow; Messrs. Stirling and Co., Limited, Edinburgh; Messrs. Weir, Limited, Cathcart, Glasgow; Mr. W. E. Berry, Manchester; and Messrs. Penman and Co., Glasgow. It is estimated that the total power required will be about 5,000H.P.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96091. Lightning Protector, p. 407.
96098. Sensitive Fishing Tackle, 407.
96102. Extracting Gold, 407.
96110. Aluminium Castings, 407.
96114. Ear Wires of Spectacles, 407.
96116. Lathe Heads, 407.
96120. Substances to Ignite on Contact, 407.
96123. Ruck-Sack, 407.
96127. Boiler Scale, 407.
96128. Power for Boat, 407.
96138. Grammaphone Motor, 407.
96145. Bicycle Spokes, 407.
96146. Chemical, 407.
96148. Thermo-dynamics, 407.
96149. Nose-bleeding, 407.
96150. Still, 407.

96295. Bookcase, p. 495.
96297. Reflected Object, 495.
96298. Steam Launch, 495.
96300. Gas-Engine, 495.
96302. Annexation, 495.
96303. Brighton Railway, 495.
96314. Graphic Statics, 495.

QUERIES.

[96504.]—**Macadam.**—Where can I find an authentic account of Macadam's directions for making the road surfaces known as macadamised? It is stated that in many cases our roadmakers use stones too large, and it certainly seems like it from what can be seen on the Embankment now.—Via.

[96505.]—**Lithia.**—Which is a suitable form of taking lithia for the purpose of eradicating uric acid from the system?—Aqueous.

[96506.]—**Figure of the Earth.**—It seems, by the nebular hypothesis, that the present oblate-ellipsoidal figure of the earth may not have been its shape in earlier times. What proofs can be adduced to show it had attained its present figure in, for instance, the Palæozoic period, or even later?—J. D.

[96507.]—**Lawn Tennis.**—In the "Lawn Tennis Handbook" it is stated that the average length of a game was calculated some years ago to be 4·6250 strokes. This appears to be too low an estimate, considering that the minimum number of strokes required to win a game is four, and that the maximum is indefinite, owing to the "deuce-'vantage" method of scoring. How was the official estimate arrived at?—H. L. S.

[96508.]—**Motor Cycles.**—I have read the articles now appearing on this subject with much interest, and should be glad if the writer of the articles or other kind friend would inform me how to make a core-box for the cylinder cover and valve-box. I have left the prints on cylinder cover cavity ⅝in. long and valve-box prints ⅜in. long. I should like to know the dimensions of ignition and exhaust box on cylinder cover.—G. S. Deadman.

[96509.]—**Resistance Coil.**—Could Mr. Bottone or other readers tell me how to make a spiral resistance coil with 2lb. No. 22 iron wire? Also what size windmill should I want to give ½H.P.? A sketch of mill, if possible, and dimensions would oblige.—W. Pretty.

[96510.]—**Coppering Carbons.**—I have recently recoppered some carbons of a bichromate battery, and wish to paint the copper deposit with something to prevent creeping. I believe pitch dissolved into a varnish with some kind of spirit is what is mostly used, and I shall be glad if one of "ours" will confirm this, giving the name of the spirit necessary to dissolve the pitch.—A. R. Barrett.

[96511.]—**Brazing Lamp.**—Will any correspondent give me a sectional diagram showing the principle of any powerful brazing lamp?—E. M. S.

[96512.]—**Electric Lighting.**—I am desirous of lighting my shop window by two incandescent lamps during the coming winter. Will someone please show me the cheapest way of doing this?—A. R. P., Ledbury.

[96513.]—**Hereditary Insanity.**—Will one of "ours" kindly answer the appended question? Facts: Father of family in his youth was dissipated, married, and had children. Two years after birth of youngest became insane through paralysis of the brain, died five years later. Youngest child now 16 years old, and all are particularly intelligent. Are they or their children likely to develop insanity? No insanity previously in family. Anxious.

[96514.]—**Dry Cleaning.**—Can any of "ours" kindly give full particulars of the dry-cleaning process as done at the large cleaners? I do not think it is a patent or secret process.—W. Nash.

[96515.]—**Model Steamer.**—I am building a model steamer, 3ft. long, 6in. beam. I propose to use the boiler, cylinders, &c., of a small model locomotive. I should like to know if you think they are powerful enough to drive it? The cylinders are single-acting, oscillating, ⅜in. bore by ⅝in. stroke. The boiler has one tube through it from spirit flame to the funnel. If I put another tube, so as to increase heating-surface, shall I want a stronger safety-valve? Where the propeller-shaft passes through the stern, will it have to go in a long tube reaching inside the boat to the water-line, or shall I only want a short piece of tube?—Green Hall.

[96516.]—**Heat Consumed in Mechanical Work.**—If air of a specified temperature and pressure is supplied to an engine, what is its pressure and temperature on leaving engine? What would be its temperature if simply allowed to escape in the atmosphere?—W. T. H.

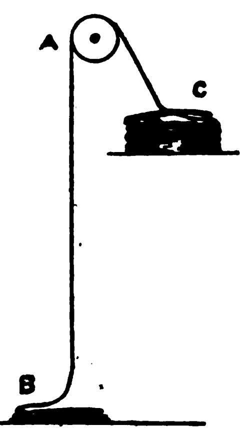
[96517.]—**Clarifying Methylated Spirits.**—I have a quantity of methylated spirits mixed with equal parts water and a little colouring matter, and as the mixing of the water with the spirits turns the whole to a colour resembling milk, I shall be obliged to any reader for information of a simple method whereby I can clarify it and bring it back to the original clear appearance before being mixed?—Glasgow.

[96518.]—**Charging Accumulators.**—I am charging motor-car accumulators by means of a plating dynamo 6 volts, 50 ampères. What is the best arrangement for charging, say, four cells at once—in series or in parallel, or both? What voltage and ampèrage should be employed, and how long should the accumulators take to become fully charged? How can their condition be correctly ascertained? I shall be glad of any definite information on the subject.—E. A. W.

[96519.]—**Water Power.**—Will anyone kindly explain whether a 4in. pipe 100ft. long, with 10ft. head, will discharge freely into space the same amount of water as a 4in. pipe 1,000ft. long with 100ft. head (the mean hydraulic gradient being the same), and if this be the case, would the latter give a greater horse-power than the former, and reason why?—J. F. B.

[96520.]—**Velocity of Light.**—Will some expert on the properties of light kindly inform me whether the relative velocities of red light and of violet light in space have been ever accurately determined, and with what result, and in the same manner as arrived at by Foucault and others for white light? I do not mean the number of wave-lengths per second, for it has been usual to assume that the velocity of white light divided by the wave-length of any colour will give the velocity of such wave-length. And would anyone also say whether sound of high pitch travels through air with the same velocity as that of a low pitch?—J. F. B.

[96521.]—**Speed of Falling Chain.**—Let A be a pulley, C a coil of chain of great length, which can "pay out" easily, B the bottom of a pit. Let A be 580ft. from B. Supposing that the chain be allowed to run freely over



the pulley to the bottom of the pit. The chain will therefore start from rest at C, fall 580ft., and then settle down at rest at B. If this be kept up for a length of time, would the chain not have a uniform velocity all the while, and would the velocity not be equal to mean velocity at the end of each second of time of a free-falling weight—i.e., a free-falling body would at six seconds have a velocity of 193ft. per second, and fallen 580ft., but as the chain is linked together, there would be a retardation tendency of the advancing part. Hence I assume that, taking the velocities at 1, 2, 3, 4, 5, and 6 seconds, the mean would be about 113ft. per second—neglecting friction. As there would be a certain tension on the chain, would it not be greater near the top than at the bottom, for the chain has to start from rest and suddenly take up 113ft. per second speed? Would someone kindly help me out?—J. F. B.

[96522.]—**Electric Motor.**—Will one of our electrical friends kindly give the dimensions of a motor suitable for driving a coffee-mill? Capacity, 200 volts at 8amps.? Also—(1) What is the least power motor that can be economically designed—i.e., without excessive loss in armature and magnet coils, to run off 210 volt mains? (2) Will ring or drum armature give best results? Gauge and number of convolutions required. (3) Will series or shunt be best for magnet coils? Gauge and number of turns required. (4) Can it be run at 1,000 revs. per minute? What variation of speed will resistance of 10 ohms effect, five coils in series, each 2 ohms? (5) Should a well-designed motor when driven as a generator give as good results as it would have done if it had been designed as a dynamo?—E. B. L.

[96523.]—**Water Lifting.**—Can any reader experienced in the above tell me the cheapest and most efficient means by which I can force 20,000 gallons of waste water (in about two hours) from a tank to a meadow about 500 yards distant? The top of the tank is level with the ground, but the meadow is about 33ft. higher than the bottom of tank. The apparatus must not be liable to clog. I have a 10H.P. steam-engine, which is 25 yards from the tank.—Redbun.

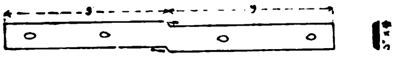
[96524.]—**Automatic Flushing Cistern.**—Will someone please give a working sketch and explain the construction of the automatic cisterns used for flushing urinals?—Householder.

[96525.]—**Phonograph Shaver.**—Can any reader give me any information as to the best method of grinding and polishing a sapphire shaver, which has not a very good edge?—R. T.

[96526.]—**Fly-Catchers.**—Can any of "ours" inform me what ingredients are required for making sticky fly-

papers, also those now sold called "Tanglefoot"? I cannot get any chemical fly-papers now. How can I manufacture some? I have some powder arsenic.—PESTERED.

[96527.]—**Fish-Plate.**—I have a lot of railway fish-plates to set thus, which is a slow process, being heated in



a smithy fire and set with a handle and screw. Could any reader suggest a machine to be driven off a 3½in. shaft which would give the same set? Also a small furnace to heat plates in?—FISH-PLATE.

[96528.]—**Chemical Action.**—Kindly state the chemical action likely to occur by mixing a water solution of permanganate of soda with sulphuric acid, and the probable effect of adding such a mixture to crude town sewage?—J. HAMSON.

[96529.]—**Duffett's Battery.**—Can anyone tell me how long Duffett's battery will deliver a current of two ampères? Also is there any local action when cell is idle? If so, to what extent?—i.e., how many hours will it take to polarise through local action alone?—F. RIGBY.

[96530.]—**Alternator.**—Would Mr. Bottone or some of our electrical correspondents kindly reply to the following? Is there any difficulty in running alternators made by different makers in parallel? If so, what is the difficulty? Also, is it necessary to have a synchroniser on the switch-board when running alternates in parallel? What is the advantage claimed of a synchroniser?—R. S.

[96531.]—**Heating Power of Coal.**—Can any readers inform me whether any book or work is published which gives information as to the heating power and durability of the various kinds of house, hard steam, and Welsh coals?—ENQUIRER.

[96532.]—**Geometric Solution.**—In issue of Aug. 4 "J. S." kindly gives construction of this difficult problem. Querist finds himself unable to understand reasons. Would "J. S." be so good as to give proof, and say how are the lines G P, G Q, G R drawn? Might the points 1, 2, 3 happen to fall on same straight line?—M. C. F.

[96533.]—**Liquid Fuel.**—I am fitting up a small launch, 20ft. long, and am thinking of using liquid fuel. I shall feel obliged if some reader of experience in this will inform me the best burner and the cost of running compared with coal. The boiler is vertical, with bottle tubes, and brass tubes from firebox through side of shell. I think it is on Kingdon's pattern. Grate 12in. diam.; engine 3½in. by 4in. stroke. I require about 300 revs.—C. J. F.

[96534.]—**Dental Chair.**—Will some ingenious friend kindly give me a hint or two as to the home construction of a cheap but efficient dental chair—one that can be raised and lowered and fixed at any inclined position? I find it most trying to the back and head using an ordinary chair, with cushions arranged for head, &c. I started dentistry because of the prices charged by dentists and was successful "first shot" in supplying myself with 18 teeth on vulcanite. I have since made several sets and partial sets in vulcanite, gold, combination, &c., for friends at half ordinary prices.—DENTURE.

[96535.]—**Flagstaff Stays.**—Will one of "ours" kindly supply particulars of wire stays necessary for a pole 50ft. long, on top of building, gauge of wire, and where to fix them?—ROYAL STANDARD.

[96536.]—**Crucibles for Silver.**—I am engaged in the melting of silver. The crucibles hold about 2,000oz. The difficulty is that the silver eats into the crucible, and causes waste. The crucibles are made of plumbago. Can any reader tell me what to mix with the plumbago that will prevent the above difficulty?—LUCKCOCK.

[96537.]—**Electric Lighting.**—To MR. BOTTONE.—I must thank you very much for your reply No. 96389 in last week's "E.M.," but am not quite clear on two points. (1) Which main ought the automatic cut-out to be—on positive or negative? also main switch? (2) Will not the lamps get more than 50 volts when running at 65 volts? If not, please explain why.—W. H. C.

[96538.]—**Gravity.**—What is meant by the "instantaneous propagation of gravity"? Are we to understand by this phrase that the earth's attraction acts through infinite space without any relation whatever to time, or that it acts so quickly through great distances that its velocity is incalculable? I should be obliged if any of your readers will explain, and give the data upon which the idea is founded.—HUGH ALEXANDER, Sowerby Bridge.

[96539.]—**Ebonite Boxes.**—Could any of the readers of the "E.M." give me a recipe for stopping up cracks and holes in ebonite boxes which are used for accumulator cells?—ACCUMULATOR.

[96540.]—**Cycle Motor.**—Will "Writer of the Articles" kindly say if there is any tendency to drive the crankshafts out of line with each other when running? It seems to me that there is with the present method of construction. Should not the crank-bolt carrying the hardened steel sleeve be keyed some way to discs? Also, I should be pleased to hear if the writer has tried raw hide for the large gear-wheel. Not surprised to hear that the pinion made from this material wore itself out so soon, as the wear is so much greater on the pinion than on large gear-wheel. Trusting these queries will come under his notice—MOTOR.

[96541.]—**Carburetter for Motor-Cycle.**—I am much interested in the current articles on Motor-Cycles. Will the writer of the articles, also "Monty," please give their opinion on the advantage or objection to running the baffle-plate down into the petrol., so that the air must pass through the spirit before passing through the wick? Would not that method give a more thorough carburetting of the air, and also allow the use of petrol. of a lower specific gravity? Is there any objection to placing a light lifting check-valve just above or below the gauze, as an additional precaution against back-pressure into the carburettor in case of back-fire?—BETA.

[96542.]—**"Nordrach" Treatment of Consumption.**—Will any reader kindly give me any particulars of the system pursued by Dr. Otto Walther at his sanatorium at Nordrach, in the Black Forest, which is known as the "Sanatorium" treatment, the "Nordrach" cure, or open-air cure?—CONSUMPTIVE.

[96543.]—**Sundial.**—Can anyone inform me what would be the best cement to use to fasten the style of sundial down to the face of the instrument? The style is of brass, the face of slate. There are brass pins that go down into the face; but they have worked loose.—NAUTICUS.

[96544.]—**Lard Refining.**—Please give me particulars of lard refining, suitable for about 40lb. or 50lb. weekly. For what use are the oils chiefly? Any information will be esteemed a favour.—J. M. STUBBS.

[96545.]—**Rubber Rings.**—Having a number of gauge-glass (rubber) rings which have grown hard and thus useless, the cause of which is, I expect, owing to their having been exposed to the air for some time, I would be much obliged if someone could tell me how to put them right, or, failing that, how I could utilise them?—R. DOW.

[96546.]—**Motor Batteries.**—Will some reader kindly give me advice about the above? When my motor (De Dion Quad) was new the dry batteries gave from 7 to 8 ampères. After running about 500 miles they only gave from half to one ampère. This not being enough, I ordered a new set (which are very expensive), and dissected the old ones. After chipping away the pitch which seals the battery, I find that the case of cell itself is of zinc and forms one pole of battery. The other pole is the ordinary carbon surrounded by a composition that looks like plumbago paste, which is wrapped in canvas. Between the canvas and the zinc case there is sawdust, damped with what tastes like salammoniac and water. I find that the sawdust nearest the walls of zinc case is dry, I suppose because of the hot weather. Is this a reason for the battery getting weak so soon? Will some kind reader tell me how to renew the chemical next the carbon, what the composition is, and would fresh sawdust re-damped give the battery new life? It seems absurd to throw away the battery when the zinc case is not a bit corroded by galvanic action. I shall be very glad of any information on the subject.—SAUREY.

[96547.]—**Saturn.**—Will some astronomical friend kindly give a sketch in "Ours" of this planet, as he now appears, for the guidance of those who have not been able to view him on account of his great S. declination?—S. S.

[96548.]—**Bent Timber.**—Will anyone kindly say what smaller curve it is necessary to give to a piece of timber that has been steamed to be bent, so that when it springs after removal it may assume the correct curve that was desired?—DOUBTFUL.

[96549.]—**Encke's Comet.**—Can any of "ours" oblige with the time of the last perihelion passage of above, which took place about 1898, May 24?—W. S.

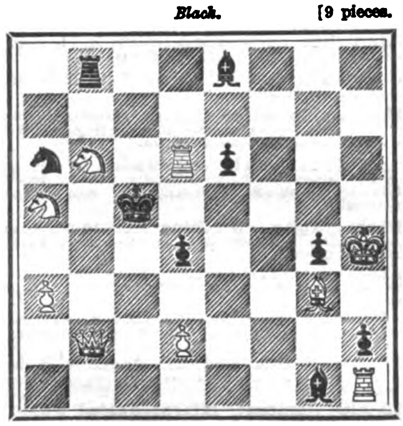
[96550.]—**Mensuration.**—Will one of your mathematical readers kindly show the working out, by mensuration, of the following? A circle is described about a regular hexagon, and a second hexagon is described about the circle. The difference between the area of the two hexagons is 813sq.in. Find the area of the circle.—PUZZLED.

CHESS.

All communications for this column to be addressed to THE CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1689.—By H. VON DUBEN.

Black. [9 pieces.



White. [9 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Sept. 4.*)

Solution of PROBLEM No. 1687.—By P. G. L. F.

Key-move, K-B 6.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1687.—Correct solutions have been received from Mary R. Phillips, J. E. Gore (also No. 1686), Richard Inwards, Quizco, F. B. (Oldham), T. Clarke, A. Tupman, Rev. Dr. Quilter, Whin Hurst, Hampstead Heathen, Mahtale.

FORTY-ONE warships were launched in Great Britain during 1898.

THE judges of the Liverpool Self-propelled Traffic Association have decided not to publish any figures whatever, further than those already issued, until the publication of the report about November next.

ANSWERS TO CORRESPONDENTS.

. *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

. Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, August 23, and unacknowledged elsewhere:—

ALEX. B. MACDOWALL.—Scorpio.—O. G. A. P. or ——.—Louis Senecal.—W. Ewart Gibson.—C. W. Krohne.—Electric Engineer.—D. M.—Ivo H. Carr Gregg.—C. J. Charnock, Sereda, Russia.—W. H. B.—Ajax.—W. Ritchie.—T. L. Spencer.—A. Caplatzi.

S.—Do not know it. Storage batteries are not novelties; but if someone has invented a superior device he should make it known in the usual way. Anything really good will always find space in our columns.

L. S. D.—In the back volumes you can find the particulars desired; but you do not specify the size of the boiler. If a book is wanted, try Alexander's "Model Engine Construction," published by Whittaker and Co., White Hart-court, Paternoster-square, E.C.

SUBSCRIBER.—Do not know anything more than is given in the article. The date would be a few days before that of the number in which the article appeared.

NAUTICUS.—From the Assistant Secretary, Burlington House, W. You can obtain all particulars about the Royal Astronomical Society and its publications.

J. J. J.—Pitch is the distance between the teeth; boss is another word for hub. Please see the back volumes, or any elementary work on mechanism.

A. ASTON.—See the article. A mere sketch would be waste of space in asking the writer to "supply dimensions."

CAROLAN.—See the almost innumerable replies about wiring dynamos.

B. LEIGH SMITH.—We do not know of any "economical" rotary engine in the ordinary sense of that term; but Parson's steam-turbine, which is a rotary engine (in terms), is a decided success.

J. B. P.—You will find many recipes of the kind desired by searching through the back volumes; but as to cheapness, that depends mainly on the quantities in which you can buy the ingredients. Obviously cheaper by the ton than by the pound.

SEMPER SURSUM.—Nothing better than bisulphide of carbon or benzol—not benzoline. Answered many times in back volumes.

COUPLER.—See the back numbers, or such a work as Mr. Stretton's "Safe Railway Working," published by Crosby Lockwood and Son, Stationers' Hall-court, E.C.

J. C. C.—We do not know, but probably, if published, by Macmillan and Co., St. Martin's-street, W.C. Why not ask the professor himself if the lectures are published?

T. A.—Can be obtained from the secretary of the Society of Arts, John-street, Adelphi, W.C.

A. DRYSDALE.—Tell him to try boracic acid rubbed all over the feet. It is a dry powder, and harmless.

THE Washington monument was struck by lightning on July 14, and the wires used for signalling to the lift conductor were burnt out.

IT is stated that the Japanese coal market still continues in a bad condition, and the accumulations of stock at Kyushu and the coalfields show no signs of diminishing. Prices are so low that shipments from Kyushu do not cover the expenses.

A NEW patent automatic ticket-recording machine, known as the Ohmer Fare Collector, has been brought under the notice of the Leeds Tramways Committee. The dimensions of the machine are 5¾in. by 1¾in. For every penny received the conductor is expected to strike the "recording plunger," which rings aloud the amount of money paid, and indicates it by figures displayed on an automatic wheel. At the same time the conductor should touch a lever which automatically prints and delivers a small paper ticket to the passenger, and exposes to view on another counting wheel the exact number of passengers carried. It is claimed that the machine does all the registering necessary, and that there is no need for an elaborate system of office checking.

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent One Month before expiration, in order to give them time to forward fresh remittance before subscription expires.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each, post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. No reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No Displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

For advertisements on inside pages, except page facing leader, for less than a quarter-page; per inch, single column—

1	6	13	26	52 insertions.
7s. 0d.	6s. 0d.	6s. 0d.	5s. 0d.	5s. 0d. each.

Per Column.—

1		13	26	52 insertions
£3 0s.	£2 15s.	£2 10s.	£2 5s.	£2 0s. each.

			13	26	52 insertions.
	£ s.	£ s.	£ s.	£ s.	£ s.
Per Page....	8 8	7 0	6 0	5 5	5 0 each.
Half-page ..	4 10	3 15	3 10	3 0	2 10 "
Quarter-page	2 10	2 5	2 0	1 15	1 10 "

Back Page, £10 10s. A few dates open during 1899.

ORDINARY ADVERTISEMENTS.

	s. d.
Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements must reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements except those in the Exchange and Sale Columns) may be addressed to "———," care of the English Mechanic Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to The Strand Newspaper Company, Limited, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

Special Notice. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

"English Mechanic," 517 numbers to date, clean and perfect. Offer wanted.—Schofield and Hilton, Diggle, Oldham.

Donkey Pump, cost £20. sacrifice £5, suitable for small yacht. 1H.P. Horizontal Engine, new, cheap.—Below.

Quantity of 1½ **Shafting,** Plummer Blocks and Pulleys. A Gents' Tandem Cycle, bargain, £5 5s.—Below.

Wanted, in **Exchange for Above,** small Vertical Launch Boiler, Propeller, Shafting, Sailing Boat.—Cooke, Mile End, Portsmouth.

Crystal Palace Pattern Polished Chain Box **Mangle,** new, cost £9. Exchange. Postcards refused.—Albert Blake, Portsea.

One-man power Bischoff **Gas-Engine,** in good working order, £4, or would exchange for good Drilling Machine.—Hart, 47, Godiva-street, Coventry.

Reflecting Galvanometer, Kelvin, under glass stand, magnificent instrument. What offers? or exchange value £10 cash. Letter.—O., 83, Burghley-road, Highgate-road, N.W.

Locomotive Model (working); length with tender, 5ft. 6in.; gauge, 5½in.; cost over £400; accept half, or part exchange musical; bargain; one of the grandest models ever built. Also rails, sleepers, and trucks. Photo. six stamps. Seen appointment. Letters only.—O., 83, Burghley-road, Highgate-road.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

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F. C. Allsop's Electrical Handbooks, over 80,000 copies sold. "Practical Electric Bell Fitting" (7th edition), post free 3s. 6d.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 1, 1899.

MOTOR CYCLES.—XV.

AT this stage of the work a general arrangement of the complete machine will be of assistance in understanding the uses and positions of the various parts which have been described in detail.

Fig. 95 shows the tricycle with the right-hand rear wheel removed. In making this show. The petrol is contained in the oval tank T, held to the back stays by clips. From the tank the petrol is led to the float-chamber by the copper pipe U. V is the screwed cap over the filling hole. To control the admission and vary the quality of the explosive mixture admitted to the combustion-chamber of the motor, two small levers are provided in a convenient position on the top tube. One of these appears at W; the other is precisely the same, but on the further side of the tube, and is therefore hidden. The lever which is seen is the one controlling the supply of pure air. The levers are coupled to the handles of the plug of mixing cock, and its air-regulating plate by light rods, the one shown, G′. This plug-switch is of great use in preventing any unauthorised person from riding off with the machine, or exhausting the batteries by turning on the handle-bar switch at a time when the cam on the motor-valve gear-sleeve is making contact with the contact-springs.

In building the frame of the machine, great care must be taken to insure every joint being sound, and the intending builder cannot do better than follow the clear directions recently given by "Derwent" in the ENGLISH MECHANIC. It would be waste of time for me to repeat them here, and nothing can be added to them; therefore I will confine myself to giving the dimen-

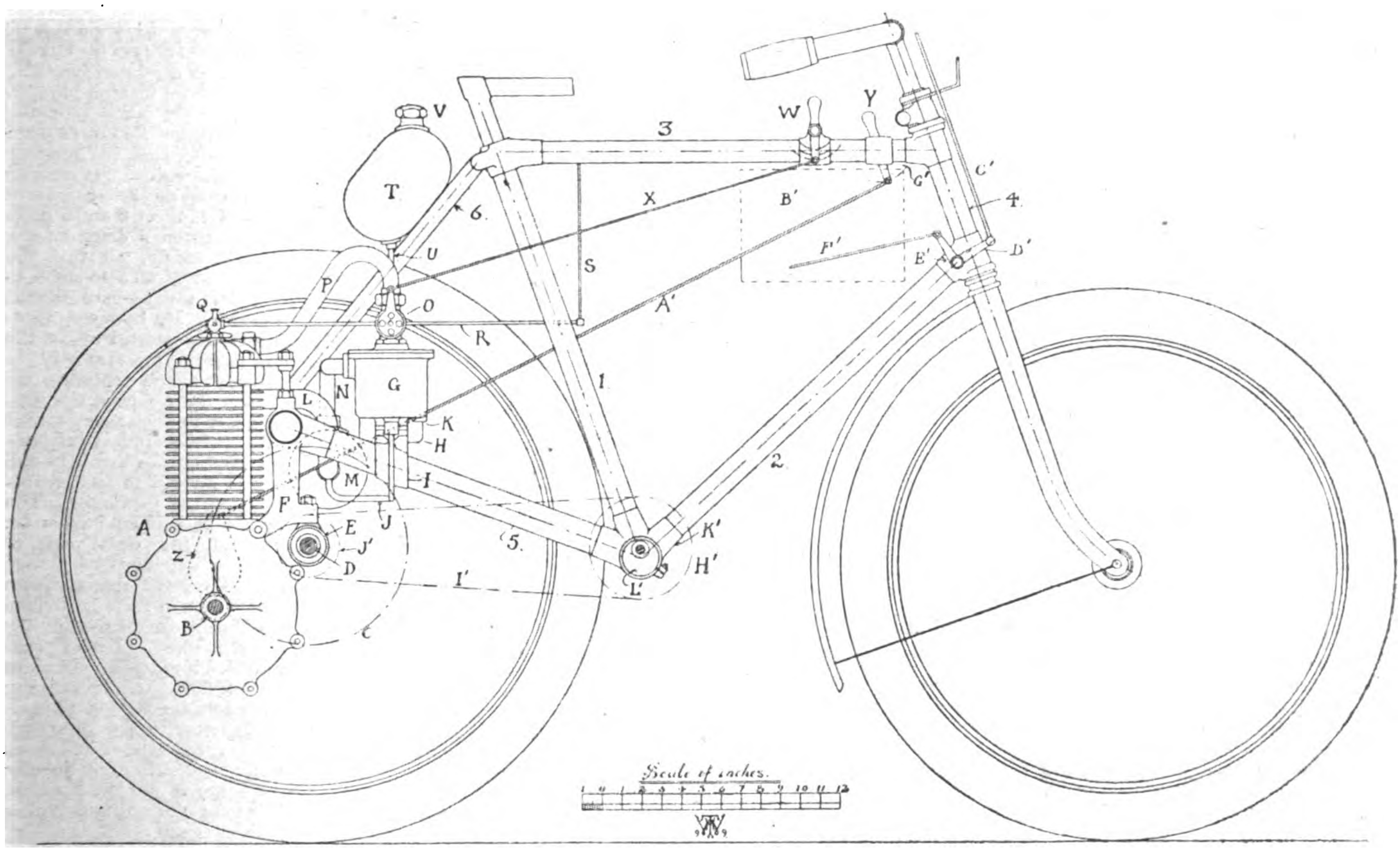


FIG. 95.

drawing I have been guided entirely by the dimensions given of each part, and, therefore, if the various components have been made to the sizes given they will come together correctly. The reference to the letters in Fig. 95 is as follows:—A is the motor complete, B the driving pinion, C the driving-wheel, D the axle, E one of the axle bearings, F the bridge tube and compression stay lug shown in detail in Fig. 56, G is the carburetter, H being the float-chamber behind it, I is the lug holding carburetter and float-chamber in place, for details of which see Fig. 88. The exhaust branch pipe is seen at J, and the outlet of the exhaust coil in the carburrertter at K; L is the exhaust pipe leading to the silencer M. The pipe which leads from the air heating chamber to the carburetter I have lettered N. O is the mixture regulating cock, and P the vapour pipe to motor; Q is the compression relief cock, to the plug of which is fastened the long rod R, which passes through, and is supported by, a lug brazed to the seat-tube, but not shown in Fig. 95. At the end of this rod, remote from the cock, is a lever connected by the vertical rod S to a handle, pivoted on a lug on the top tube, by means of which the rider can manipulate the compression-relief cock while seated in the saddle. As both lug and handle come behind the top tube in Fig. 95, they do not lettered X, being attached to the air-plate. There is one more handle on the top tube, seen at Y, the movements of which control the position of the sparking apparatus Z by the medium of the rod A′. The battery case is shown dotted at B′. It is suspended by two straps from the top tube, and steadied by another passing round the bottom tube, in much the same way that a luggage carrier is attached to the frame of a bicycle. The induction coil is slung from the bridge tube in the same manner as, but on the opposite side to, the exhaust silencer. We come now to the brake controlling gear. There will be two levers on the handle-bar, one on either side, neither of which appear in Fig. 95, as they would obscure the levers on the top tube. The lever on the *right* hand of handle-bar operates the band-brake on the back axle through the rod C′, which is adjustable, and attached to the bell-crank D′ by a ball-joint. This bell-crank is pivoted at E′ to the lower head lug, and, by means of the rod F′, is coupled to the upright rocking-shaft lever seen in Fig. 72. The lever on the *left* of handle-bar works a brake on the front tire in the ordinary manner, or one of the many rim-brakes or front-hub band-brakes now on the market. The handle-bar switch is contained in the *left*-hand handle-bar grip; the plug switch, used when the machine is left for any period without anyone to look after it, is placed at sions and gauges of the tubing to be employed. All the lengths are given from centre to centre, and due allowances must be made for mitring the tubes together. Liners should be used throughout, especially at the junctions of the steering tube and forks with the crown plates. The tubes are numbered in Fig. 95, thus:—1. Seat column, 1¼in. diameter by 18 gauge; length from centre of bottom bracket to *top* of seat-lug, 22¼in. 2. Bottom tube, 1¼in. diameter, 18 gauge; length from centre of bottom bracket to centre of steering socket, 22¾in. 3. Top tube, 1in. diameter, 18 gauge; length from centre of seat-column to centre of steering socket, 22in. 4. Steering socket, 1¼in. diameter, 18 gauge; length from centre of top tube to centre of bottom tube, 5½in. 5. Compression stay-tube, 1⅛in. diameter, 18 gauge; length from centre of bottom bracket to centre of bridge-tube, 19in. The length of the two back-stays (6) will be best determined after the rest of the frame has been built. They are intended to be ⅞in. in diameter, 18 gauge, round tube, though D or oval tubing may be used at the discretion of the builder, but round tubing is the strongest. Whichever section be employed, eyes, formed from steel stampings, are to be brazed into each end, and drilled to take the seat-pillar, bolt at one end, and the ⅜in. bolts at the other ends, by means of which they are clamped to the bridge tube lug (Fig. 54). These

eyes must be "set" so that they lie close to their places without strain when the bolts are tightened up. The front forks are to be especially strong, of best weldless steel tube brazed into a three-plate crown. Forks such as are used for triplets and quads will be suitable, and if they can be obtained 1¾in. by 16 gauge so much the better—they cannot be too strong. A tandem or triplet hub will do for the front wheel drilled for 40 No. 13 gauge spokes. The steering pillar, brazed to fork crown, should also be very strong, 1⅛in. diameter by ⁵/₃₂in. thick will be right. At the top end it can be turned down and screwed to fit closely into the handle-bar, clip, and adjusting-nut; but be sure in turning it not to leave a shoulder, but taper it gradually from the thicker to the thinner parts. In the journals devoted to cycling there is advertised a form of tube which has much to recommend it. I refer to a patent seamless drawn tube with thickened ends, which requires no liners, and as liners are always troublesome to fit and involve heating the tube twice, which adds to the risk of burning, I advise the employment of the butted tube.

The remaining references to Fig. 95 are:—H', sprocket-wheel; I', chain; J', sprocket-pinion; K', bottom bracket; L', bottom bracket eccentric.

The mixture pipe leading from carburetter to motor, and the hot-air pipe to carburetter, I shall not give drawings of, as these are best bent and fitted after the parts they belong to are fixed in position. The hot-air pipe is to be of copper, ¾in. inside diameter by 18 or 20 gauge, and the vapour pipe of the same material and gauge, but ⅝in. inside diameter. This latter has a cone for union (Fig. 30) brazed to each end, and see that the union nuts (Fig. 30) are slipped over the pipe before brazing the second cone on. The hot-air pipe is brazed into the socket (Fig. 38) on air-heating chamber, the other end having a flange brazed on ⁵/₁₆in. thick, and of the shape and size given in Fig. 39. The float chamber is connected to the petrol tank by a copper pipe, ¼in. outside diameter by about ³/₁₆in. bore. There is a cock and union immediately below the petrol tank to allow the pipe to be disconnected when there is petrol in the tank. Details of the petrol tank, regulating levers, and a diagram of the electric circuits will form the subject of the next article.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—II.

It is not everyone who possesses the mechanical dexterity necessary for repairing a barometer when it gets out of order; and indeed, in the long run, it is better to return a faulty instrument to the maker thereof. There are, however, certain adventurous individuals who will attack the difficult manipulations connected with mending and overhauling a barometer, and since such operations at least lead to a better understanding of the principles on which the instrument is constructed, they are not altogether to be deprecated. In any examination of a barometer the first question which arises is as to the quality of the mercury in the tube. The mercury used in the construction of a barometer should be as pure as it is possible to make it, and it is commonly necessary to free it from such intruding substances as lead, iron, and sulphur, since traces of these are often to be found in it. These impurities are driven out by treating the mercury with diluted acetic or sulphuric acid, and it is then fit for use. A simple test to discover whether the mercury is suitable for putting in a barometer tube, consists in dropping a little of it in a thermometer tube of a very small bore, which has been exhausted of air. If the mercury then freely runs up and down this constricted tube it will probably rise and fall easily in any barometer tube no matter what the diameter of the latter may be. Moreover, mercury is at all times liable to collect minute air-bubbles, and search should be made for these with the aid of a lens, and if it then appears bright it may be considered satisfactory. As already mentioned, the cisterns of some barometers need to be raised or lowered when reading the instrument, and if after making the reading the cistern be lowered, the mercury will be depressed out of reach of intruding dust, and its surface will be kept bright and untarnished.

Of all the vitiating circumstances likely to interfere with the working of a barometer there is none so difficult to detect as the presence of air in the tube. It is in handling and moving the instrument that air is most likely to enter, and although with some barometers its expulsion is not a very difficult matter, it may easily be overlooked. When once air has found its way into the tube it gradually pushes its way upwards until it enters the Torricellian vacuum at the top of the column, and since the air has tension or pressure it prevents the mercury from rising as high as it otherwise would do, and the readings of the instrument are accordingly below the truth. Similarly, moisture or a little vapour of mercury may find its way up the tube and destroy the perfectness of the vacuum. The presence of moisture is always to be suspected when the mercury appears to cling to the sides of the tube and renders the movements of the column sluggish. A common way to determine whether there is air in the tube is to incline the latter so that the mercury may strike the end of it, a sharp click indicating that the vacuum is perfect, while a dull sound denotes that air has collected and formed a cushion. Seeing, however, that the column of mercury has considerable weight, it will be realised that this is a test which needs to be applied cautiously, for too great a momentum will result in a broken tube. When filling a barometer tube for the first time moisture and air are driven out by boiling the mercury in the tube itself over a charcoal fire. Bubbles of air are sometimes easily expelled by slowly depressing the tube so that they travel upwards to the cistern and so escape, refractory bubbles being hastened upwards by very gently tapping the end of the tube on one's foot.

Seeing that there are so many accidents to which a barometer is liable, it is always desirable to spend a little time in seeing that it is properly hung in position, and so protected that it cannot be knocked by passers-by. Two bars of wood about 18in. long, 6in. wide, and 1½in. thick may be fixed along the wall, one being about 5½ft. from the ground and the other 2ft. These two bars should be perfectly horizontal, the face of the lower one being in exactly the same vertical plane as the upper. To these bars, which should be firmly fixed in position, a cage or wire box may be attached in such a way as to inclose the two wooden bars, and one particular kind of cage is made wedge-shaped, so that the two doors or flaps open right out. This, for many reasons, is a better arrangement than a four-sided cage, for with this latter form much of the light is cut off from the barometer, and its indications are not readily seen. In places where the barometer is likely to be knocked by children, or in public buildings where many people pass, some such protecting cage as the above, which is very easy of construction, will be found to protect the instrument from damage. The barometer is, of course, hung by means of a bracket fixed to the upper board, and it is recommended that the bracket be put not in the middle of it, but at one side; so that if at any time it is desired to hang another barometer alongside for purposes of comparison, room may be available for it.

When tilting a barometer for the purpose of expelling air it cannot fail to be noticed that the more it is inclined the higher up the tube the mercury travels, and from this observation it may be concluded that to obtain a correct reading it is important that the barometer be hung truly vertical. Any departure from the vertical makes the reading too high, and, accordingly, when hanging a barometer it is necessary to put it on the bracket which carries it in such a way that it swings quite freely, and after the true vertical has been found by a plumb-line the lower part of the barometer may be fixed in position. Moreover, since the mercury in the barometer contracts and expands with alterations in its temperature, a correction is necessary for this change in the length of the column, and it is for this purpose that all good barometers have an attached thermometer. But this correction is one which requires a reference to correction tables, and although this is a highly important operation in scientific meteorology, it may be supposed that this is a matter with which the ordinary individual does not concern himself.

To reduce this correction for temperature as much as possible, it is necessary to keep the barometer in a part of the house where it will not be subject to great extremes of temperature, and to this end it should be kept away from the direct rays of the sun, and placed also where no heat can reach it from hot-water pipes or from a fire. The north side of a house is commonly the best quarter in which to find a spot where temperature is most equable, and it is well also to remember that, like an invalid, a barometer is very susceptible to draughts. Further, when a barometer is hung in such a way that the top of the mercurial column is above the line of sight, the recorded readings will always be too high, for the scale and the top of the mercury do not coincide. Accuracy of reading is therefore secured by hanging the barometer so that the meniscus or top of the column is on a level with the observer's eye. These are methods of procedure which do not call for a very large amount of work; but their observance always results in adding to the efficiency of the barometric records.

When once it is understood that changes in the weather do not depend so much upon the height at which the barometer stands as upon the rate at which it rises or falls, the first step is taken towards getting the best results from its indications. Now, there is no better way of showing these risings and fallings than by plotting the barometer readings on a diagram, and so produce a curve. Commonly, all that the unprofessional meteorologist is able to do is to read his barometer twice a day—once in the morning and the evening. If, however, these two readings be plotted as suggested above, the daily march of atmospheric pressure will be shown far better than by simply entering the records in a note-book. Such curves are produced by ruling a diagram in such a way that it may be divided horizontally into thirty-one spaces—one for each day of the month;—and vertically the diagram is divided so as to represent the scale readings of the barometer. The horizontal spaces should be half an inch wide, and if they be divided into four equal parts, as many as four readings a day may be plotted without confusion. The vertical spaces should be one inch high, and if each of them be divided into ten, there is no difficulty in discovering the correct position for each entry. Ten of these vertical spaces thus divided into tenths will allow of any reading between 28in. and 31in. being plotted. When the barometer is read twice a day it is quite easy, therefore, by plotting each entry in the form of a dot, to put each individual reading in its correct place. Then, by joining the dots by a line, a curve is produced which, day by day, clearly shows the changes taking place in the atmospheric pressure.

As already mentioned, when using barometer readings for strictly scientific purposes, it is necessary to correct them for temperature, and if also it be desired to compare the readings with those taken at neighbouring stations, it becomes necessary to reduce them to some common standard or height. Any height might be taken; but it is the common practice to reduce all barometers to the level of the sea—or, in other words, they are made what they would have been had they all been taken at this level. Supposing, therefore, that the observations are made at an altitude of 500ft., there may be considered to be a column of air between the point of observation and the sea-level; and the necessary correction for altitude resolves itself into discovering the weight or pressure of this column of air. Further, since this column of air changes in weight with every alteration in temperature, it is necessary to know the temperature of the air before the amount of the correction can be properly determined. It will, however, be seen that at a station having a Continental situation it is a fiction to speak of a column of air being between the station and the sea-level, and only when the observer is in a balloon floating over the sea can this column of air be strictly considered to be present. However, it is the weight of this fictitious column of air expressed in barometric inches that forms the correction which an observer needs to add to his barometer readings when he desires to reduce them to the mean sea-level. Moreover, since it is impossible to determine the average temperature of this column of air, what is done is to take the temperature at the point of observation, which is, after all, but the temperature of the top of the column of air between the observer and the level of the sea. It will be gathered, therefore, that in reducing

Occultations of (and a near approach to) Fixed Stars by the Moon, visible at Greenwich.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
12	39 Ophiuchi	6 0	8 47 p.m.	Dark	28	2	9 26 p.m.	Bright	318	287
13	1 Sagittarii	5·3	5 5 ,,	Dark	51	66	6 9 ,,	Bright	299	303
17	B.A.C. 7717	6·5	6 18 ,,	Dark	64	98	7 21 ,,	Bright	247	274
24	A[1] Tauri	4·5	3 29 a.m.	Bright	125	131	4 25 a.m.	Dark	216	205
24	A[2] Tauri	6·5	†4 17 ,,	S. by E.	172	162				

† A near approach. A description of the above table will be found on p. 455 of Vol. LXVIII.

barometer readings to the mean sea-level there are many considerations which tend to complicate the question, and while the results obtained by this method commonly adopted may serve for the purposes of comparing one station with another, the barometer readings thus reduced cannot be taken as absolute values.

Tables giving these corrections for reduction to sea-level are given in many meteorological publications; but similarly to the correction for changes in the temperature of the mercurial column, it is to be feared that most people when consulting their barometer ignore the fact that they may be a considerable height above the level of the sea. Seeing, however, that a knowledge of this height is so desirable, it is well for anyone who wishes to render his meteorological operations useful to inquire for the nearest bench-mark and discover what is the approximate height of his locality. Newspapers nowadays give barometer readings for many different towns, and are often the only available source of meteorological information for isolated observers; but since these readings have probably been reduced to mean sea-level, it is important that anyone comparing their barometer with these reports should apply a similar correction. Roughly speaking, one-tenth of an inch is added for every 100ft. of altitude, so that an observer 250ft. above the sea should add ·25in. to all his barometer readings when comparing them with those taken at other localities. By managing one's barometer in accordance with the foregoing suggestions, which represent the minimum of care demanded by all barometers, it wi l be found to respond to the orderly and systematic method of treatment, and the way will be prepared for using it in larger meteorological enterprises.

ASTRONOMICAL NOTES FOR SEPTEMBER, 1899.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 59 55·00 a.m.	10 41 39	8 16 30 N	10 41 43·79
6	11 58 17·91 ,,	10 59 44	6 25 59 ,,	11 1 26·55
11	11 56 35·55 ,,	11 17 45	4 32 49 ,,	11 21 9·30
16	11 54 49·96 ,,	11 35 42	2 37 44 ,,	11 40 52·09
21	11 53 3·67 ,,	11 53 38	0 41 23 ,,	12 0 34·83
26	11 51 19·70 ,,	12 11 37	1 15 35 S	12 20 17 61

The method of finding the Sidereal Time at Local Mean Noon at any other station is described on p. 454 of Vol. LXVIII.

Exhausted apparently by the recrudescence of disturbance some time since, the Sun is now apparently quite quiescent, and the period of minimum sunspots may at last be held to have arrived.

At 6h. 29m. 37s. a.m. on September 23rd the sun is said technically to enter Libra, and Autumn is supposed to commence. This, as has been explained here, signifies the *sign* and not the constellation Libra; for, as a matter of fact, he is at that instant in Virgo, at the obtuse angle of a very obtuse-angled triangle, whereof β and η Virginis are at the extremities of the base. This is the theoretical date of the equinox, but actually in London it is not until the 25th that the Sun will be just twelve hours above the horizon and twelve hours below it.

During the latter part of the month the Zodiacal light may be looked for in the east before sunrise.

The Moon.

New Moon....	Sept. 5	......	3h. 33·1m. a.m.
First Quarter..	,, 12	......	9h. 49·3m. p.m.
Full Moon....	,, 19	......	0h. 31·4m. ,,
Last Quarter..	,, 26	......	3h. 2·7m. ,,
Apogee	,, 3	......	1h. 24·0m. a.m.
Perigee	,, 18	......	6h. 54·0m. ,,
Apogee	,, 30	......	Noon

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	Sun.
	Days.	h. m.	°	
1	26·01	9 15·8 a.m.	45·9 E.	S.
6	1·35	0 46·8 p.m.	71·3 W.	R.
11	6·35	4 43·5 ,,	8·3 W.	R.
16	11·35	9 29·4 ,,	55·2 E.	R.
21	16 35	1 4·0 a.m.	74·2 W.	S.
26	21·35	5 34·0 ,,	10·9 W.	S.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

The Moon will be in Conjunction with

——	Day of Month.	Hour.	Planet.
Mercury	3	3 p.m.	4° 8′ N.
Venus	5	2 a.m.	6 44 ,,
Mars	8	1 p.m.	4 54 ,,
Jupiter	9	7 ,,	4 51 ,,
Saturn	12	6 ,,	1 55 ,,

When our Notes begin the Moon is in Cancer. She enters—

——	Day of Month.	Hour.
		h. m.
Leo	3	1 0 a.m.
Sextans	4	2 0 ,,
Leo	5	2 0 ,,
Virgo	6	5 0 ,,
Libra	9	2 0 p.m.
Scorpio	11	8 0 a.m.
Ophiuchus	11	10 0 p.m.
Sagittarius	13	9 0 a.m.
Capricornus	15	5 0 p.m.
Aquarius	16	9 0 a.m.
Pisces	18	6 0 p.m.
Aries	21	6 0 ,,
Taurus	23	11 0 a.m.
Gemini	26	7 0 ,,
Cancer	28	1 0 p.m.
Leo	30	8 0 a.m.

Minima of the Variable Star Algol.

Day of Month.	——
	h. m.
12	2 58 a.m.
14	11 47 p.m.
17	8 36 p.m.

and on other occasions when daylight will render the phenomenon invisible.

Mercury

is a morning star throughout September, attaining his greatest elongation west of the sun (18° 2′) at 7 a.m. on the 5th. He may be caught before sunrise early in the month with an opera-glass, but scarcely now with the naked eye. His angular diameter diminishes from 8·2″ on the 1st to 4·8″ by the 3rd.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	9 34·9	13 22·4	10 53·4 a.m.
6	9 52·2	13 19·0	10 50 9 ,,
11	10 19 5	11 48·8	10 58·5 ,,
16	10 52·2	9 5·8	11 11·5 ,,
21	11 26·5	5 36·6	11 26·0 ,,
26	12 0·1	1 46·0	11 39 9 ,,

Mercury will thus travel from Leo into Virgo. On the morning of the 8th he will be a few minutes to the north of Regulus, and visible in the same low-power field of view as that star.

Venus

is a morning star too at the beginning of the month, but comes into superior conjunction with the sun at 8 a.m. on the 16th, and, of course, afterwards travels to the east of him. Her angular diameter does not vary from 9·8″ from the 1st to the 30th, and her disc is, of course, for all practical purposes, circular. As, however, she will be, in effect, behind the sun during the greater part of September, this can scarcely affect the observer.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	10 28·5	11 1·9 N.	11 46·8 a.m.
6	10 51·9	8 44 9 ,,	11 50·5 ,,
11	11 15·1	6 21·9 ,,	11 54·0 ,,
16	11 33·5	4 24·1 ,,	11 57·2 ,,
21	12 0·9	1 23·7 ,,	0 0·3 p.m.
26	12 23·6	1 8·5 S.	0 3·3 ,,

Starting thus from a point to the N.E. of the 4th mag. star ρ Leonis, Venus will cross into Virgo, and be found at the end of the month to the south and east of γ Virginis.

Mars

has left us until the beginning of 1901.

Jupiter

is too near to the sun to be fairly visible, an observation which is equally applicable to

Saturn,

who is too low down for observation when it becomes sufficiently dark. This is equally true of

Uranus;

and

Neptune,

who comes into quadrature with the sun at 5h. a.m. on the 20th, scarcely rises soon enough. Thus the night sky, as far as the planets are concerned, is a perfect blank.

Greenwich Mean Time of Southing of Nineteen of the Principal Fixed Stars on the Night of September 1st, 1899.

Star.	Magnitude.	Souths.
		h. m. s.
Vega	0·2	7 50 32·91 p.m.
β^1 Lyræ	3·4 to 4·5	8 3 20·96 ,,
ζ Aquilæ	3·1	8 17 44·09 ,,
δ Aquilæ	3·5	8 37 22·50 ,,
β Cygni........	3·1	8 43 32·57 ,,
γ Aquilæ	2·8	8 58 19·08 ,,
Altair	1·0	9 2 42·29 ,,
α^2 Capricorni....	3 8	9 29 14·23 ,,
β Capricorni....	3·4	9 32 6·96 ,,
γ Cygni	2·3	9 35 21·43 ,,
α Cygni	1·5	9 54 41·46 ,,
ζ Cygni	3·5	10 25 15·70 ,,
β Aquarii	3·1	10 42 49·56 ,,
ϵ Pegasi	2·4	10 55 46·21 ,,
α Aquarii	3·2	11 17 5·12 ,,
η Pegasi	3·1	11 54 39·18 ,,
Fomalhaut	1·3	*12 8 25·53 a.m.
Markab	2·6	*12 16 3·35 ,,
γ Piscium	3 8	*12 28 13·42 ,,

* Early morning of the 2nd.

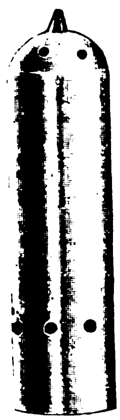
The method of finding the Greenwich Mean Time of Southing of either of the Stars in the above list on any other night in August, as also of determining the Local Instant of its transit over the Meridian of any other station, will be found on p. 456 of Vol. LXVIII.

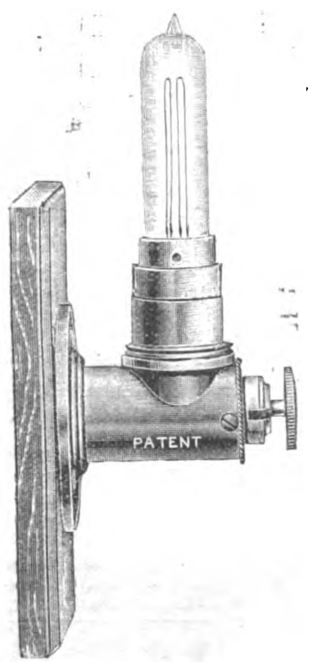
Shooting Stars

are neither very numerous nor conspicuous in September. They are predicted for the 4th, 5th, 10th, 15th, 21st, 22nd, and 27th.

SEGNITZ'S PATENT ELECTRIC LIGHT REDUCING APPARATUS.

THE apparatus shown in the accompanying illustration has been designed specially for the purpose of reducing the lighting power of incandescent electric lamps. The apparatus is





extremely simple, and is made of brass or other metal, and consists of a suitably constructed lamp-holder and switch. The lamp-holder is made to fit the usual size of bayonet-socket incandescent lamps, and for this purpose tubular lamps of various resistances are used. One wire of the light circuit which it is desired to reduce is cut away in any suitable place, and the two ends are connected to terminals inside the apparatus. By means of the switch these two terminals can be bridged at will. Thus it will readily be seen that the lamp of the apparatus can be placed in or out of series with the lighting lamp, and consequently the light reduced, or put on full at will. By using lamps of different resistances in this apparatus one or more incandescent lamps may be reduced in power to any desired degree fixed upon, and, moreover, if it is desired to change a lamp, say, of 16c.p. which was being reduced to 2c.p. for one of 32c.p., and yet reduce the light to 2c.p., it can readily be done by simply placing a different-sized lamp in the holder of the reducing apparatus. There is absolutely no danger from fire, as the greatest heat produced is never more than the hand can bear, and it is well ventilated. When the light is reduced with this apparatus, the electricity consumed is less in proportion to the amount of reduction. A metal shield, as shown in the illustration, is made to fit over the tubular lamp for protection, but may be taken off with ease if desired.

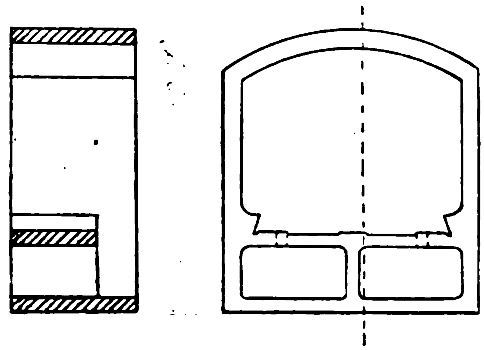


FIG. 41.

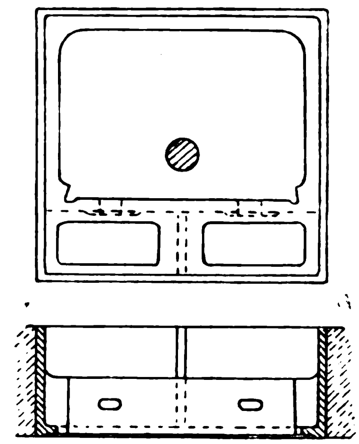


FIG. 42.

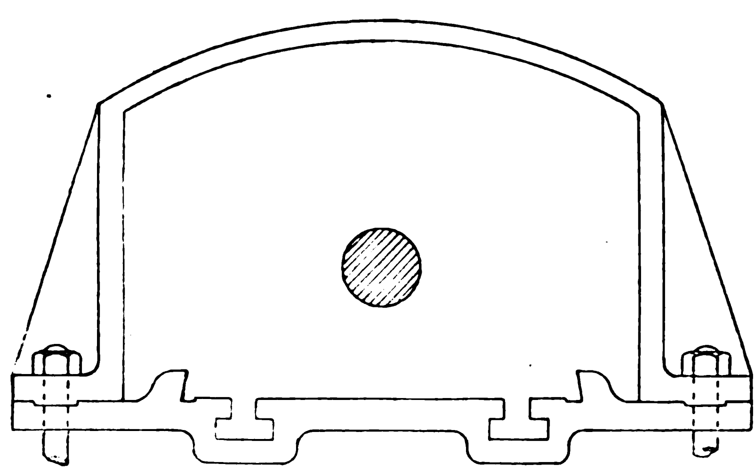


FIG. 43.

MILLWRIGHT'S WORK.—VII.

WALL-BOXES are employed in several forms, as in Figs. 41-3. They carry plummer-blocks when shafts have to be brought through from one department to another. Their outlines vary in a considerable degree. The commonest form is shown in Fig. 41, being a plain square box which is built into the wall. The widths of boxes bear some standard relation to the size of pedestal, and do not always coincide with the thickness of masonry in the wall. The width of the plate upon which the plummer-block is bolted is less than that of the outer frame of the box. It is raised above the bottom to permit of the insertion of the hold-down bolts. Usually joggles are cast at the sides, as in base-plates, to permit, in conjunction with the slot-holes, of lateral adjustment, and of wedging. If vertical adjustment is necessary, it must be done by wood packing between the block and its base-plate. The top of the frame is flat in small boxes. In large ones it is generally arched, for increased strength.

A stronger type of box is shown in Fig. 42, being stiffened with a narrow flange on one face. Such castings have to be produced at a very low price, and even the addition of a flange increases cost of moulding. If, therefore, a flange is cast, it should be reduced to a mere narrow rib or fillet.

A neat wall-box, made by Robert Poole and Son, of Baltimore, U.S.A., is shown in Fig. 43. It is made in two parts, bolted together with four bolts. Instead of casting a plate above the bottom to receive the foot of the pedestal, tee-grooves are cast, so that the bolts can be slid in from the front.

Wall-boxes take the common pedestals, or the swivelling ones of any type—those which swivel

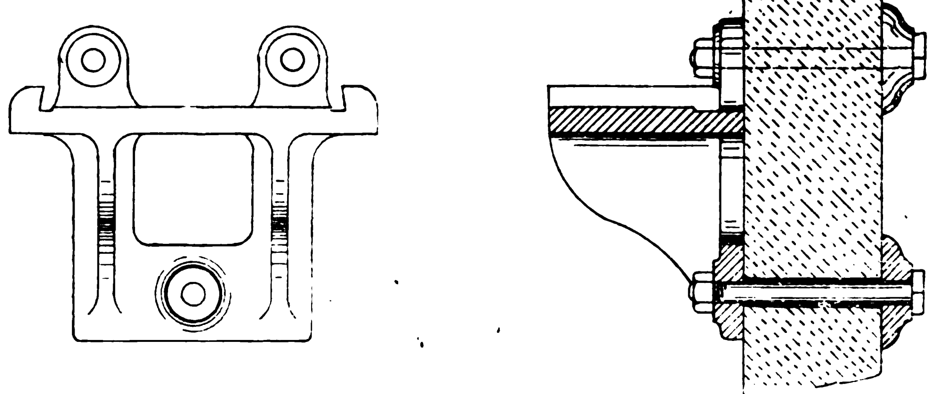


FIG. 44.

sideways only, or those which can also be adjusted in a vertical direction.

End-plates carry plummer-blocks when a shaft comes up close to a wall without passing through it, and when there is no means of attaching wall-brackets adjacent, or pillar brackets. The forms of end-plates are mostly similar to those shown in Fig. 44. The pedestal is bolted to the plate,

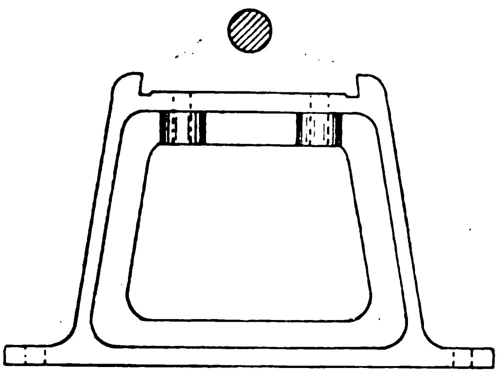


FIG. 45.

adjusted with end wedges, and the back-plate is bolted to the wall with three through-bolts and broad washers.

There are two methods of arranging line shafts —one under or on the floor, the other under the ceiling. One of the largest examples of the first, or underneath the floor, which the writer has seen is at Crewe Railway Works, in the joiners' shop, where the wood-working machinery is driven without a shaft being visible. This arrangement is a matter in which, though, opinion and practice vary; the general consensus favours overhead shafting. There are several reasons for this. In favour of underground shafting there is the absence of belts coming down from above, which cause some amount of risk, unless they are fenced in, which is an inconvenient arrangement in the case of machine tools at least. But the room which is occupied by the belts could not be utilised for any other purposes; so there is little in this point. Another, and perhaps the best reason for the

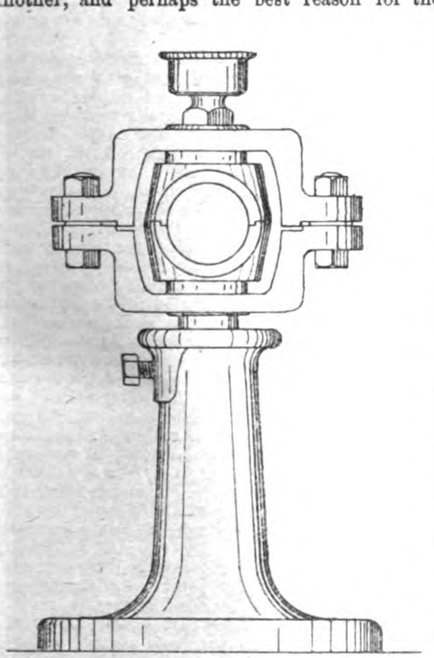


FIG. 46.

employment of underground line shafting, is that, being fixed on rigid foundations, much less care is necessary in attendance to those details of fitting which are necessary in shafting which is suspended from a roof. The shafts in a pit may be heavier, bearings more rigid, and couplings of the massive, solid type, without affecting results, excepting in so far as absorption of power is concerned—a detail too often overlooked, and upon which no check is made.

Against the underground shafting the risk of fire must be discounted. Everyone knows how accumulations of dust and grease in a factory increase risk of spontaneous combustion, and a pit affords a receptacle for accumulations of dust carried down by the belts or falling through the floor. Then the expense of brick-lined pits must be added to that of the shafting and fittings.

The conditions most favourable to the use of underground line shafting are those in which the shafts are exceptionally large and heavy, such as is required in driving a large shop of wood-working machinery, and when the joists overhead are not sufficiently rigid to support its weight. In ordinary cases, engineers give preference to the overhead method of driving.

Speaking generally, the same class of pedestals, so far as bearing arrangements are concerned, are used for floor as for top shafting; but stands are used in the first case to carry the pedestals (Fig. 45). They are bolted down to timber or stone, and the top forms a sole-plate for the plummer-block, which is packed with wood and wedged and bolted in place. For light shafting, the type of bearing, Fig. 46, of the Unbreakable Pulley Co., is more suitable. It is light, occupies little room, and the bearing is adjustable vertically by slackening the set screw and raising or lowering the bearing portion in the base, and it can swivel universally. J. H.

NOTICES OF BOOKS.

The Steam-Engine and Gas and Oil-Engines. By JOHN PERRY, D.Sc., F.R.S. London: Macmillan and Co.

ON the title-page of this work there is a sentence which is rather sarcastic, although it may not be intended; but it reads, "A book for the use of students who have time to make experiments and calculations." Surely all students have time to study their work, or where does the student come in? However, Prof. Perry has had much experience, and knows what he is talking about. He says:—"Readers have great faith. Tell them that some philosopher obtained a certain law of adiabatic expansion of steam, and they use that law, never testing it for themselves, although the test may only need half an hour's work. Tell them that there is a method used by everybody for showing the wetness of the steam in a cylinder, on the indicator diagram, and they use that method, although the exercise of a little common sense would show them that the method is based on a fallacious assumption." That gives the keynote of the work, which may be commended to the attention of all students who wish to master the subject of their study, and it applies to all branches of science. "Try it yourself," is the teaching of Prof. Perry, and his aim is to show students how they may themselves attack problems, and perchance solve them. Even if they fail, the work done will assuredly give them a better grasp of the real nature of the problems than if they had accepted the statements made in the books, and had never attempted to verify the "figures"—a term which, in this case, includes everything. When a pound of average coal is carefully burnt and all the available heat is measured, it gives out about 11,700 Fahr. heat-units (8,500 Centigrade), and that is equivalent to 12,000,000ft.-lb. A pound of kerosene gives 17,000,000ft.-lb., and a cubic foot of average coal-tar gives 530,000ft.-lb. at atmospheric pressure and 0° C. (32° Fahr.) Then, remembering also that 33,000ft.-lb. per minute equal 1H.P., we have the data for proceeding with the study of the subject. Prof. Perry says "it is very easy to measure with more or less accuracy the true pressure of steam on the piston of an engine by means of an indicator, and from this to calculate the indicated power. But the power actually given out by the engine is less than this; hence a man who sells engines is not so anxious to talk of this brake-power, the power actually given out, which might be measured by a brake or any other form of dynamometer." The volume is well supplied with illustrations, and there are many exercises (with answers); but the real purpose of the work is to inculcate the principle that to learn a subject thoroughly it is necessary to do something more than merely read books. The reader or student of this work will need to have some acquaintance with mathematical formulæ; but it will be worth his while to acquire the requisite knowledge in order to understand the author.

The Management of Small Engineering Workshops. By ARTHUR H. BARKER, B.A., B.Sc., Wh.Sc. Manchester: The Technical Publishing Co., Ltd.

IT might be supposed that in these days there can be no need for such a work as this; but those who have made a study of the subjects are well aware that much money is wasted in small workshops under the system of management adopted. It would be more correct to say—owing to the absence of any system. The smaller engineering workshops are, as a rule, badly managed. So-called "economies" are practised which turn out to be very expensive mistakes. As the author of this work says, "Good works management consists of two elements—(1) Promptly supply to the shop both the material to work on and precise and unmistakable instructions as to what is to be done with it; and (2) Seeing that the work ordered is properly and quietly done. Broadly speaking, the first is the province of the manager himself; the second, that of the foreman. It is a sign of bad management somewhere when these are not efficiently done, and where the people in the works have to do any of the first, or the manager any of the second." Enormous amounts of money may be wasted in working both worn or inaccurate tools, and no wise manager or foreman will tolerate them for a day longer than is absolutely necessary, is a truism well known; but it will bear repeating, for there are still many shops in which old tools are "made to do," sometimes with difficulty, but always with a loss of economy. There is much sound advice in this work, and the proprietors of small shops, as well as their managers, may derive much benefit from a perusal of its pages.

Ajax Loquitur. By ROBERT WEATHERBURN, M.I.M.E. London: Crosby Lockwood and Son.

THIS is a work which will have a certain amount of interest and charm for all who like to read about the history of the locomotive and its technical details. "Ajax," otherwise known as the Old No. 9, being doomed to the scrap-heap, tells the story of his construction and his life—in other words, he writes his autobiography. "Ajax" says he is the child of Invention and Experiment, and proceeds to trace briefly the history of steam-engines and locomotives; but being rather old, his memory is not always trustworthy, and he seems to have forgotten some of his ancestors. However, he says "Watts and Newcomen demonstrated the power of vaporised water, and showed the value of reciprocative action; and then another ancestor, named Catch-me-who-can, was made a raree-show of by one Trevethick, on a circular track at Bunhill-fields." That probably refers to the locomotive exhibited, by Vivian and Trevithick in a field near where Euston Station now stands. "Ajax," it appears, was "matured in Lancashire," under the direction of one of the best men of the day, who was so pleased that he labelled the engine with his own name. Having introduced himself and given an account of his family history, "Ajax" proceeds to talk about cylinders, motions, pumps, injectors, &c., and in his way conveys a great deal of information about the details of locomotives, which will certainly be found read b'e by all, and interesting to those who would like to get an idea of the progress of the locomotive. The volume is freely illustrated, and there are two excellent portraits of George Stephenson (frontispiece) and his son Robert.

Portland Cement. By D. B. BUTLER. London: E. and F. N. Spon, Ltd.

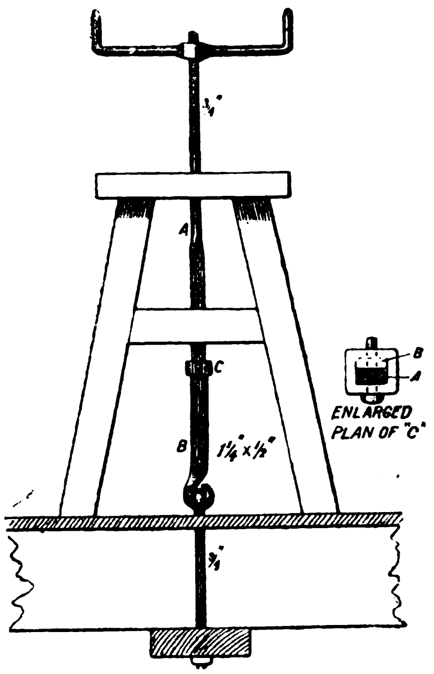
PORTLAND cement is so valuable a material in connection with the arts of construction from the builder's point of view, that any work on its manufacture is sure to meet with attention. Smeaton years ago made elaborate experiments on cements and the methods of preparing them; but it need scarcely be said that great improvements have been made since his time. The earlier experimenters in the manufacture were, as the author says, afraid of pushing the calcination too far, and therefore did not arrive at the present degree of perfection, which still leaves room for improvement. Portland cement is one of the few industries which originated in this country, but as suitable materials were found in other countries the trade soon ceased to be a monopoly, although this country still holds a leading place for quality if not for quantity. Portland cement from the chemical point of view consists mainly of lime and silica, with varying proportions of

alumina, iron oxide, and some other substances, the most important of which is probably sulphuric anhydride; but the quality of the cement depends to a very great extent on the processes employed in the manufacture. The principal raw materials used in its manufacture are the chalk and estuary muds found in great abundance in the lower reaches of the Thames, especially near the mouth of the Medway. These are dried and ground very finely and calcined; but the manufacture has of late years become almost a fine art, requiring the attention of the chemist to analyse the raw materials, and so to direct the proportions in which they should be mixed to obtain the best results. In this work full details of the manufacture are given with illustrations of the plant employed, and in the section on the "use" of Portland cement the importance of having it properly matured is dwelt upon, for the cement is really a rather "tricky" material. It must not be too new or fresh—that is fatal—and it must not be too old; it is imperatively necessary that all surfaces should be clean, and that loam or other "dirt" does not mix with the cement. Mr. Butler's work is the latest on the subject, and contains all the information available up to date. It may be that one result of its publication will be to increase the number of cement works, for there are other places than the estuary of the Thames in which so-called Portland cement can be made, if a few experiments are tried.

We have also received *The Maintenance of Solar Energy*, by An F.R.A.S. (London: The Southern Publishing Company, Ltd.), which consists of preliminary notes on the evolution and devolution of the Solar System. It is a work that will interest many, especially solar physicists, for the author says, "If the sun is heated matter, increasing in heat in the deepest portions, why, when the deeper parts are exposed to view, as in the spots, do we not find it more luminous below?" The author thinks the photosphere to be by far the hottest portion. Those who study Selenography and Areography will find something to interest them in this little volume.——*Metal-Plate Work*, by C. T. Millis, M.I.Mech.E. (London: E. and F. N. Spon, Ltd.) is the third edition, considerably enlarged, of a work which has become a standard textbook for students, and those who have to shape metal plates into useful articles.——*The Merchant's Handbook*, by W. A. Brown, M.A., LL.D. (London: Edward Stanford) is the fifth edition of a well-known work on money, weights, and measures of the nations with their British equivalents. It has been brought up to date and is a standard work of reference in connection with moneys, weights, and measures.——*A First Book in Statics and Dynamics*, by Rev. J. L. Robinson, M.A. (London: Longmans, Green, and Co.), is a textbook for those who are preparing for the matriculation of the London University, and for those who are reading for the elementary stages at South Kensington. It is well adapted for its purpose, as the examples are clearly set forth, and beginners will find much help from them.——*The Arithmetic of Electrical Measurements*, by W. R. P. Hobbs, R.N. (London: Thomas Murby), is the seventh edition of a useful work for those who wish to learn all about electrical measurements in practice. There are numerous examples worked out, and those who carefully follow will find no difficulty in fully comprehending all about electrical measurements.——*Pocket-book of Useful Formulæ and Memoranda*, by Sir Guilford L. Molesworth and Henry Bridges Molesworth (London: E. and F. N. Spon, Ltd.), is the twenty-fourth edition of a well-known and widely appreciated pocket-book for engineers and workers all the world over. The electrical portion has been thoroughly revised and brought up to date.

A STAND FOR HOLDING WHEELS TO BE FILLED.

THE following plan is contributed to the *Blacksmith and Wheelwright* by Mr. J. Vestal, Walnut Hill, Arkansas, who says:—Take a piece of iron ¾in. round, about 2ft. 10in. long. Cut threads on it 10in. on one end, and flatten the other end about 16in., and punch ⅜in. hole in it every 2in., as far as the flat part goes. Then take another piece, ½in. by 1¼in., 12in. long, turn an eye on one end of it, B, and then make a cuff, C, out of the same size iron, 1¼in. square, slip cuff over the piece A, ½in. by 1¼in. at end, and weld to one side of cuff. Then drill a ⅜in. hole through cuff piece you weld to, so as the flat part of the ¾in. round piece will slip through. Take another piece ¾in., any length wanted, turn an eye on one end, thread the other, and put this piece through the floor with eye on top of floor; then hook the flat piece with cuff on to it, then run the flat end of the round piece through the cuff, and put a ⅜in. pin through the hole in cuff. Make a tap to tighten down with on top. Have two handles to tap or nut, then build around it anything to hold up wheel, and by using the above you can fit every length hub, and only use one block to



do it. It can be adjusted underneath in one minute's time. My stand is made like that shown in the inclosed sketch.

THE PREPARATION AND MOUNTING OF WOOD SECTIONS.

I COMMENCE this paper with the full realisation that, by the side of highly specialised laboratory methods, I am writing in a very humble sphere, but I offer no apology. It is to be remembered that there is a great deal of valuable microscopical study that is not done in laboratories, and by those who have not the time or means for elaborate methods, nor is it to be forgotten that well-prepared vegetable sections hold a large place in educational work.

The first thing required for successful section-cutting is a good microtome; no matter how cheap, or by whom made, so long as it does its work well. It is not everyone that can train his nerves and muscles to cut free-hand sections of any size and uniformity of thickness. Good section-cutting means a knife of the finest steel, and the finest edge; the wake of "saw teeth" in an imperfectly sharpened knife never looks well in a wood section, and this sharpening of a knife is something that does not come of itself, it requires practice. No edge thin enough for fine sectioning will stand hard wood unsoftened, and I have found nothing quite as good for this purpose as boiling for a short time, or soaking for two or three days in a strong solution of pearline; it softens without destroying any part of the tissue.

For imbedding use hard paraffin, especially in the summer; it shrinks less, holds the object more firmly, and the edges of material imbedded are less likely to tear. If the paraffin rolls, as it most likely will, press it lightly with the ball of the finger as the knife goes through it—no danger of sectioning the finger.

Next in importance is the right thickness of the section, which should be governed entirely by the object to be attained by observation, and not by the exercise of mechanical genius in cutting as thin as possible. Hard and compact tissue, like most of the woods, requires to be cut very thin, while objects like Pteres aquilina, root or stem, with large fibro-vascular bundles, require to be cut thicker to preserve the structure complete, and the section entire. This holds true especially of longitudinal sections. After cutting a few sections, examine with the microscope and vary the thickness, if necessary, till the desired result is reached; time spent in this way is time saved. It makes a difference whether the section is to be mounted in balsam or some other medium, as will be seen hereafter.

If transparency is desired, most sections require to be bleached before staining. A good rule is to bleach till the chlorophyll disappears, or the colour from the wood is discharged, and no longer. If bleached too little, the sections will be disfigured with dark blotches; if bleached too much, the section will go to pieces, or its character will be destroyed. The bleaching fluid must be well soaked out, in repeated changes of pure water, or staining will be a failure.

The primary object of staining, single or double, is not for beauty, but for use, and yet a beautiful slide is not to be despised on that account. Slides are educators, and the education of the sense of beauty is no barrier to scientific research, and it is quite possible that in some cases it may be an inspiration. It requires but little skill to so stain a wood section as to bring out stunning colours, but that is not staining in any high sense of the word. Staining means such use of colours as to differentiate structure for accurate observation. And let me here say that there are no line-drawn rules of universal application; it is largely an empirical art, and the best results, as a rule, are wrought out by careful and intelligent experimenting, and my aim is to offer a few simple and general rules which may serve as guides in lines of work within limited means and opportunities.

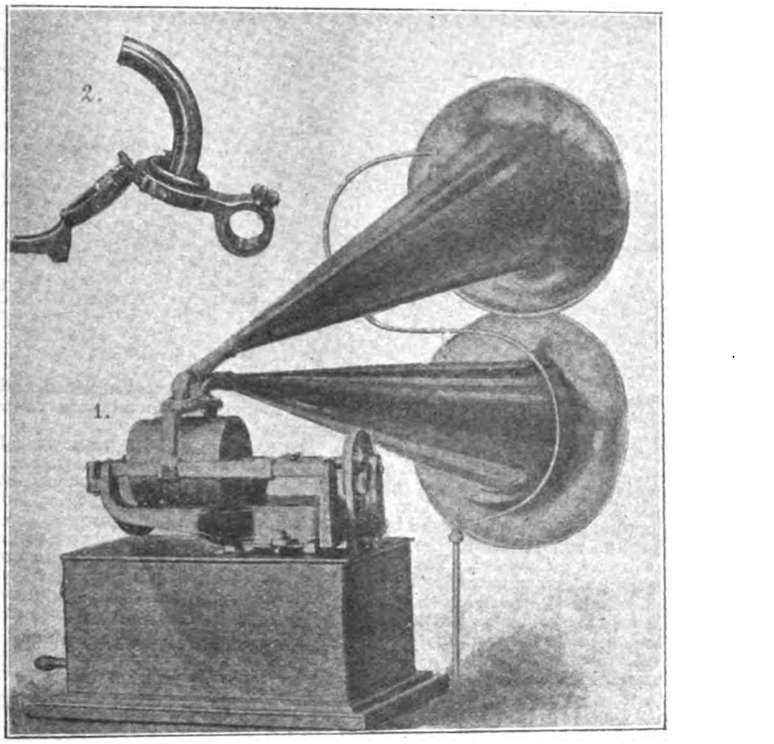
Reagents.—There is a long list of reagents in use, all of more or less value, but I mention a few only, with their use, which will be found most effective in the line of work before us; and I will preface this part of the subject by mentioning a single condition without which success is impossible, and that is cleanliness. No dish, or glass, or instrument should ever be used without cleaning the last thing before using. Water, whether distilled or not, should be filtered, and all staining fluids will bear to be watched, and filtered as often as the least impurity appears.

For staining cell walls there is nothing superior to Delafield's hæmatoxylin, but nine-tenths of the staining done with this reagent is so deep as to render the object opaque and comparatively worthless. This fluid should be diluted with the purest water obtainable till the colour is a very little deeper than that sought in the object, and allowed to stain slowly, or the section should have a very brief immersion in full-strength fluid — always rinsing in water. Hæmatoxylin has a delicate reaction, is permanent, and when properly used nothing is better for many things, if quite as good; but when unskilfully done, no staining is worse.

Bismarck brown is a very valuable, but, as far as my observation goes, a very much neglected stain. It is somewhat opaque, and therefore not adapted to compact tissue, but where lace-like structure, or large spiral or scalariform vessels are to be shown, it has no equal. In combined, compact, and loose structure, it has all the striking and brilliant effect of double-staining. Use the same methods as with hæmatoxylin.

The easiest and most effective double-staining is done with red and green, and of these colours Grenacher's borax carmine, and methyl, or anilin green, will be found most generally reliable. Borax carmine is more properly an animal stain, but it is of the highest value in botanical work, when it plays its part in double stain. It requires time, and does not colour deeply, but it is transparent, and can be made deep enough for all practical purposes if the following method is followed:—First place the section in borax carmine for twelve hours or more, as found necessary; wash rapidly, yet thoroughly, in 50 per cent. alcohol; place for two or three seconds in a saturated solution of any of the anilin greens, preferably anilin or methyl; wash as before, and return to borax carmine till the red reappears, changing the borax carmine after the superfluous green is driven out. As soon as the outlines of the colours are distinctly marked, and secondary tints disappear, rinse as before, and place for a few moments in alum cochineal; this acts as a mordant to the borax carmine without destroying its transparency. This process, like any other, is liable to failure by over-doing or under-doing some part of it, but when successfully followed the result will be all that can be desired. It may seem superfluous to call attention to the chemical relations of reagents; but in years of teaching I have found it necessary to guard this point with special care. Hæmatoxylin and alcohol must be kept separate, or you will have more mud than colour, and rinsing borax carmine with 95 per cent. alcohol will ruin everything by precipitation.

Mounting Media.—Which is the best—glycerine, glycerine jelly, or balsam? We will dispose of glycerine by counting it out entirely; it gives the poorest definition of all, and, however well sealed, cells are liable to leak from expansion of the fluid by heat. The comparative merits of balsam and glycerine jelly are best determined by experiment. Balsam has three faults which render it objectionable where the fine details of structure are to be preserved. It shrinks protoplasm, and the process of dehydrating for mounting, distorts delicate tissue, and the medium makes it worse. Its tendency is to make everything transparent, and sometimes so transparent as to be worthless. There is an acid in balsam that is an enemy to colour. The chemist that will furnish a neutral balsam will be a bene-



factor. Balsam has its merits, and is indispensable where the object is in itself opaque, or when outline definition mainly is wanted. It is easy to use, and the objection of transparency may be in part overcome by cutting the section thicker or staining deeper.

For mounting in balsam, dehydrate by passing quite rapidly through 50, 70, and 95 per cent. alcohol to absolute, and clear in oil of cloves, or in xylol, which is better, if xylol balsam—which is to be preferred—is used.

Personally, I prefer glycerine jelly to all other media for general use; it preserves structure and colour best, and gives a character of honesty to the slide. Kaiser's formula is best as far as it goes, but, to stand summer heat, more gelatin should be used than the formula calls for, and it should be carefully and faithfully filtered. It is not as easily used as balsam, but little difficulty will be experienced if the following directions are followed:—

Work in a warm room.

Heat, and keep hot while using, in a water-bath.

Mount from chemically pure glycerine and 95 per cent. alcohol, one volume of each, kept till perfectly homogeneous, and filtered.

Warm the slide, and place the jelly on it with a glass rod, kept clean.

Place the object in the jelly, being sure that it is well covered. This may require an additional drop.

Hold the object in place and drain the slide to get rid of the glycerine and alcohol.

Cover the object again with jelly, and examine carefully under the dissecting microscope for air-bubbles, especially for *stowaways*. Air-bubbles should be worked off with a dissecting needle and not picked out with the forceps.

Cover the object again, take the cover-glass between the thumb and finger, breathe on it, cover it well with jelly, take it by the edge with the forceps, turn it over quickly, place it gently on the object at an angle, and apply a clip.

If it is desirable to mount more than one object on a slide, place them in just jelly enough to cover them safely from air, and give time to harden, after which an additional layer may be added, and the cover placed as before, and held with a clip. Next pass the slide over a spirit lamp, till the entire mass of jelly is melted. If the right quantity has been used, the objects will not slide out, or if they become displaced, push them back again with a slip of pointed paper slightly moistened in the mouth. If the glycerine jelly becomes too thick by repeated heating, or from other cause, add a small quantity of filtered water.—J. D. KING, Ph. D., Cottage City, Mass., in the *Journal of Applied Microscopy*, N.Y.

THE "POLYPHONE" ATTACHMENT FOR PHONOGRAPHS.

ONE of the simplest, and at the same time one of the most ingenious, attachments for talking-machines which has yet appeared, is found in the "polyphone," a phonograph sold by the Talking-Machine Company, of 107, Madison-street, Chicago, Ill. It has long been a well-known acoustic principle that when a sound has been reflected or repeated within an exceedingly short interval of time, the original and the repetition sound in unison. The makers of stringed musical instruments apply this principle by using sounding-boards, upon the resonance of which the quality of the tone depends. In the "polyphone" a similar principle is employed.

The "polyphone" is fitted with two diaphragms and two styli, arranged one in front of the other, so that the same sound is twice produced. At first blush it might appear that one diaphragm would reproduce one word and the second another word. But when it is considered that the cylinder makes two revolutions in a single second, it is evident that the interval between the two sounds is so small that the repetition and the original practically coincide. Since the repeated sound is equal in volume to the initial sound, it follows that the "polyphone" is capable of reproducing a word with twice the loudness of the ordinary phonograph. In addition to this increased volume, the use of two diaphragms imparts to the sound that quality which, as before remarked, depends upon the application of the principle of resonance, or of repetition. The double diaphragm can be applied to any phonograph whatever, so that any ordinary talking-machine can be converted into a polyphone.—*Scientific American*.

PRODUCING STRAIGHT CASTINGS: METHODS OF STRAIGHTENING.*

TO be thoroughly equipped for handling all the crooking castings that come to a jobbing foundry requires a clear understanding of the causes by which warps are produced, and the several devices for correcting them—that is, it should be known beforehand what the crooks will be, and the proper treatment for each case. Straightening by bending the pattern in the sand in an opposite direction is one of the most simple methods, and easy to understand; but it is only applicable to a very limited number of cases, such as long, slender lathe-beds, where the pattern has only moderate stiffness to overcome.

By Stripping.—The lintel-box, Fig. 1, is a good sample of a crooking casting, and one easily treated, as it has the heavy side on top. I have handled very successfully all sizes up to 40ft. long. and weighing nearly 5 tons. Although the long sizes have lately been largely superseded by the more reliable made-up steel article, these still serve to illustrate one straightening treatment. A 12ft. lintel of this form would have a top-plate, as moulded, say 1½in. thickness, the sides ⅞in., tapered down for draught to ½in. at the bottom. Such a casting would cool very irregularly as to time. The top side, when the cope was removed, would be a bright red, while the thin edges at the bottom would be a very dull red, and the casting still straight. Such a combination, with irregular shrinkage to follow, would promise a crooked casting—that is, the top side, having the most shrinkage to occur, would become too short, and would be concave a half-inch or more, or contrary to mere shrinkage set. It presents a simple case. The metal has been distorted by shrinking irregularly under confinement, and the remedy lies in stretching the top side by stripping two or three sections near the middle, or about 5ft. of its length altogether. Cooling the top, if it cannot lift the ends, is a stretching process on the top plate. Weighting down the ends would be harmless in this case, and might be needed, as a lift of the ends would defeat the stretching of the top plate.

By Heating.—An 8in. fluted building column, 12ft. long, which, on account of the anchor blades being too thin, had sunk into the loam core, allowing the core to rise, and which promised a crooked casting, was treated thus:—The top was stripped nearly bare, and 100lb. of cold melted iron poured, a little at a time, all over the top, then all was well covered with sand. On examining it later the colour of top and bottom was found about equal, and the casting in the morning proved to be straight—a

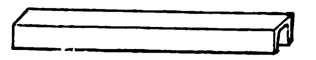


Fig. 1

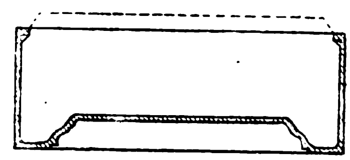


Fig. 2

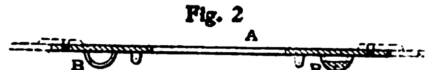


Fig. 3

more valuable quality in a column than perfect equality of metal; and this treatment reduced the permanent shrinkage strain by insuring an equal time of cooling. With a stiff cast "barrel," the core, at the exact centre, probably raised ¼in., leaving ¾in. on top and 1in. on bottom, instead of ⅞in. all round.

By Bending, while Hot, in the Sand.—There are a few cases of long, slender castings showing objectionable warp, on account of unequal cooling, where the warp can be corrected very easily, and with more certainty than by any other process, by simply bending the flask in an opposite direction from the warp. The bend should be made soon after pouring, or while the metal is still a high red, so that it will yield easily, and receive the true set without fracture. My first experiment with this device was on stationary engine-beds, the casting forming one side of a bed for 16in. and 18in. cylinders, with 4ft. stroke, and used quite extensively for driving Louisiana sugar-mills. They were of the bold-panelled ogee-moulding style, 20in. wide, 8in. deep, and 22ft. long. Fig. 2 presents a section cut through one of the four panels. They were cast with the face down, as shown, the inside being formed of green-sand cores hung in the cope, with two screws in the wrought-iron core skeleton, the pattern being solid. The dotted lines show the core-print guides for setting the cores, which were hoisted to place on the bottom of the core-box. With green-sand cores there will be considerable strain, a thickening at the bottom, which will increase the warp. These warped according to rule—that is, the ends sprung down 1¾in. Soon after pouring I set a heavy bar of iron under the bottom board, 2ft. or 3ft. from the end of the flask; then hooking on two sling hooks, hoisted the flask end until the end batten showed a lift of fully 1¾in. from its bed. Plenty of large wedges were then driven under several of the battens for a firm support. The crane was then taken off, and the other end of flask was treated in the same way. The flask in this case was of iron, but being long, and relatively slender, it bent under its weight with a very regular curve, producing a very true casting every way. These engine-bed castings, thus treated, averaged between 36 and 50 a year for a long term of years, and not costing a cent for treatment, the device proved valuable.

By Reheating.—These bed castings had formerly been straightened by the machinists who fitted them, under the direction of a very incompetent manager, by reheating with a wood fire and weighting down. They blundered in many ways, and obtained an imperfect job in every attempt. They persisted, against repeated advice, in resting the casing on one centre bearing, and in heating a very short section only, compelling a few inches of the length of it to stand an excessive amount of stretching, and almost invariably starting perceptible cracks, and kinking the top edges by excessive compression—that is, the top edge, as moulded, but the bottom when straightened. There is no excuse for committing such violence on a few inches of length when we have 22ft. to act on,

* By R. D. MOORE, in the *American Machinist*.

and worn-out flasks to slaughter. Besides, the longer the bend, the nearer the curved line is converted into a straight line.

Straightening by fire will be found to be one of the most delicate and difficult feats for the manipulator of castings. One of the most universal faults observed is the habit of piling on an excessive load of weight before heating, thus often cracking the casting before the highest heat is reached; the weight necessary is often surprisingly small. After witnessing many of those imperfect jobs, I volunteered to try one, and succeeded well in the following manner:—The bed was placed on two bearings, about 4ft. apart and 4in. high. A rough wall of firebrick or double grate-bars was made, 8in. or 10in. from the casting, to check the draught and the escape of heat, also to confine the fire closer to the casting. A strong wood fire was then applied to fully 5ft. of the middle of the casting. Gauge-blocks were set under each end to bend the casting to; but they were not final, as they should be adjusted when the bend is made. The heating may have raised or lowered the ends, and then the bend given would be out to that amount. To prevent the long ends from settling too soon, when heated, a lever was placed under each end, and a bar or plank to sustain one-third to one-half of the projecting weight until the time came to adjust the gauges and weight down. Such levers, carefully poised, will accommodate themselves to the heat bends, and not distort the casting beforehand.

I once had a very interesting experience in straightening the centre or column pieces of fire-fronts used on Western steamboats. The castings were plates about 26in. wide, 42in. long, by ⅝in. thick. Such a form has none of the crooking elements; but the manager thought it too plain, and he punted up a 4in. column pattern, not in use, and nailed the two halves on the front of the pattern, coring them with a half core, as shown in Fig. 3, which represents a section, split through a door opening at A, the dotted lines showing the adjoining overlapping plates, three plates constituting one boiler-front. The columns were only ¾in. thick, and cast on one side of a ⅞in. plate, made a combination very favourable for a crooked casting. The manager was duly warned of this tendency; but he only replied with a sneer. As one might have reasonably expected, those short plates warped ½in.—that is, they came out hollow, or concave, on the side opposite the column. They were, of course, required to be nearly straight, to match the adjoining plates. A few of the best were stretched with a hammer; but they were mainly so crooked as to require bending when red-hot. The fitters made some attempts at straightening with fire, but generally failed; they piled nearly a ton of pigs on each end before lighting the fire. After the fire had weakened the casting, it settled under its load, and, not being soft enough to properly bend, it broke, and was condemned. I finally offered to experiment, and with success, in the following manner:—After the casting was set, eight light pigs were placed on one end and three pigs on the other end. The casting was then heated up to a good red, then pigs were added until it settled to the bearings. Six light pigs on each end were found sufficient, showing that the former practice was overloading, three or four to one, and ruining good castings, mainly by that error.

Not having the time to spare for treating five or six castings for every boat we were building, I adopted another trick, which removed that trouble for the year following. I, "on the sly," fitted a board in the bottom of the column core-box, which added enough metal, out of sight, to make the shrinkage even and the casting straight. The added metal is shown at B B, Fig. 3.

PECULIAR TAP AND A FREAK COLLAR BUTTON.

THE following notes by Mr. H. J. Clegg, of Providence, Rhode Island, will interest many readers besides those who regularly study the *American Machinist*. The writer says: In the trades allied to the jewelry business occasional call is made for tools to fit altogether different conditions from the usual machine-shop practice. The main factor in this different order of things is, of course, the higher price of the materials, and scrap-saving devices are of more importance, as a general thing, than the reduction of time and labour usually sought in other shops.

The tap shown in Fig. 1 is one of these contrivances. It is intended to put a 36 thread through a 5/16in. hole. The bushings tapped with it are, when finished, ½in. long, and are the largest that we use in this class of work, most of the taps being for smaller bores, and having correspondingly greater numbers of threads to the inch. The part at *a* is thinned down to 3/32in. after being threaded in the usual manner, the diameter of the shank at *b* being somewhat less than the bottom of the thread. At *d* the teeth are given a radial face, and at *c* several teeth are brought down and backed off taper. The The shank at *b* is cut away for ½in., brazed on to

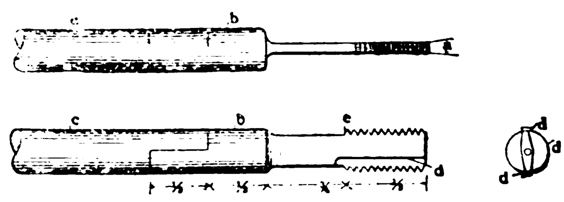


Fig. 1

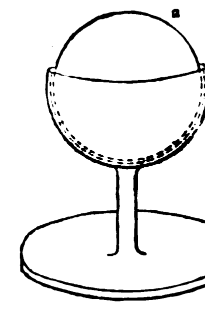


Fig. 2

the steel rod *c*, and then the tap is hardened and tempered. Although the tap is intended to cut a right-hand thread, it is backed off and relieved as if it were left-handed, or, rather, is made to cut backward, the cutting teeth being at *e* instead of at the end. The rod *c* is usually 3ft. long. The tubing to be tapped (about the same length) is slid on to *c*, which is then gripped in the chuck of a speed lathe. On starting the lathe to run backward, the tube is drawn over the tap and off the rod. The tube is held from rotating by a few turns of overlapping belt lacing passed around it, one end of the lacing fastened to a file held in the hand. The tubing is then cut up in the desired lengths by a thin slitting saw, wax being used for a lubricant.

A few taps cut with three grooves did not work anywhere near so well, would not stand the speed, and were apt to clog up with chips. I have talked the matter over with others who have had similar experience, and who pronounce this the best way of making a tap for this particular job—i.e., tapping drawn tubing in lengths.

This running a right-hand tap backwards reminds me of that (presumably) machine-shop fiction about the inventor who made a successful pump out of an unsuccessful rotary engine. It is to be hoped it is true, if only to prove how one may get the best of a very bad job. Be that as it may, an inventor came my way not long ago with a notion, and this inventor has made a unique application of a well-known mechanical device. The inventor's opinion of the thing it is unnecessary to quote. To put it mildly, he was enthusiastic; but I have not yet fully made up my mind whether the scheme will be a blessing or a curse.

Anyway, there it is in Fig. 2, a ball-bearing collar-button. The ball *a*, about 3/32in. diam., is nicely beaded, with a burnishing tool, either in press or by hand, into the belcher setting at *b*, and is free to turn loosely in any direction. I suppose an ordinary point-setting (or claw-setting used with diamond work) would do just as well if made heavy enough to retain the ball and not bind. Aside from the novelty of the thing, it is claimed that it can be pushed through the most obstinate shirt with an ease and readiness akin to the action of "greased lightning."

Have the fellows who have talked about the slippery collar-button these many years, in prose and poetry, earned their money honestly or not? It is said that all men are liars, but have not the shirt-waisted folks chimed in with the aforesaid opinions; and what shall be said of an attempt, based upon an everyday mechanical device of known character, to increase these baleful qualities of the collar-button that have caused so much annoyance?

JOINTS IN STEAM-PIPES.

THE increasing pressures which are met in modern steam plants have rendered necessary a review of the accepted proportions of pipe-flanges, valve bodies, and similar connecting elements, and an important study of the effects of pressure upon existing designs of these members has recently been made by Prof. C. Bach, and published in the *Zeitschrift des Vereines deutscher Ingenieure*.

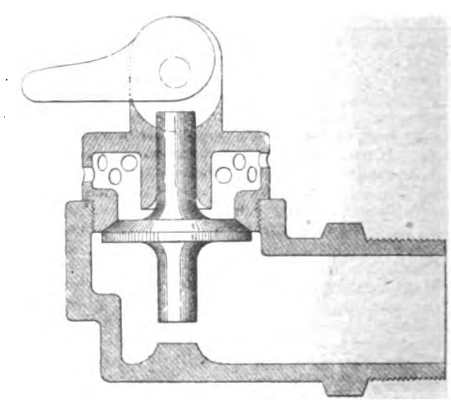
Every mechanic knows that it is one thing to make a flange-joint which shall be strong enough to resist breakage, and quite another thing to insure that it shall be tight against leakage under all the trying conditions of continuous service. Much of the trouble in connection with leakage lies in the fact that flange connections, whether on pipes or on valve bodies or fittings, are not stiff enough to resist deformation when subjected to high pressures. Realising this fact, Prof. Bach has conducted a series of experiments in which contact points were so arranged that the deformation under pressure of the various important parts could be accurately measured, and thus he obtained data as to the weakness of existing designs, so far as deformation is concerned, which no rupture tests could furnish.

By comparing these deformation tests with the actual strength and elasticity of the material, as indicated by trials in the testing-machine, the nature and magnitude of the fibre stress in various portions of the tested pieces was obtained, and thus a check upon theoretical computations of resistance was secured.

The tests were made upon wrought-iron pipes, and upon valve-bodies of cast iron, cast steel, and bronze, and the data thus obtained are tabulated in a manner which renders them available for use in connection with future designs. The whole subject of steam connections should be revised, in view of the changed conditions which modern practice has brought about, and makers of valves and fittings for such service might well conduct some such tests upon their own account, in order to be insured of the correctness of the proportions adopted by them.

STEAM-CHEST RELIEF-VALVE.

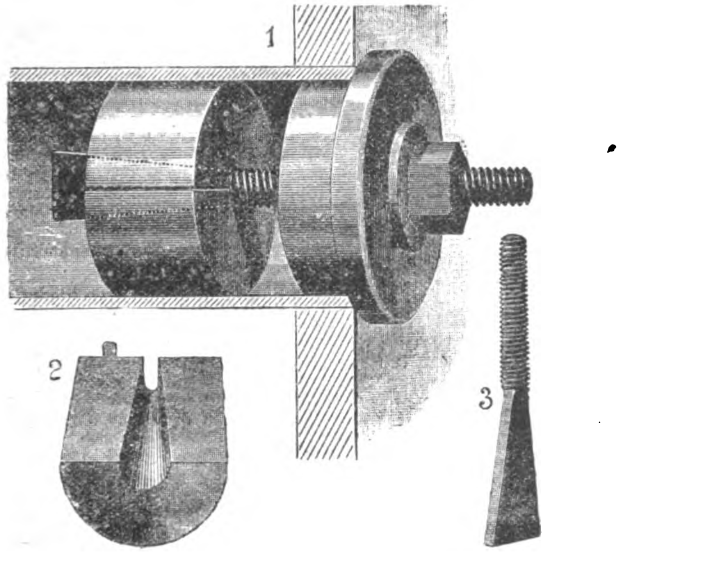
THE Norfolk and Western people make a relief-valve with a cam attachment which can be turned over when the engine is standing where they do not wish it to be moved, and the relief-valve will be held open. In case the throttle leaks, or the cylinder cocks are shut, the valve cannot work shut. This is convenient when standing on the cinder-pit, or at any place where the engine does not have



someone on or about her, as the amount of steam coming out of the relief-valve will call attention at once. The cam when turned over holds the valve off its seat in the same manner that the Sellers injector cam operates the overflow valve. The cut makes this matter plain.—*Locomotive Engineering*, N.Y.

PYROCATECHIN.

THE *Photographische Mittheilungen* again draws attention to this developer, which is closely related to hydroquinone. As it can now be manufactured chemically pure at a low price, and excellent formulæ for its use have been devised, it will probably take an important place amongst developers. It is often complained that fresh solutions of hydroquinone are prone to fog the plate. Pyrocatechin is free from this defect, and, whether fresh or several months old, yields negatives of great purity. Another advantage is that the image develops regularly and with rapidity. When the image has attained full strength, there is still some latitude, as it retains its character without risk of fog if the plate is left a little longer in the developer. This is more particularly the case with the pyrocatechin-phosphate formula (see the *British Journal of Photography*, May 6, 1898, p. 296), and the pyrocatechin-caustic soda formula as follows:—Solution 1: Sulphate of soda, 25 grammes; distilled water, 250c.c.; pyrocatechin, 5 grammes. Solution 2: Pure caustic soda, 3 grammes; water, 250c.c. For use take one part each of 1 and 2, and two to six parts of water. If the formula for combined development and fixation is used, the characteristics of the plate and the exposure must be taken into consideration. Although there is some latitude even with the com-



bined development and fixation formula, it is desirable to modify the formula for over or under-exposure. In the case of marked under-exposure it would be desirable to add more alkali to the developer, in order to obtain sufficient density.—*The British Journal of Photography.*

A RACE WITH THE SUN.

IN these days of quick travelling on land and water it is interesting to calculate some of the ways in which man could alter Nature's laws (according to the *Daily Mail*) for his own convenience by means of enormous speed. Imagine an aërial machine capable of travelling at any rate up to 1,000 miles an hour. A traveller in such a machine moving in a direction from east to west could, by making his speed equal to that of the earth's rotation, view the countries and seas of the world in perpetual daylight.

Suppose our imaginary traveller started from London at 10 a.m. at a speed of 660 miles an hour. As long as he kept that up he would be able to arrest the progress of time. To him it would always be 10 a.m. If he were travelling in the latitude of the Shetland Islands a speed of only 510 miles an hour would be necessary, whereas at the equator he would have to travel at over 1,000 miles an hour. Should he find unending day monotonous, he could reverse his direction, in which case he would have a quick succession of short days and nights of some six hours duration; but the length he could regulate by the speed of his machine.

Then suppose he started from London one night at 10 o'clock and travelled in a westerly direction at a speed of about 1,000 miles an hour. He would, as it were, overtake the earth, and would presently experience the extraordinary sensation of seeing the sun rising in the west, where it had set a short time before, and eventually setting in the east. In fact, the day would be reversed, and time, as we measure it, would be going backwards. If he stopped his machine he would have his day over again; but this time the right order of things would prevail, and the sun would travel in its wonted direction across the sky. The upsetting of another of Nature's laws might prove disastrous. Sound is known to travel with a velocity of 750 miles an hour, so that a warning whistle on board a machine travelling at anything like this rate would be utterly useless. A machine travelling at some 900 miles an hour would be rapidly overtaking its own sound, and anywhere in front the sound of its approach would be absolutely inaudible. In the event of a collision the warning whistle would be heard some time after the accident.

FLEMING'S FLUE-STOPPER.

The flue-stopper shown in the engravings annexed has been patented by Mr. J. W. Fleming, of Brooklyn, N.Y., and its construction will be readily understood, for Fig. 1 shows it in operation, Fig. 2 shows the body of the stopper in section, and Fig. 3 shows the key or expander which brings the "stopper" into action.

The stopper-body is constructed in two sections, each of which, as shown in Fig. 2, is formed with a groove, whose tapering side walls and inclined bottom wall deepen its contracted end. The channel formed by the registering grooves is adapted to receive a key (Fig. 3), having a wedge-shaped inner part and an outer, threaded, cylindrical part. Before the body-sections are brought together, the wedge portion of the key and a part of the threaded cylindrical portion are placed in the groove of one of the sections, so that the wedge can expand the sections.

When the stopper-body has been properly placed within the tube, the threaded part of the key extends through a cap having a body which enters the flue, and which is provided with a flange formed with a peripheral groove to receive the end of the flue. A lock-nut is carried by the threaded portion of the key, and has a bearing on the cap. By turning the lock-nut the stopper-body sections are expanded, and at the same time the cap is tightly forced against the inner edge of the flue.

THE RELATIONS OF PHYSICS AND ASTRONOMY TO THE DEVELOPMENT OF THE MECHANIC ARTS.*

(*Continued from p.* 34.)

VI.—Science Stimulates the Mechanical Arts.

THE demand for measurements of the highest attainable accuracy is characteristic of the study of astronomy and physics, and always keeps in excess, or, more properly, in advance, of the current state of the art of construction. Consequently, the needs of science have made many demands upon the mechanical arts, and have steadily stimulated their progress. Science and art mutually stand to each other as cause and effect. The demand has always exceeded the supply. The supply has always, eventually, responded to the demand. The patrons of physics, and especially of astronomy, have always been willing to pay for the highest art, and no instrument-maker of genius has laboured without abundant recognition. Consider the manufacture of optical glass, which has reached its highest development in such works as those of Chance and Co., Feil and Co., and the School of Glass Technology establishment at Jena (under the control of Schott and Prof. Ernest Abbe). Here are manufactured great plates of optically perfect glass, having any required characteristic as to refractive and dispersive power, or even as to elastic and electric properties. The construction of telescope lenses as perfected by van Clark, and of microscope lenses by many artists too numerous to mention, all involve mechanical processes of the rarest delicacy, and illustrate how perfectly one class of men, the mechanicians, have been able to realise the ideals conceived by another class of men—the investigators.

The mounting of the great steel tube and all the accessories of the telescope, the construction of the revolving dome and the movable floor by such firms as Warner and Swazey, all demand the best engineering, while the delicate micrometer, with its perfect measuring screw, the spectroscope, the photometer, the camera, the chronograph and the clock, the transit instrument with its perfect pivots, the vertical circle with its delicate graduations, the altazimuth instrument and the spirit-level on which everything depends, each and all call for the most delicate manipulation, the most absolute homogeneity of material freedom from internal strain, the finest work with the lathe, dividing and planing machines, and numerous other characteristics of the highest type of the mechanical arts. For two centuries past the stationary astronomical clocks and, especially of late years, the portable chronometers used by navigators at sea, by explorers on the land, by geodesists and astronomers everywhere, have been reckoned among the marvels of mechanism. Hundreds of men have directed their best thoughts to the perfecting of these timepieces, so that they shall respond to the needs of the practical astronomers. From this work has resulted the possibility of the establishment of the manufactories of high-class watches on an immense scale, so that now everyone purchases, for a few dollars, that which a century ago it was entirely impossible to obtain. We wind our watches daily, and boast of their accuracy to within a few seconds, quite forgetful of the fact that the astronomer and mechanician had to combine together to evolve this great system by which a million of timepieces of high character are annually manufactured for popular use. But, not satisfied with this, the scientist takes the most perfect specimen of all these, and uses it in pushing his astronomical studies to a still higher perfection. Astronomy is often called the parent of all the sciences, because it is said to have been the first in the order of development. But it has also been the foster-parent, because astronomers found it necessary to develop, encourage, and protect every other branch of science in order that their own might prosper. Astronomy has demanded the most perfect apparatus. The command of large funds consecrated to this work by generous patrons has enabled astronomers to stimulate active minds and nimble figures so as to secure those triumphs of accurate workmanship that are necessary to the advance of every branch of science. In this way the sextant and chronometer come to be devised for the navigator; the theodolite, the base apparatus, the pendulum apparatus, and the spirit-level were devised for the use of the geodesist; the Gaussian apparatus for the study of terrestrial magnetism; the modern balance for the use of the chemist; the self-recorder for the use of the meteorologist. When the investigator needs better apparatus, he usually invents or designs its necessary features, and then calls in the mechanism to help construct it. The former discerns the sources of error, and the latter devises methods to overcome them. Generally, the student leads the mechanician; science directs the art of the mechanic; the mind guides the hand. The popular idea of science includes both the increase and the diffusion of knowledge. To the general English reader the scientist may be either a discoverer, an investigator, or a teacher. But the teacher cannot exist without the discoverer. Since the investigator must add to the sum total of human knowledge in order that the teacher may have something to teach, therefore he must know both what has been done by others and also how to improve upon that. He, therefore, it is who is the true inventor, the one who *finds out*, and it is he who in his desire to study deeper stimulates the mechanic to produce better tools and apparatus. Thus it is that both the astronomer and the physicist and all the special students of nature take a prominent part in the development of more perfect apparatus. They must have the means to make better measurements of length, area, and volume; of time, velocity, and angle; of weight, mass, attraction, and repulsion; of electrical current and resistance, density and potential, conductivity and capacity; of temperature and heat, expansion and radiation. They must have all the apparatus especially appropriate to the study of heat and light, elasticity, gravity and electricity. The best they have to-day will not be good enough for to-morrow.

VII. — Fundamental Improvements in Machines Follow the Development of Fundamental Principles in Science.

Every important advance in the mechanic arts has been preceded by special scientific investigation and the determination of data that were fundamentally necessary to the success of that particular advancement. This seems like a very strong and, perhaps, a rash statement. I may not have made an exhaustive examination of the subject; there may be an exception to the rule; but we shall find so many illustrations of its truth that we must accept its general application in modern times, whatever may have been true in the earliest stages of the arts. At the present time, those whose tastes incline them to research pave the road for those whose tastes incline them to invention and manufacture. The heroes of invention and manufacture would still be lost in the wilderness of ignorance had not the devotees of science prepared a highway and paved it with a solid Belgian pavement of blocks of knowledge on which all may march to success. I will illustrate this by, first of all, considering the subject of the efficiency of a machine. In the construction of a tool or machine every device has for its object to secure the attainment of some specific motion or result with the greatest possible economy of force, in the least possible time, with the least possible waste of material. The original source of our power may be falling water or tidal waves, the burning of coal or the consumption of some precious metal, it may the wind or the direct energy of sunlight, or that indirect effect of gravitation represented by the electric currents that flow through the earth and atmosphere. In extreme cases, we may go back to the old-fashioned sources of power, the horse, the dog, or the man

* By Prof. Cleveland Abbe, U.S. Weather Bureau, Washington, D.C., an address delivered before the Franklin Institute.

working in a treadmill, or travelling round and round in a circle. But in every case we nowadays have to compute the ratio between the cost of the power and the value of the work that we finally get out of it. This involves essentially the question of the relation of the motor power itself to the amount of resulting work. This latter ratio we call the mechanical efficiency of the machine; the perfect machine of modern times is characterised by a large per cent. of efficiency. For instance, we use an axe to split logs of wood. A dull axe, or one whose blades are rough or wrongly inclined to each other, will waste a large percentage of our strength in friction and unnecessary resistances. After we have given it a sharp edge and a proper angle of cleavage, we still have to consider the ratio of its weight or mass to the power available in our muscles and the resisting power of the log that is to be split. With a small mass in the head of the axe, such as 3lb. to 5lb., we should in vain attempt to cut the tough wood that would yield to a heavier axe of from 5lb. to 7lb. Among our natural sources of power we reckon the wind as one of the earliest to be used, and still one of the most important. To increase and to measure the efficiency of a windmill is a problem that has taxed the genius of our best inventors and students. It is not measured by the quantity of work done per hour, but by the ratio of that to the work done by the wind in passing between the sails of the windmill. Having given up some of its momentum to the sails, the wind must still retain a large portion in order that it may move onward and make room for a fresh supply of air that is coming onward from behind. It would not be advisable to abstract from the wind more than one-half of its momentum, therefore, from this point of view, the efficiency of the windmill sail should not exceed 50 per cent.; this is the external efficiency of the mill. If we now compare the work done at one end of the machine with the energy of the revolving windmill-sails at the other end, we obtain the internal efficiency of the mill, which in properly-constructed apparatus may be as high as the factor for the best machinery of any other kind; but, in fact, the windmill is not generally constructed with great care, and Prof. Franklin B. King, of Madison, Wis., finds but a small percentage for the best windmill investigated by himself. The mechanical efficiency of a machine is now recognised as a matter of the very highest importance. Much of our manufacturing competition is based upon the relative merits and relative expenses of running our machines. The modern methods of measuring efficiency and of investigating the sources of waste emanate always from those who are fully alive to the laws of force involved in all mechanical operations. They are essentially due to the physical laboratory and the mechanical laboratory. They often involve mathematical considerations of a very abstract character. Many an engineer keeps the records of his indicator card and sums up the foot-pounds per minute in a mechanical sort of way that shows that he can have no conception of the labour given to the study of thermodynamics before this simple device could be made equally useful to the manufacturer and to the inventor. The former sees in it a record of how much his engine is wasting, the latter sees in it suggestions as to how to improve the machine. The indicator card is an application of physical laws to practical machine work that has during the past fifty years been quietly revolutionising the construction and use of the steam-engine. The injector, first made by Giffard, a French engineer, which, by the way, has received numerous important modifications by William Sellers and Co., of Philadelphia, must be allowed to be not an efficient machine from a mechanical point of view. But, from a thermal point of view, it is almost perfectly efficient, since all the heat of the steam and the feed-water goes back into the boiler; it is this that enables it to add to the efficiency of the steam-engine as a whole. The Bessemer process for making steel is a good illustration of a method that is highly efficient mechanically, thermally, chemically, and I may also say chronometrically, since the time required is reduced to a minimum, consequently also financially, and it is no wonder that we have now suddenly arrived at the age of steel as distinguished from the age of iron. The process of welding by means of the electric current is another illustration of an economy of time, fuel, and power that is truly remarkable. You will perceive that all these improvements were preceded by a long series of laborious scientific determinations of the necessary fundamental data. The pumping of water by means of reciprocating force-pumps, as distinguished from the rotary pumps, is a very ancient process, the crudeness of which, from a mechanical point of view, might have been thought to have been overcome by the rotary and centrifugal pumps. The reciprocating pump is still indispensable when great heights or resistances are to be overcome; but it is recisely also in this case that the strains upon the machinery are most dangerous to its welfare. Here come in the improvements made by your fellow-member, Mr. D'Auria, whose devices have overcome important difficulties experienced in other machines, while at the same time he attains a remarkably high percentage of mechanical efficiency. If his construction of tubes and his arrangement for the flow of water and diminution of shocks is properly analysed, it will, I think, be seen to be the outcome of a long study into the flow of water in rivers and channels. His application of theoretical hydrodynamics to the construction of pumping machinery is a fine illustration of my general principle that all the higher improvements that our present types of machines have received or are still susceptible of, in order to become more perfectly efficient, can only come from that profound study of mathematical and physical principles that belongs to the scientific and technological courses of our universities. If any further evidence were wanted, you have only to consider the other side of the case, viz., the fearful sacrifice of time and money, human thought and human life, that is represented by the thousands of useless devices that are annually patented by over-sanguine inventors. These usually proceed from men of little education or experience, who have heard, perhaps, that John Smith made a fortune out of his little invention, and vainly imagine that whatever is new and patentable is naturally of some value. It would be impossible to quote to-night all the important inventions, even by members of the Franklin Institute, that illustrate the importance of economy and efficiency as the prime characteristic of any great invention; but I will mention, still, the brilliant invention of the sand-blast by Mr. B. F. Tilghman. This simple jet of air or steam with sand does in a few minutes the work of cutting that the finest engravers might spend years in doing. It substitutes machinery for the engraver's hand; but, of course, it cannot replace the artistic imagination of the famous cutters of gems. The mechanical principles involved in this process were explained by Prof. Osborne Reynolds in the *Philosophical Magazine* for November, 1873. The first and fundamental item is a law of impact—viz., that at the instant of first contact the pressure between two bodies is independent of their size, their mass, or their velocity, but depends principally upon the density of the bodies and their hardness, so that a dense soft body may cause as much pressure as a less dense but hard body. Singularly enough, very much the same principle applies to the soaring flight of a horizontal plane surface flying through the air. If the plane were to fall vertically from rest to the ground, it would quickly set all the air below it in motion outward in all directions, and would fall more rapidly because falling with the moving air; but, when flying horizontally, it experiences at every moment the necessity of giving motion to a fresh mass of quiet air. It falls more slowly, as if experiencing a greater resistance. In this way, the air, considered as a soft body, causes an upward pressure sufficient to support a heavy body for a long time. So in the sand-blast, the first effect of the impact of the grains of quartz is to impress on the molecules of the softer glass a slight motion, which is a certain percentage of the movement of the harder particles of sand, and just sufficient to tear them away, one at a time, from the rest of the glass. You will perceive that Reynolds's law applies again to the polishing burr-wheel, to the spinning of sheet-iron and tin plates, and to the cutting of stones, metals, and glass by the edge of the rapidly-revolving wheel of soft lead or copper. Prof. Reynolds shows that, in order to produce the same effect, a sand-blast that is cutting into lead must have a velocity about eight times as great as when cutting into the glass, the ratio depending upon the relative densities of the lead and glass. The geologist has occasion to apply these principles, since the sand-blast is always at work eroding the face of the earth with the help of wind and water. I cannot refrain from quoting another modern invention that illustrates the recent application of simple physical principles to machines. I do not know the personal history of the inventor of that which we call the "Babcock Cream Separator," but he must have been a student of physics who first proposed to substitute centrifugal force for the force of gravity. As you all know, the particles of cream rise to the surface of quiet milk because of their buoyancy. Cream is specifically lighter, or has less density than water. Gravity pulls down the water harder than it pulls the milk, and therefore the water pushes the cream up by a hydrostatic pressure that it owes to the attraction of gravitation. Mr. Babcock puts his milk into a rapidly-revolving cylinder; the rotation gives rise to a centrifugal force, all particles have the same rotatory velocity, but, each particle of water being denser than a particle of cream of the same size, is pressed outward by its centrifugal force more forcibly than the particle of cream. Thus, therefore, a great centrifugal force is used in place of gentle gravity to generate a great difference in centrifugal pressure, and thus quickly force the separation of the water from the cream. In a very analogous way, the drier in a modern laundry, whirling rapidly around, separates the water from the wet cloth by centrifugal action. So, also, the whirling atmosphere of the earth drives cold air from the North Pole toward the Equator, pushing aside the warm south winds. Among the many branches of physics that are studied in the laboratory, none has more interest than the flow of metals, whether elastic or non-elastic. All that we have learned about this subject has found immediate application, first, in the improvement of the ancient process of wire-drawing, second, in the modern process of rolling rails, again, in the still more modern process of drawing the seamless tubes, and, finally, in the rolling of the immense plates for our ironclads. The steam locomotive is often said to have begun with the work of Oliver Evans, of Philadelphia, in 1772. The improvements made by George Stephenson, of England, for a while gave English engines a high position as models; but since those days Philadelphia has come to the front, and the Baldwin Locomotive Works are now sending their engines to England herself. You all know from personal experience that the modern locomotive embodies at every point the best thought of investigating physicists, and illustrates again the absolute necessity of securing for our inventors, engineers, and manufacturers the best graduates of our best techinal schools. You will not, therefore, be surprised if I emphatically urge upon your attention the general principle that the relation of astronomy and physics to the mechanic arts is not wholly an historic one, in that astronomy and physics preceded and fostered all important improvements; nor is it merely one of dependence, in that astronomy and physics look to the mechanician for the perfect apparatus. It is not merely a relation, but a relationship, and a close one. It is a twinship, in fact, a Siamesian twinship, where the blood of each flows through the other. If art is the right hand, science is the left. If one is the tool, the other is the worker. Neither advances without the other; if one steps forward to-day, the other steps forward to-morrow. Among the most important features of the development of modern mechanics has been the introduction of a class of machinery sometimes designated as machine tools, by which we mean machinery that is more or less perfectly automatic and is designed for the construction of many copies of some one part of another machine rather than for the direct manufacture of crude material as in textile work. These parts were formerly made entirely by hand; they were forged or filed, sawn and hammered, scraped and polished until they were of the proper size, shape, and smoothness. A watch, for instance, is a machine intended to keep correct time; every portion of it, from the minutest screws and pivots to the chasing on the outside of the cover, was formerly done by skilful hands, and the expenditure of time and labour was enormous, while the resulting mechanisms always presented minute differences, such that no two similar parts of two watches could be interchanged. Now, however, tools are available by which every part of the watch is made by machinery. The human hand and eye scarcely ever intervene, the similar parts are always interchangeable, and the resulting watches are, to a very great extent, perfectly comparable with each other in their performance as timekeepers. Just as a file is a simple tool in the hands of the workman, so the Waltham lathes, planing machines, engraving machines, screw-cutting apparatus, and drilling machines are complex tools—namely, machine tools—for manufacturing the parts of the watch. The history of the modern development of the mechanic arts is the history of the application of the highest science to the perfection of the machine tools. But a machine tool may be almost useless without the steady supply of power necessary to drive it. The foot-lathe is a simple machine tool, but it cannot be applied to fine work on a very large scale, such as that now required, owing to the unreliability and irregularity of the power that is used as the prime motor. The development of the modern lathe and its application to innumerable problems was necessarily dependent upon the invention of the steam-engine, the turbine-wheel, and the dynamo, all of which furnish an abundant and perfectly equable supply of power that can easily be transmitted to any desired spot. Among the important machine tools we may quote the lathe as applied to the cutting of screws and the production of all manner of symmetrical surfaces; the planing machine for flat and curved surfaces; the drilling machine for cylindrical pits; the boring machine for hollow tubes. Modifications of the lathe are seen in the vertical drilling machine and the slot-drilling machine. The machinery for making the blocks that are used in connection with tackle was one of the earliest machine tools. The trip-hammer, as modified by Nasmyth into the steam-hammer, works as if endowed with intelligence. The rivet machine replaces hundreds of labouring men, but makes it possible to set thousands at work on other lines. A very important class of tools is that for testing and measuring the dimensions and the fitting of the various parts of a machine. When once a perfect machine or tool has been made, there immediately comes a demand for perfect copies of it, and these cannot be made without accurate measuring machines and machine tools that are correspondingly accurate. The great advantage to be derived from the system of manufacture in which each part of a machine is identical in size and shape

with the similar parts of other machines was appreciated in England many years ago, and was especially insisted upon by Sir Joseph Whitworth. The perfect measuring machines that are necessary to carry out this idea have, however, been manufactured and used most freely in this country, William Sellers and Brown and Sharpe being well known in this work. The average errors of properly-made interchangeable parts of a machine will not, in the present state of the art, exceed $\frac{1}{1000}$in., and even in the largest cylinders and pistons of a steam-engine freshly turned out of a huge lathe there ought not to be an error of $\frac{1}{100}$in. or the ten-thousandth part of their own diameter. Still greater accuracy can be attained whenever needed. Some of the heaviest and, at the same time, most accurate machine tools are those built for the purpose of manufacturing heavy ordnance, armour-plate, and the machinery of the great naval vessels of the world. In the construction of these the best engineering talent and the soundest scientific knowledge are always utilised. They illustrate the best that can be done at the present time; but who can tell what another year may bring forth? We have spoken of the mechanic arts as though we have to deal only with working tools and moving machinery; but, of course, all great stationary engineering structures being themselves the products of the mechanic arts, illustrate, on the one hand, the perfection to which the arts have attained, and, on the other hand, the physical problems that must be solved in the course of this progressive development of the arts. Within our own lifetime we recall such monuments as the tubular bridges over the Menai Straits and over the St. Lawrence, the suspension bridges over the Niagara and the East Rivers, the London Crystal Palace of 1851, the Eiffel Tower at Paris, and the Ferris Wheel at Chicago. These were only possible after machinery had been devised for rolling the iron and steel, cutting and bending it, punching and bending it, punching and twisting it in all directions, and, finally, testing every portion of the structure as to its strength and expansion with stress and temperature. Even in the fine arts, our pianos, organs, and brass instruments respond to the increasing knowledge of physics and the finer arts of the modern mechanic. Only the violin remains as yet unimproved by the progress of the mechanical arts. Perhaps the modern bicycle illustrates, in a small way, that which the dynamo and electric motors do in a large way, the fact that at every turn our knowledge of physics is of vital importance to our future progress. It is about thirty years since the first French bicycles made their appearance. The idea—that is to say, the invention—was ingenious, but it was impossible to popularise this vehicle in its first crude stage. The wheels were simply those of a small ordinary waggon; the tire was iron for the sake of durability; both front and back wheels were too large, so that an unnecessary strain was brought upon the rider, which proved disastrous to many. Since those days successive changes have taken place; the iron tire is replaced by the indiarubber pneumatic tube; the heavy wheel of the wheelwright gives place to the elegant steel wheel and frame; the chain and sprocket give place to perfectly bevelled cog-wheels and rods. The fatiguing journey then indulged in as an athletic exercise now becomes the regular and easy work of an hour in discharge of one's daily duties, to say nothing of touring for pleasure, day after day, all summer long. Every step in this progress has been, and every future step in development will be, but an application of principles discovered and taught in the physical laboratories of our universities.

(To be continued.)

THE new passenger jetty at Colombo has been finished.

THE work of fitting the United States torpedo boat *Talbot* with machinery for the use of liquid fuel is in progress at the Norfolk (Va.) navy yard.

IRON mines have been started in the new Cehegin-Calasparra district, near Cartagena, and a cableway is now being built from the mines to the nearest railway station.

THE Phos Acetylene Gas Co. are exhibiting at Earl's Court Exhibition between 30 and 40 different kinds of portable lamps. This firm claims to be the only one which has devoted itself exclusively to portable acetylene lamps, and their exhibit includes table lamps, carriage, ship, and cabin lights, lamps for mining, night excavating, shaft sinking, engine fitting, &c., in every case complete with generator. They have in the larger forms of lamps overcome the difficulty in connection with frequent charging, inasmuch as the generators are now made that the lamp can be used as many as six times without recharging. The Phos Co.'s lamps are used in the milling exhibit at the Exhibition, and their practical utility will be at once apparent to all. We have ourselves found the portable table lamp both ornamental and useful, as it gives a brighter light than oil, whilst the same is so thoroughly diffused that it is easy to read even when holding a book between the light and the eye.

SCIENTIFIC NEWS.

IT appears that although Swift's comet (1899 *a*) is practically invisible, it is worth while to keep an eye on it, as it exhibits some remarkable variations in brightness.

Holmes's comet is in a good position for observation, but it is doubtful whether any good observations will be made. Its position is about R.A. 3h. 3m., N. Dec. 40° 2'.

The following paragraph appears in one of the London morning papers:—Prof. Pickering, who is known in connection with discovery of the Satellite of Saturn, is reported to be favourably impressed with the atmospheric conditions for the use of the remarkable telescope now being made at Harvard University for photographing the new planet Eros. The designed focal length is 162ft., while the aperture may exceed a foot by only an inch or two. It is intended to mount the instrument permanently in a horizontal position, and to observe or photograph the image reflected by a mirror, the earth's motion being compensated for by a clockwork arrangement. This novel instrument will be practically a horizontal photo-heliograph, giving images of the moon exceeding a foot in diameter. Perhaps this is like the Paris siderostat illustrated on p. 191, April 14, 1899.

The death is announced of Prof. James Cuming, M.D., F.R.C.P.I., who for many years had occupied a leading position in the medical profession in Ulster, and whose name was well known on both sides of the Channel. Born at Market-hill, County Armagh, in 1833, Dr. Cuming was educated at Queen's College, Belfast, obtaining the degrees of Doctor of Medicine and Master of Arts in the Queen's University, subsequently becoming a Fellow of the Royal College of Surgeons in Ireland. He also studied at Vienna. On settling in Belfast, he rapidly secured a very extensive practice, and for a considerable time past held the foremost position as a consultant. In 1865 he was appointed to the chair of Medicine in the local Queen's College, and also became a member of the medical staff of the Royal Hospital, of which he had for many years been senior physician. He was also consulting physician to the Ulster Eye, Ear, and Throat Hospital, and chairman of the governors of the Belfast and District Lunatic Asylum. A ripe scholar both in professional and general literature, he acted with great success as president of the British Medical Association during the visit to Belfast of that body in 1884, being subsequently elected a permanent vice-president.

English horticulture has sustained a great loss in the death of Mr. Thomas Francis Rivers, of Sawbridgeworth, Hertfordshire. He was the son of Mr. Thomas Rivers, the founder of the advanced system of fruit culture which during the last 50 years has placed this country far in advance of all others. He was a member of the council of the Royal Horticultural Society.

It is stated that owing to the precautions taken the death-rate from tuberculosis (Lungenschwindschuct) in the German army has fallen from 0·42 to 0·24 per thousand in 1898-99. In the Bavarian army the decrease in cases has been 2·3 and in the death-rate 0·32 per thousand. The number discharged from the German army on account of the disease during the five years ending in 1896 was 7,205, or 51·9 per thousand of those discharged for any reason whatsoever. It must be remembered that no man is admitted into the army who in the medical examination which precedes entrance is found to be suffering from the disease; apparently, therefore, it is contracted in the army. The chief predisposing cause is stated to be a "cold"; the next in importance is the strain of military duty, but this does not include the blowing of musical instruments, which comes under a separate heading. The treatment was more or less successful in 23·3 per cent. of the cases; in 1·2 per cent. a perfect cure was effected. In the remaining 76·7 per cent. the treatment failed, and death resulted in 16·1 per cent. The decrease in the number of cases in recent years is attributed largely to the discovery of the bacillus of the disease by Koch in 1882, owing to which it is easy to detect the disease and reject recruits suffering from it who would otherwise have passed the medical examination.

The number of deaths from the administration of chloroform are bringing that anæsthetic into disrepute. Mr. C. W. Krohne calls attention to the reports of two inquests recently held, and it does seem certain that if medical men cannot administer chloroform without causing death it is time that an inquiry should be held. It is asserted, and on the best authority, that chloroform can be administered safely in every case; but deaths are frequently reported, and the juries seem perfectly satisfied.

During the meeting of the British Association, the Mayor of Dover, Sir W. H. Crundall, J.P., assisted by a representative managing committee, purposes holding a three days' show of automobiles. The secretary is Mr. F. E. Beeton, Park-street, Dover, and all particulars of intended exhibits should be forwarded to him by Sept. 4. The show will be held on Sept. 19—21.

In a memoir contributed to the Paris Academy of Sciences, MM. Berthelot and Delépine state that dry silver acetylide detonates when heated in a vacuum. They also state that the temperature is sufficient to volatilise the carbon, and that the flame from the acetylide approaches a temperature of 4,000° C. If that is correct, it ought to be a very useful temperature in many of the arts; but perhaps there is some mistake.

Boiler pressures are going up steadily, and those who can remember the remarks of Watt will wonder what he would have said. Some new heavy ten-wheeled passenger engines built by the Schenectady Locomotive Works for the New York Central Railroad weigh over 73 tons. The total wheel-base is 26ft., the cylinders are 20in. diameter by 28in. stroke, the heating surface is 2,886sq.ft., and the grate area 30·32sq.ft. The boilers are designed for a pressure of 200lb.

It is stated that Chicago is about to utilise the current of sewage in its drainage canal for lighting and other purposes, and a dam is being constructed where the stream discharges into the Desplaines River. At this point there is a head of 16ft. It is estimated that the work will cost only £66,000, and that 15,000 or 16,000H.P. will be obtained with the present maximum flow of sewage. This is quite a new device in the utilisation of sewage, and possibly something might be done with the enormous volume discharged by the northern sewer of London.

A curiosity in wheat has just been brought to light at Wisbech, where Mr. Holmes of North Brink has had in his possession a sealed jar containing wheat that is sixty years old. This grain was grown upon a field in Barton-road at Wisbech, and there is no doubt about its having reached the hoary age of three-score years. Mr. Holmes has just handed over the little hoard to a firm of Boston millers, who have examined the wheat and found it in an excellent state of preservation, its condition comparing very favourably with wheat of last season's growth. It is now intended to sow a part of the grain this season, and the remainder will be re-sealed, to be kept for a longer period, the object presumably being to test the vitality of English wheat. The experiment exemplifies the marvellous keeping properties of wheat under the best conditions. But what is sixty years compared with the 3,000 years ascribed to the Egyptian mummy wheat, which has been re-sown and has shown its vitality after the lapse of ages.

The *Ermak*, which has arrived in the Tyne, has completed a cruise in Polar seas, and broken all previous records. For fourteen days continuous steaming was kept up to the north-west of Spitzbergen. Dense fields of ice were encountered for 200 miles, and were broken through without the slightest interruption, the estimated thickness being 14ft. on one occasion. The crew passed through many exciting adventures. Immense floating islands of ice were met with, and in several instances, from soundings taken, their depths proved to be seven fathoms below the surface.

In spite of the recent rain, the Thames at East Molesey and Hampton Court was on Tuesday 2ft. 3in. below summer level. The river is now lower than it has been for the past 40 years. No water has passed over the weir for some days, and in consequence of the shallowness of the river several barges are unable to get through Molesey Lock. At Tagg's Island the sides of the river have the appearance of a seaside beach, the boats of the local watermen being left stranded, while the rollers at the lock cannot be approached on account of the lowness of the water. A few months ago the floods were out, and riparian residents were inconvenienced. The Thames Conservancy needs reforming.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE PERSEIDS—HOLMES'S COMET.

[42745.]—This rich annual shower was very well observed by myself, two other members of the B.A.A., and my two brothers from the tops of the Malvern Hills during the two chief nights of its long-enduring display—viz., August 10 and 11. Between us, during the two nights, we saw in round numbers 500 meteors, by far the greater majority of which were Perseids. We were favoured with exceptionally fine weather, not a cloud being seen in the sky on either night.

During the first night our watch was on the Worcester Beacon, altitude about 1,500ft. above the sea. We did not begin our watch till 12h. 15m., and then kept on till 15h. 30m. During this time 226 meteors were seen by three observers, about 200 of which were Perseids. Only the paths of a very few of the brighter ones were registered, as the main object was to ascertain the horary average and time of greatest frequency; consequently, very few meteors were missed during the watch.

The time of greatest frequency on both nights was about 14h. Between 13h. 15m. and 13h. 45m. on the 10th, 36 meteors were seen by two observers; and between 13h. 30m. and 14h. on the 11th, 36 meteors were seen by two observers.

The time of greatest frequency was on the 11th, when meteors were falling at the rate of 92 per hour, from 13h. to 13h. 15m. During this time 23 were seen; 14 of these fell from 13h. to 13h. 5m. The brightest on either night were seen about 14h. On the 10th one was seen at 13h. 55m. equal to Venus at its brightest; and on the 11th two magnificent meteors were seen, one at 13h. 44m., twice as bright as Venus, and the other at 13h. 57m., three times as bright as Venus. These three meteors partially lit up the sky, and left trails for about half a minute. One of their paths was obtained, and was from R.A. 21h. 45m., Dec. S. 17° to R.A. 22h. 30m., Dec. S. 23°. This was the one seen at 13h. 44m.

Of 74 meteors seen on the 11th, of which the magnitudes were estimated, eight were of the 1st mag., 16 of the 2nd, 11 of the 3rd, 6 of the 4th, 9 of the 5th, and 21 of the 6th mag. Besides these, one was half as bright as Jupiter. The remaining two have been mentioned above.

The following table gives the number of meteors appearing every half-hour during the time observations were made during the two nights, for two observers:—

Date.	G.M.T.	Number of Meteors seen.	Date.	G.M.T.	Number of Meteors seen.
1899.	h. m. h. m.		1899.	h. m. h. m.	
Aug.10	12 15—12 45	26	Aug.11	11 0—11 30	15
,, 10	12 45—13 15	26	,, 11	11 30—12 0	18
,, 10	13 15—13 45	36	,, 11	12 0—12 30	27
,, 10	13 45—14 15	25	,, 11	12 30—13 0	23
,, 10	14 15—14 45	10	,, 11	13 0—13 30	23
,, 10	14 45—15 15	4	,, 11	13 30—14 0	36
			,, 11	14 0—14 30	34
			,, 11	14 30—15 0	29
			,, 11	15 0—15 30	2
			,, 11	15 30—16 0	3

Thus, in three hours on the 10th, two observers saw 127 meteors, and, in five hours on the 11th, two observers saw 210 meteors. A third observer saw on the 10th, between 13h. 35m., and 14h. 35m., 51 meteors in another part of the sky. Two observers only watched on the 11th, myself and Mr. Alfred Watson, from the North Hill, altitude about 1,400ft. above the sea. The last meteor seen on the 11th was at 15h. 55m., in bright twilight, and of the 1st magnitude. The watch on this night extended from 11h. to 16h. The shower seemed to be equally fine on both nights. As will be seen from the above table, the time of maximum was later on the second night than on the first. A glance will also show that each night the meteors gradually increased in number, and then fell off towards morning.

I should say from our observations that the maximum of the shower was about 14h. on the 11th, as meteors fell then at the rate of 70 per hour. (See table from 13h. 30m.—14h. 30m.)

A very curious meteor was seen on the 11th, at 14h. 30m. in the west, low down. It was very faint, about the 4th magnitude, with no streak, and had a very long path. It appeared to move somewhat slowly, and did not seem to go quite straight. Its duration was about 5sec.; it path was from R.A., 16h. 20m., Declination N. 32, to R.A., 14h. 0m., Declination N. 46. This was not a Perseid; it was low down on the western horizon, and came from somewhere in Hercules.

Has anyone seen Holmes's comet yet, as I should like to know what magnitude it is, and what is the smallest aperture it can be seen with? I have searched for it recently in my $2\frac{1}{8}$in. refractor, but can find no trace whatever of it.

Ivo. F. H. Carr Gregg.

Maynard Cottage, W. Malvern, Worcestershire.

THE BRITISH ASTRONOMICAL ASSOCIATION AND THE ROYAL ASTRONOMICAL SOCIETY.

[42746.]—I should like to know what is supposed to be a "bar" to the fellowship of the R.A.S. In a penny London morning paper I find a notice (it cannot be called a review) of what is known as the "eclipse volume" of the British Astronomical Association," the opening sentence of which is: "The British Astronomical Association was founded some ten years ago for the advantage of intercourse between amateur astronomers whose means or qualifications might be a bar to fellowship in the Royal Astronomical Society."

What "means or qualifications" are a bar to fellowship in the Royal Astronomical Society? I do not believe the Society recognises any such "bar." I am inclined to believe that the "critic" knows nothing of the subject, and I am confirmed in that belief by the last sentence of this precious review, in which it is stated that, "If the summary of results given in a concluding chapter of the volume show that no important addition to our knowledge of solar physics has accrued from the observations, they at least supply further material for the solution of problems."

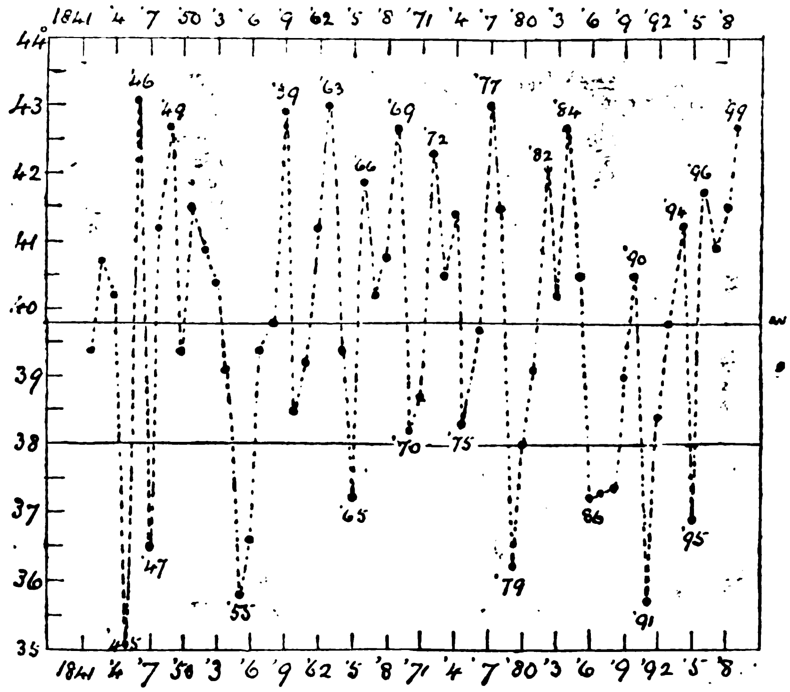
I suppose the writer has some idea of what he means; but I have an idea that it is as hazy as his grammar is rocky. In hazy weather the most experienced seaman runs a risk of running on rocky ground.

An Old Printer.

SOME FACTS ABOUT LONDON WINTERS.

[42747.]—Winters may be studied from various points of view. The item I propose to consider here is the mean temperature of the period December to March, as given in the Greenwich records since 1841. For brevity, we may designate each winter by the year in which it ends (e.g., 1842 meaning Dec. 1841 to March 1842).

The variations of winter, so considered, are given in the curve herewith; and the following may be noted as curious features of this curve.



1. Distinguishing winter above the average as *mild*, and those below as *severe*, we find these winters severe (some conspicuously so): 1845, '55, '65, '75, '86, '95 ('85 was rather mild).

2. Suppose we draw a line at 38°, and call winters under this *very severe*, we find the following have this character:—1845, '47, '55, '56, '65, '79, '86, '87, '88 ('91), '95. We may note about these eleven winters that all except one ('91) are in the later half of a decade (represented by 5 to 9). No winters ending in 0, 2, 3, or 4 have been very severe.

3. On the other hand, there are very mild winters in most years of the decades (0 and 5 being excepted).

4. We find a succession of four severe winters on two occasions—viz., 1854, '55, '56, '57; and 1886, '87, '88, '89. These cold times are, say, 32 years apart, which is about the period of Bruckner's cycle (35 years on an average). The second group is separated from two more severe winters by the moderately mild winter 1890.

5. We have just had four mild winters, 1896, '97, '98, '99. Shall we have a fifth? That seems unlikely, as there has never been, since 1841, a succession of five. There are two groups of four besides that specified—viz., '66, '67, '68, '69; and '82, '83, '84, '85. On the other hand, next year is 1900, and as no winter ending in 0 has been more severe than 38° (1880), we might be disposed to expect no extreme severity. But I do not lay stress on this.

Your readers may be interested to trace further relations in the curve. This particular curve is not so suggestive of sunspot influence as some winter curves, I think, are—those relating to the first quarter especially.

Alex. B. MacDowall.

Gadebridge, Crouch End.

"PROF. BONNEY'S STORY."

[42748.]—The quotation I made (p. 15) was from no sermon, but from one of the lessons the professor is bound to read twice every year. Formerly they were read thrice a year, but the *New Lectionary* reduces the readings to two. St. Luke xvii. 26 is read *Feb.* 13 (a Sunday this year) in the morning, and *Oct.* 14 in the evening. The other, in St. Matthew xxiv. 38, is also read *Feb.* 13 morning, and *Aug.* 15 evening: "And as were the days of Noah, so shall be the coming of the Son of Man. For as in those days, which were before the Flood, they were eating and drinking, marrying and giving in marriage, until the day that Noah entered into the Ark, and they knew not till the Flood came and took them all away; so shall be the coming of the Son of Man."

Now, if the Flood was allegorical, as Mr. May teaches (p. 40), and no physical catastrophe, what is to be said of the Saviour predicting as above? I cannot see what Prof. Bonney can call him, pretending to knowledge that he never possessed. This may be the view Mr. May has been taught to hold, but I object to paying any reverend clergyman for it.

Mr. May also (letter 42722) shows himself ready, if he discovered the Ark timbers, to use them in letter exact way I have cautioned you against in letter 42491, p. 401. Let me repeat that they should not publish their discovery, even as much as Dr. Nouri, before petitioning the Sultan for soldiers to guard the relics.

E. L. Garbett.

ELECTRO-METALLURGY.—DEEP MINING.

[42749.]—HAVING seen in last "E. M." to hand (June 30) an article on Electro-Metallurgy, I thought perhaps that the report of the July 15th meeting of the Chemical Society of this place would form an appropriate supplement; as in the president's address is a description of the most up-to-date practice on these fields.

Inclosed also is a paper read by Mr. Yates before the Association of Engineers, on "The Mines of the Future," extracts from which may interest readers of "Ours" in other mining countries.

The "Consolidated Goldfields" have now under consideration the sinking of shafts over 5,000ft. vertical depth. The "Catlin" shaft of the "Jupiter G. M. Co." is now over 3,000ft., and is still being sunk. The rise of temperature being only 1° Fahr. for every 203ft. will enable profitable mining to be carried on at unprecedented depths.

Johannesburg, S.A. R., July 31. F. B.

PRESIDENT WILLIAMS'S ADDRESS.

Some ten years ago the stamp mill was the only metallurgical operation in existence for the recovery of gold, and, with a few exceptions, these were in a crude state, free gold and amalgam being found in the tailings, while to-day I think we may say that our mills and the work done in them will compare more than favourably with any other part of the world. The chlorination process, with the necessary Frue Vanners, was started in 1889, and though it is one of the most perfect metallurgical processes that has ever been discovered, its high working costs have resulted in its being supplanted by the less perfect but more profitable process, that of hydraulic classification, and subjecting the products to varying time of leaching with cyanide of potassium solution. Here I would like to add that, while we have reason to congratulate ourselves upon the high state of perfection that has been attained in the use of this process, you must not forget that it could never have been done so had not the local ore been so particularly amenable to such treatment. When the cyanide process was first started on the Rand its sphere of operations was very limited—the use of agitating vats capable of working one ton charges with a 2 per cent. solution rendered its profitable application very small. To emphasise this, I would mention that the introducer of this process refused to grant me permission to work it upon 8dwt. tailing, giving as his reason that there was no margin of profit. To-day 1½dwt. tailings yield a fair working profit. How has this been accomplished? By the joint labour of the engineer and the chemist and metallurgist, and last, but not least,

THE COURAGE OF THE CAPITALIST,

who has not hesitated to put half a million of money to develop a mine, with the necessary surface equipment, before the first ounce of gold could be obtained. I think you will agree with me that the most essential improvements are due: (1) Working on a larger scale. (2) Direct filling, which has brought the cost of handling from 2s. 9d. down to 5d. per ton (or a saving of more than the total cost of treatment in some of our modern plants), and effected a saving of cyanide of from 3s. to 4s. per ton, permitting a longer time for treatment, as preparatory washes are not required. (3) The use of weaker solutions, and the open door of all works giving free exchange of ideas, and at the same time creating a spirit of emulation among our workers. (4) To the engineer who, in addition to perfecting the mechanical appliances, has raised the status of the cyanide workers from a drudge to an intelligent worker, by enabling him to have sufficient time to give more attention to the more essential points of the process. (5) To the invaluable work done by our chemists, who have been most indefatigable in finding out the seats of mischief, and giving us remedies for same. It is only about two years ago that the problem of slimes treatment was tackled in a practical form, a product that was considered previously as worthless and cumbersome. I am pleased to be able to say to-day that slimes treatment is an accomplished success, slimes of 2½dwt. giving a direct profit of 5s. and upwards per ton. It is with great satisfaction I am able to point out that the great discrepancy mentioned by one of our former presidents (Mr. Chas. Butler) between the gold called for and the gold obtained has now practically disappeared, and I am sure it will be a matter of pleasure to all of you to know that a fair profit is being made on slimes of less than 2dwt. in value. This, I consider, the Chemical and Metallurgical Society should be proud of, as so large a proportion of this success is due to its work. So much, gentlemen, for the past and present. It will be

A SOURCE OF SATISFACTION

to you to know that, after a careful examination of the returns of several companies, an average actual extraction of 90 per cent. and over was obtained. I have no doubt but there is still plenty to do in the margin of the 10 per cent. Some of my friends seem to think that all the work has been done, and that now all we have to do is to let well alone. That would be the greatest mistake in the world. Our watchword should be, must be, and will be: Progress, Progress, Progress. It may be generally admitted that a 60 per cent. recovery from sands, &c., is very easy, that 70 per cent. requires more skill and attention, and that after a certain point every 1 per cent. becomes more and more difficult to obtain. Have you ever thought what 1 per cent. extra extraction means? It would mean an extra profit of £200,000 per annum from these fields. As a suggestion as to how these extra 1 per cent. may be obtained, I would say, pay every possible attention to the fitting of your tanks, thereby eliminating all the slimes, and in your slimes plant—beware of sands—endeavouring at all times to keep each product in its own department. I cannot emphasise this point too strongly if you wish to make improvement. Give much more thought and time to your precipitation, as good work in this department means a decrease in the soluble gold in your residues, and a consequent lower value. At present, final water washes have to be limited, but I hope that Mr. Coldecott will shortly read a paper on a new process he is introducing, and go more fully into this branch. Due attention to the alkalinity of mill water and slimes solution will be remunerative, as good settlement in residues means less gold leaving the works. I would like to add that "cleanliness being next to godliness" applies as much to cyanide works as to anything else. We have had several very interesting papers on assaying during the past year, but I am of opinion that far too little has been said about the absolute necessity of care and competency in sampling, without which the work of the assayer is

LABOUR IN VAIN.

The same applies to mill tonnage, for unless these two factors are dependable, any comparison of recoveries between two companies is of no value. As a case in point, I may mention an instance where a company had an actual recovery of 102 per cent. of the assay value of the ore going to the mill, notwithstanding the fact that their slimes were untreated, and the cyanides residues were 1dwt. (Laughter.) I am looking forward to an interesting paper on this subject from Mr. S. H. Pearce at an early date. I am certain it will be interesting, and I hope it will be followed by others. Sampling and tonnage, gentlemen, are the foundation stones upon which our entire superstructure is built, and their importance cannot be exaggerated. I am aware of a cyanide manager who takes a true ton of 20 cft., after several estimations, who had his attention drawn to the fact that his discrepancy of 3½ per cent. between actual and theoretical extraction denoted poor work, because his next-door neighbour had a difference of only ½ per cent. The manager, perhaps, did not know that this man was taking 7½ per cent. more than his true ton. I am, however, pleased to say that this cannot last much longer, as slimes plants will soon be found necessary on all the mines, and decrepancies in tonnage will not be tolerated. The successful working of tailings plants has increased the crushing efficiency of our mills very considerably. In the past it was a case of catch all the gold you can on the plates, as the rest was lost. Of late there has been a great tendency to crush very coarsely, because you can catch more sand in the cyanide works. This I have proved to be a dangerous policy. I will only give you one instance. A new mill was started, and because their neighbours were using a 700 mesh they did likewise, with a result that their first residues ran 3dwts. and upwards. Upon examination, these tailings showed no free gold or amalgam after panning, but on regrinding the coarse particles, there was no doubt about incased gold, which, of course, cyanide solutions were powerless to deal with, owing to not coming in contact with it. A change of screen in this case brought down the value of the tailings by 2dwts., and the cyanide residues to under 1dwt. This, I think, proves the necessity of screen experiments when starting any new mill, as undoubtedly the physical conditions of the ore varies even on the Main Reef series. I need hardly remind you that all gold caught in the mill means 100 per cent. actually recovered, and not 75 to 80 per cent. only as it does if it leaves the mill in the form of tailings. With the erection of

SLIMES PLANTS

the dread of sliming has vanished, as slimes can be treated nearly as cheaply as sands, and with just as good an extraction. The duty of all connected with metallurgy, more particularly mill and cyanide managers, should therefore be to work together in the interests of their various companies. The want of this co-operation has been (as I have overwhelming evidence to prove) the loss of many thousands of pounds in the past. To the mill manager I may offer golden advice—that is, when his colleague tells him he is crushing 6½ tons per stamp against your 5 tons, show him your 92 per cent. recovery from all sources, as against his 80 per cent., and what does this mean on a dwt. rock—50 per cent. more is required to pay expenses, so the 80 per cent. means a profit of 12s. per ton, whereas your 92 per cent. shows a profit of 17s. 8d. per ton. Our motto should be: the mill and cyanide plant are the recovery works. Let us, not I (remember the organist), do all we can to get, not necessarily the maximum extraction, but rather the highest possible profit.

MR. JOHN YATES'S PAPER.

The features of the auriferous banket beds of the Rand are such that there is no reason to apprehend that their extent to the dip is very limited; on the contrary, the evidence available practically places beyond doubt that they will continue in depth far beyond a point where high temperature will render mining operations impossible. Where is this limit of work as fixed by temperature likely to be? Mr. Seymour has informed us that specially conducted experiments have discovered a rise of 1° Fahr. for every 203ft. of vertical depth. If, therefore, we assume that the average temperature at a depth of 1,000ft. is 72° Fahr., that the maximum air temperature in which men and boys can do a shift's work is 100° Fahr., and that this corresponds, say, to the rock temperature of 125° Fahr., we find that the limit of work by temperature is 12,000ft. vertical, so that unless we are favoured with a series of up-throw strike faults—a not unlikely contingency—the pegging of claims more than four miles from the outcrop will probably prove a waste of both time and money. In the headings and rises the difference between the temperature of the rock and that of the air is not likely to be so great as that mentioned, owing to the less perfect ventilation, and for these, at a depth of 12,000ft., compressed air or other means of cooling the atmosphere would be needed to create a bearable temperature. In shaft sinking, the temperature limit would also be less than 12,000ft. vertical; the imperfect ventilation and the presence of a crowd of men and boys will probably make it 7,000ft. — a limit which, of course, could be extended by supplying the sinkers with cooled air—but it is open to question whether men and boys will be easily found who will sink vertical shafts to a depth of even 7,000ft. In view of the fact that the practicability of working at a depth of 5,000ft. is not infrequently questioned, the idea of working to a vertical depth of 12,000ft. will, I am afraid, be generally regarded as too visionary to call for serious discussion. The idea of seeing miners at a depth of 12,000ft. shivering in a cold draught is at present calculated to raise a smile; but things are moving so fast, and so many impossibilities have become possibilities, that it takes a venturesome man to predict what things we are not going to see in the future, and no matter how much the probability of reaching 12,000ft. vertical may be doubted, the possibility of the thing cannot safely be ignored in the laying out of our next deeps. It is not unlikely that our third row of deep level mines will have vertical shafts of about 5,000ft. Between these shafts and the 12,000ft. vertical limit there will be 14,000ft. of reef as measured on the line of dip, assuming the latter to be 30° and the formation undisturbed. Owing to the enormous cost and the difficulties attending the sinking of very deep shafts, together with the possibility of heat limiting the maximum depth of verticals to 7,000ft., I take it that it is improbable that more than one row of shafts will be put down south of the 5,000ft. series. In order to discuss this I will now assume that it is practicable to put down a 9,000ft. vertical shaft, that the third row of deeps, with their 5,000ft. shafts, have 8,000ft. of reef measured on the dip, the reef leaving the property at 9,000ft. vertical, and that from this to the 12,000ft. vertical limit constitutes a fourth row of deeps with 6,000ft. of reef on the line of dip. Present operations have placed the prospects of 5,000ft. deeps practically beyond doubt. But it is not likely that a 9,000ft. shaft for the fourth row is going to be started without some positive evidence of the value of the ground at that depth. Calculating on the present rate of sinking in the stiffer ground of the Central Rand—rates which will undoubtedly be improved on in the future—the sinking of the verticals and inclines of the third row of deeps would take:—

	Months.
5,000ft. vertical, at 90ft. per month ……..	55·5
8,000ft. incline, at 100ft. per month ……..	80·0
Total …………………….	135·5

whilst to put down a 9,000ft. vertical shaft—assuming it is possible—on the fourth deeps, to reach the same point, would, allowing 75ft. per month, take 120 months, or practically the same time; in other words, the reef of the fourth and final row of deeps can be reached and opened up as quickly by the verticals and inclines of the 5,000ft. deeps, as by vertical shafts sunk within their own boundaries—presupposing that there is no material upthrowing of the reef by revere faults. This is favourable to working such fourth deeps through the shafts of the thirds, or, to go a step further, to having the third row of deeps work to the heat limit, opening them up in a manner comparable with the claim area, and thus have the full number of stamps allotted to this area dropping much sooner than would be

the case if the claims were divided into independent third and fourth deeps. The total length of incline working to the heat boundary through the 5,000ft. shafts would be 14,000ft., so that winding in four stages in this distance would probably suffice and constitute a satisfactory working arrangement. Doing all the hoisting through the 5,000ft. shaft would be a little more costly for power than having the 9,000ft. vertical for the lower section of the reef, inasmuch that the ore from this section would be pulled 8,000ft. along the incline instead of 4,000ft. vertical, but against this there would be the saving of wages and of maintenance due to there being one shaft instead of two. There would appear to be nothing simpler than one stage rope hoisting, and about 5,000ft. is apparently the present limit for this, so that by having shaft of this depth, with one stage hoisting, we apply the maximum of power direct, thus avoiding some of the loss connected with the transmission of power to motors underground. Before proceeding further, I would like to touch upon what we may see on these deeper levels regarding the relation of the number of shafts to the number of claims and stamps. The great expenditure, both capital and working costs, which the shafts will entail will compel us to keep their number down to the lowest possible limit. Now the number of shafts in the undisturbed ground is influenced mainly by the requirements of the law, by ventilation, hoisting capacity, underground tramming, the time taken by the men and boys to reach their working places, and capacity for development. The law permits of any property having but one shaft, provided that this is connected up with another. Let us see, therefore, whether one of these contemplated 5,000ft. shafts is adequate for working, say, 1,000 claims and supplying 400 stamps. Take the 1,000 claims to be a rectangular block extending 11,900ft. horizontally to the dip (to the heat limit), and 5,000ft. along the strike. The distance between this shaft and that of an adjoining property similarly laid out would be little less than a mile, and the longest tramming and drive would be about half a mile. The ultimate length of the incline shaft would be 14,000ft. To supply 400 stamps, each underground shift would have to number about 2,000 men and boys. Allowing 70cub.ft. of air per man per minute and an air velocity in the down-take section of the shaft of 1,500ft. per minute, I find that a bratticed shaft 38ft. by 7ft., inside timber, would serve both as downcast and upcast for the 140,000cub.ft. of air needed per minute. With large fans placed in the intake, both at the bottom of the vertical and on the stations on the incline, with an independent ventilation for each pair of levels by means of supplementary fans, and with a fan on the surface at the upcast, the maintaining through one shaft of an adequate supply of air even at the extreme southern boundary would appear quite feasible. Further, it must be remembered that the securing and maintaining of very liberal ore reserves for 400 stamps would not call for the incline shafts to be down more than 4,000ft. below a level connecting the two shafts, and that by the time the full milling stage was reached, in about three and a half years after cutting the reef, the two shafts would have sufficient levels connected—ten—to permit of a joint system of ventilation. The first level would be connected in 27 months after cutting the reef, as against the ten to twelve months of some of the present deeps, and if we can carry on a one-shaft ventilation for the latter period, what difficulty is there in the way of extending it to the former time, more especially seeing that the ventilation will be a mechanical one, and that with fans, &c., there is no very great difference between ventilating a 2,500ft. drive and one of half the length? During the 23 years out of the 26 years of its life, after cutting the reef, the property would really be a two-shaft proposition in everything but hoisting. In the matter of development, the width of the property influences the capacity of the shaft. Thus, with the lateral boundaries 2,500ft. distant from the shaft, it would take 27 months to connect, driving at the rate of 90ft. per month, and in this time the incline would be sunk 2,700ft. at the rate of 100ft. per month. Taking the levels as being 150ft. apart, the number of those unconnected would be limited to 18, and the number of development machines driving to twice this, or 36. Therefore, for the development to keep pace with the 400 stamps, it would necessitate each machine opening up only 1,700 tons per month, thus allowing an ample margin even on a 3ft. milling width. I would here point out that placing the shafts but 2,500ft. apart—like those of the present Angelo Deep—instead of 5,000ft., does not increase the ultimate average monthly development capacity of the property, which is explained by the fact that development must wait on the incline shafts. Coming now to the important matter of hoisting capacity, with the 38ft. by 7ft. shaft needed for ventilation, I find that, taking the 5,000ft. vertical section first, if this is divided into five 7ft. by 7ft. compartments — four hoisting and one pumping compartment—that with four 10-ton skips (the same size as in the Red Jacket shaft of the Calumet and Hecla Mine, as described by Mr. Seymour), and an average hoisting velocity of 2,500ft. per minute, each pair of skips would raise 1,400 tons per twelve hours, or 28,000 tons (sufficient for 400 stamps, allowing for 30 per cent. waste being sorted out) for the four compartments in the same time. By continuing this 38ft. by 7ft. shaft on the incline to the heat limit, and having four winding stages, each of 3,500ft. length, with 10-ton skips, and an average velocity of 1,800ft. per minute, the hoisting capacity of the incline would equal that of the vertical, and it would be noticed that by having the skips and velocities stated—the hoisting in both vertical and incline is really in duplicate—one pair of compartments could, if necessary, supply the 400 stamps by hoisting the whole 24 hours. From these considerations it is apparent that there is much that might be urged in favour of working everything below 5,000ft. vertical through shafts of this depth which do not need stage winding, allotting each shaft 1,000 claims and 400 stamps, thus giving the property about 23 years' milling life on the very moderate basis of a 3ft. milling width. Of course, it is likely that there will be isolated cases where circumstances will make it advisable to have the deepest vertical shafts possible, say 7,000 or 8,000ft., when, unless the present quality of ropes is improved upon, stage winding in the vertical will have to be resorted to; but even in these instances it is evident that if the heat and payable limit is going to be at 12,000ft. vertical we will be confronted with the task of sinking and working long inclines merely a degree shorter than those I have been discussing. Coming now to the capital expenditure needed by the shafts of the future, I will take the hypothetical 1,000 claims, measuring 5,000ft. on the strike by 11,900ft. to the dip, and find how the expenditure is affected by working the whole of this area through a 5,000ft. vertical and an incline, as against the working it through two vertical shafts, one 5,000ft., and the other 9,000ft. deep, with inclines. With the first system we would have—

One vertical shaft, 5,000ft. deep, 38ft. by 7ft. (inside timber), at, say, £42 per foot	£210,000
One incline shaft, 14,000ft. long, 38ft. by 7ft. (inside timber), at, say, £30 per foot	420,000
	£630,000

With the second system we have—

One vertical shaft, 5,000ft., 26ft. by 5ft. 6in. (inside timber), at, say, £20 per foot..	160,000
One incline shaft, 8,000ft. long, 26ft. by 5ft. 6in. (inside timber), at, say, £20 per foot	160,000
One vertical shaft, 9,000ft. deep, 26ft. by 5ft. 6in. (inside timber), at, say, £32 per foot	288,000
One incline shaft, 6,000ft. long, 26ft. by 5ft. 6in. (inside timber), at, say, £23 per foot	138,000
	£716,000

The magnitude of the figures is such as to arrest attention, but dividing the sum by the number of claims gives only £700 per claim, which compares favourably with the £600 of some of the properties at present working. The enormous sums, however, which will have to be spent on the mines of the future to bring them to their full milling stage—sums of £800,000 to twice that amount—afford food for thought, and incline one to ask whether it would not be advisable to keep a few capitalists on hand. If, now, I take a case where the 1,000 claims, measuring 5,000ft. by 12,000ft., are given two shafts instead of one—each consisting of 5,000ft. vertical and a 14,000ft. incline—I get—

2—5,000 verticals, 26ft. by 5ft. 6in. (inside timber), at, say, £26 per foot..........	£260,000
2—14,000ft. inclines, 26ft. by 5ft. 6in. (inside timber), at, say, £22 per foot ..	616,000
	£876,000

The capital expenditure being thus increased £246,000, or £246 per claim, a figure which would be considerably augmented by the more expensive power installation needed by the two shafts as compared with one. Further, the extra shaft would increase working costs by about 3d. per ton milled for wages alone; to this would be added extra coal, stores, and shaft maintenance. The certainty that the working of the 5,000ft. deeps will result in improved mining methods and appliances being discovered, is of itself a plea for the postponement, for a time, of work on deeper zones, and indirectly favours everything below 5,000ft. being worked through the 5,000ft. verticals. Whether the saving effected by giving the block of 1,000 claims mentioned one shaft only, and one mill of 400 stamps, is dearly purchased at the cost of the concentration of hoisting, longer headings, levels and shafts to ventilate, the longer underground tramming, and the risk of trouble arising from disturbed ground and complicated workings, is a matter on which there may be a difference of opinion; but as this saving amounts, in the case of substituting two shafts, to over £700,000, and in the case of substituting over four shafts (two of them lower deeps) to over £2,000,000 for capital expenditure and working costs connected with the sinking, equipping, and working of the shafts—exclusive of interest—during the life of the mine, it is not a point for hasty decision. In these cases it is assumed that the 1,000 claims are given one mill of 400 stamps. If, instead of this, two independent ones of 200 stamps each are erected, the capital expenditure per claim and the working costs will be still further increased. But if the magnitude of the interests at stake calls for an excess of caution in the laying out of the work, even at the expense of increased capital charges and working costs, then would not three 5,000ft. shafts—one central one of 400 stamp capacity, and two side ones, each of 200 stamp capacity—placed about 3,300ft. apart along the strike, quite suffice for two such properties as are mentioned (each with 400 stamps and 1,000 claims) and fully meet the case? The following table, showing the effect the disposition of the shafts will have on this ventilation, is of much interest:—

Ventilation.

(A) Size of property: number of claims.
(B) Number of shafts on property, all verticals being near the north boundary.
(C) Distance between shafts.
(D) Number of stamps.
(E) Number of levels being stopped and used as air connections.
(F) Velocity of air current in shaft per minute.
(G) Velocity of air current in levels per minute.
(H) Depth of the vertical section of the shaft.
(I) Total length of incline shaft. Dip 30°.
(J) Maximum number of stoping breasts which the air comes in contact with, before reaching the upcast shaft.
(K) Time required for the air current to travel the total length of downcast shaft—both vertical and incline.
(L) Time required for the air current to travel the levels.
(M) Total time.

	(A)	(B)	(C)	(D)	(E)
A	5,000ft. strike, 11,900ft. to dip, 1,000 claims.	5,000ft. strike, 11,900ft. to dip, 1,000 claims.	5,000ft. strike, 11,900ft. to dip, 1,000 claims.	2,500ft. strike each, 5,950ft. dip each, 250 claims each.	
B	1	1½	2	1	1
C	5,000ft.	3,333ft.	2,500ft.	2,500ft.	2,500ft.
D	400	600	400	200	200
E	15	15	15	15	15
F	1,500ft.	1,500ft.	1,500ft.	1,500ft.	1,500ft.
G	1,000ft.	500ft.	500ft.	500ft.	500ft.
H	5,000ft.	5,000ft.	5,000ft.	5,000ft.	8,500ft.
I	14,000ft.	14,000ft.	14,000ft.	7,000ft.	7,000ft.
J	48	24	24	24	24
K	12 2/3 min.	12 2/3 min.	12 2/3 min.	8 min.	10 min.
L	10 min.	10 min.	10 min.	10 min.	10 min.
M	22 2/3 min.	22 2/3 min.	22 2/3 min.	18 min.	20 min.

Note.—In cases A, D, and E, each property is assumed to have a joint system of ventilation with an adjoining property, on its east or west boundary, laid out on similar lines. In case B one shaft is common to two properties.

COAL CONSUMPTION IN MEN-OF-WAR.

[42750.]—The consumption of coal in the vessels which are supposed to form our first "line of defence" is attracting a good deal of attention, for though the actual consumption is not a serious matter in the ships that patrol, so to speak, the coasts, it becomes a serious matter in the case of vessels which have to traverse long distances, and may find themselves short of fuel when a long way from a coaling-station. The subject is one that the advocates of oil-fuel should take up, and, if possible, induce the Admiralty to make further experiments. The following remarks quoted from the *Engineer* may give some idea of the absence (or, rather, want) of knowledge on the subject:—

A striking inconsistency is easily found between the statements contained in the letters written by special correspondents of our daily contemporaries on board warships during the manœuvres, now happily ended, and the official reports of trial-trip results which are somewhat irregularly placed before the public. To judge from the first, our ships of war are "coal-eaters." Their furnaces are insatiable. A thousand tons of coal are burned almost as soon as they are put on board. Bunkers are only replenished to be emptied. According to the last, on the other hand, our ships of war are

eminently economical. The coal burned per horse per hour falls far below 2lb. Indeed, 1·8lb. seems to be a by no means exceptional though truly excellent result. Can the two statements be reconciled? We doubt it. We can only persuade ourselves that the truth lies half-way. The economy obtained on a trial trip is not likely to be secured in regular work at sea; we need not stop to explain why. On the other hand, the newspaper special correspondent does not seem to realise how enormous is the work done. We do not blame him. Anyone who has seen coal train after coal train run alongside a big liner, and the contents of the multitudinous trucks transferred to her bunkers, may well fall into the error that she is uneconomical, and so the landsman may easily be misled about our warships. Let us suppose that her Majesty's first-class battleship *Spitfire* works up to 10,000I.H.P., and that her engines require 2lb. per indicated horse-power per hour to keep them going. This means 20,000lb. per hour; or for 24 hours nearly 215 tons. If we add to this some 30 tons for electric lighting, condensing, and auxiliaries, we have 245 tons per day as a respectable total. This is a very large quantity of coal, and involves no more than four days' full steaming for not a few of our big warships. Anyone not familiar with the facts, if he finds that a ship which has emptied a considerable collier three days before, already begins to look out for a port where she can refill her bunkers, may not unnaturally say she is a "coal-eater."

Economy of coal on board warships is no doubt of very great importance, and we fear that the Admiralty statements about it are likely to be innocently misleading. After all, it is not a question of so many fractions of a pound of coal per horse per hour. That is only a means to an end. What is wanted is the end. For how many hours can a warship run at 12 knots, or 14 knots, or 16 knots, without refilling her bunkers? The manœuvres ought to tell us this. If they taught nothing else they would be worth the money, for it must be understood that the answer to the question involves sundry large issues. We have not only the engines and boilers to consider, but the propellers, and, indeed, the whole complicated locomotive machine called a battleship or a cruiser, as the case may be. Of course, it may be admitted that steam-engine and boiler economy is of the first importance, but, after all, they are only a part of the whole; and it is not news that the most economical machinery does not always give us the most economical ship—that is, if economy is stated in terms of $\frac{\text{knots} \times \text{speed}}{\text{coal}}$. Possibly this statement may be confirmed or refuted by the results of the manœuvres. Let us hope that they will not only be published, but published soon, while the interest is fresh and vivid. No doubt the facts will be made public abroad. Why not at home?

Commodore Melville's contribution to the *Proceedings* of the Institute of Naval Architects bears strongly on the matters we are discussing. It may, perhaps be well to explain that, notwithstanding his title which denotes executive rank, he is chief of the Bureau of Steam Engineering of the United States, holding a position akin to that of Sir John Durston in our own Navy. This, of course, imparts all the value extended practical knowledge and almost unlimited opportunities for acquiring information can convey. Commodore Melville argues in favour of three engines and three separate propellers. English engineers will hold that the additional expense and complication involved are so great as compared with twin screws, that very powerful arguments must be advanced and driven home before the triple screw can become in the least acceptable. Commodore Melville gives accordingly certain curves which promise considerable things, and he goes on to say that he does not base his advocacy on these alone. He writes:—"It appears to me that these curves, drawn as they are to give the fullest advantage to the system of twin-screw propulsion, develop fully the superior efficiency of the triple-screw system for full-power trials; or, indeed, wherever all engines are in use. However, as Sir William White says, the matter of the propulsive efficiency of the propellers is but one of the desiderata to be sought in the design of a naval vessel. I submit, however, that the superior propulsive efficiency of triple screws is an element of considerable advantage in their favour, although it must by no means be considered the deciding one. The deciding point in this matter seems to me to be the fact that naval vessels do at least 90 per cent. of their cruising at speeds below 16 knots. In vessels of the fast type, now so universally prevalent, the condensation in the low-pressure cylinders is enormous when the ships are making these low speeds."

It may be said that we are discussing not the cruising performance of our warships, but their full-power work. This is not so. The newspaper correspondents write about ships not going more than half or three-quarter speed, and Commodore Melville takes us back to the old question: How shall we get fairly economical results out of machinery much too big for its work? Two methods have been proposed. One is to use six cylinders for twin screws, and when cruising to disconnect the forward three cylinders altogether, and drive with the three after cylinders only. The other is to cut off the low-pressure cylinders altogether, and use the other two "compound." Commodore Melville advocates the use of three engines and three screws. Whether the power required is full, two-thirds, or one-third, the result, as far as each set of triple-expansion engines is concerned, will be the same. It can be worked to the best advantage. We have the drag of one or two screws to consider, but on this point he has had something reassuring to tell his hearers:—"The trials of the *Kaiserin Augusta*, which were conducted with great thoroughness, measured accurately the drag of the screw, and also the resistance of the rudder, the latter being at a speed of 14·1 knots, considerably more than twice as great as the drag of two idle screws when one of the wing engines was used alone."

All reasoning, however, is apt to be specious when the reasoner strongly favours some particular scheme, and we are, from the perusal of Commodore Melville's arguments, not converted to the triple-screw scheme. We are very far from being certain that the advantages claimed will compensate for its disadvantages. Indeed, if the triple screw is to be used at all, it seems that it would be necessary to make the two wing screws feathering, which might perhaps be less objectionable than any clutch device. We lack information, however, on one point. There is some way of working an engine at less than full power, which is more economical than any other way. Has this been ascertained? What is it? and is the method used in our Navy? The great cause of expensive cylinder condensation has hitherto been supposed to consist in over-expansion. Too early a cut-off takes place; and there is next to no steam in the low-pressure cylinder. In this theory there are gaps, to one of which at least we may refer in a moment. Meanwhile we may suggest that one way out of the difficulty lies in letting down the initial pressure by throttling, and keeping the cut-off constant. But the gap in the theory to which we have referred is that there is no obvious reason why the presence of little or no steam in the low-pressure cylinder should cause waste of steam in the other cylinders. If the third cylinder does no good, it does no harm, and may be regarded at the worst as an extension of the waste pipe to the condenser.

But Commodore Melville puts the whole case in a new light. He tells us that direct experiment has shown that cylinder condensation is a constant quantity, bearing no relation other than one which is accidental to the weight of steam passing through the cylinders; and he puts it as 1lb. of water per hour per horse calculated on the maximum power of the engine. Now let us take the case of a set of engines indicating 10,000H.P. at full speed, and using, say, 18lb. of steam per horse per hour. Of this 1lb. is condensed to waste in the cylinders, or 10,000lb. per hour—that is to say, one-eighteenth of the steam is wasted. If now we run at 5,000H.P., the loss by condensation being still 10,000lb., we waste one-ninth of the steam, and at 1,000H.P. the waste rises to ten-eighteenths, or 55 per cent. of all the steam entering the cylinder. Possibly Commodore Melville will not push the proposition quite so far as this; but at all events we have the definite statement that condensation does not depend for its amount on the quantity of steam passing through the cylinders. If this is true, then the case for the big engines becomes worse, and a very important point comes up for consideration—namely, What is the most economical piston speed?—because the speed for a given power settles the surfaces in the cylinders to be heated and cooled. One more point deserves passing mention. The Admiralty have decided on raising the pressure in warships to 300lb. on the square inch, and to go yet higher if it conduces to economy. But is not this a mistake? It is not when working full power that our ships burn too much coal. It is when they are cruising. Yet it is just at such times that high pressures and great ranges of expansion become very objectionable. How are the two conditions to be reconciled?

Here we must leave a most interesting subject. We have said, we think, enough to show that the special correspondents with the fleets, and the chief engineer of the United States Navy, have given us something to think about.

There does not seem any reason why 300lb. or higher pressures still, should not be used if economy can be gained that way; but the question arises, Are these very high pressures so very economical, taking all things into consideration? **E. R. A.**

THE BICYCLE RECORD AND TRAIN RESISTANCE.

[42751.]—The interesting account of the bicycle test ride behind a train, which you published on p. 548, No. for August 4, has called forth many comments, and some of them may be instructive reading. Thus in the *Locomotive Engineering*, N.Y., which is edited by Mr. Angus Sinclair, a gentleman who knows all there is worth knowing about locomotives, I find the following remarks which have special reference to the resistance of locomotives and the wind:—Bicycle Murphy rode a mile behind a Long Island Railway locomotive in 57 seconds. The track on which the bicycle ran was smoothly planked between the rails, and the end of the car was flanged outward at the sides, upward at the top, and downward at the bottom to within a few inches of the rails, to shield the rider from atmospheric pressure in front.

Nearly every person has observed the partial vacuum formed at the rear of a fast-running train, and its ability to pick up and carry with it for a short distance, scraps of paper, leaves, and even pebbles in its vortex. It was the purpose of this flanged end to increase the partial vacuum ordinarily made, and thereby draw the rider along. Thus it will be seen that as long as the rider kept in the vortex—where there was practically an absence of pressure in front, and atmospheric pressure behind him—he would be pulled along with little or no expenditure of muscular energy. The rider's task, therefore, was not to propel his machine as fast as the train ran, but was to keep in the vortex and move his feet sufficiently fast to prevent them from impeding the revolution of the pedals. As an athletic achievement, therefore, Mr. Murphy's performance is absolutely valueless, and becomes instead a feat of reckless, foolhardy daring, akin to bridge-jumping, should be classed with it as a misdemeanour, and likewise be made punishable.

Had Mr. Murphy, for any reason, failed to keep in the vortex, and been obliged to drop back further behind the train, he would probably have encountered the whirling, eddying currents rushing in to fill up the partial vacuum, and been caused to wobble out of his course and over the rails, which would mean certain death at that speed. This was probably anticipated by the promoters of the event, who stood on the platform and quickly hauled Murphy aboard the train the moment the finish line was crossed.

Murphy's ride has been given undue importance by some of the newspapers, one of which says:

"There is no doubt that in the construction of fast engines of transportation hereafter the problem of minimising atmospheric resistance by sharp-pointed steel prows in front, or otherwise, will be considered as carefully as is now considered the question of minimising the resistance of water in constructing the hull of a racing ship."

Although prettily expressed, the quotation shows a lack of knowledge of railway conditions. It assumes that head atmospheric resistance is the obstructing factor to high train speeds, and asserts that such hindrance is as serious a retardation to locomotives as water is to a ship. Confessedly, it is much easier to drive a locomotive through the atmosphere than a ship through water; hence, there is not the same necessity for a pointed front to a locomotive as there is for a sharp prow to a ship.

The Paris, Lyons, and Mediterranean Railway of France made very exhaustive trials of pointed prows for the front end of their express locomotives, and great advantages were anticipated in the reduction of head atmospheric resistance; but in practice it was demonstrated that there was no perceptible difference in the air-resistance offered by a pointed cone and a flat smokebox front.

Were the head atmospheric resistance minimised, there remains the wheel flange-against-the-rail resistance, which, when a side or quartering wind blows, becomes a far greater retarding factor than a head atmospheric resistance can possibly be. This is proved by the experience of our prairie railroads; and, conversely, the flange friction on curves is taken advantage of by the calculating engineer to assist in retarding the train with his air-brakes when descending mountain grades.

If our lay newspaper friends themselves believe and know no more than that which they write on this subject, they would profit by looking more closely into modern railway operation; for therein will be found a number of greater and more serious drawbacks to very high speeds, which will have to be combated before we finally revert to head atmospheric resistance, and seek to remove it by designing sky-rocket-shaped locomotives.

L. J. S.

TELESCOPES, &c. — REDUCING INTENSITY OF LIGHT. — α LYRÆ. — β ORIONIS.—THE PERSEIDS.—PHARAOH AND HIS FELLAHEEN.—A FLY PROBLEM AND ANOTHER.

[42752.]—May I add a few further remarks to my reply to "Pauper et Exul" (42662). I should not certainly join in an indiscriminate outcry against "dealers." There is one firm, at least, of those who advertise in the "E. M." from whom I have experienced the utmost courtesy and every assistance in providing myself with the best telescope that my small means could afford. If "Pauper et Exul," or anyone else in his position, likes to send me his address I will tell him which

firm it was. The telescope was old-fashioned, and very cheap indeed; but the object-glass was good and sound, and with a little (very little) extra expenditure of money on one or two additional eyepieces, and a bit of ingenuity in adapting other arrangements—e.g., the turning the altazimuth mount into an equatorial, I find myself in possession of a most efficient tool. Of course, *as I received it*, except for a pretty good object-glass, the instrument had not much to recommend it to one who could afford a better one. There was only one eyepiece—an old Kellner, power 40. But I had two others which, when fitted to the tube with a sliding adapter, gave powers of 150 and 250 respectively, and I got one of 86 made by a Newcastle optician, besides which I so modified the eye-end of the instrument that, when required, the eyepiece of finder would slide in, giving power 28, with extra large field (about 1° 15'). Thus I have an almost ideal set of eyepieces for a 4in.—i.e., 28, 40, 86, 150, 250. It is a very bad plan to leave selection of eyepieces in the hands of the dealer. A much better plan would be to buy the telescope without any, and get them made by some good optician to order. In ordering an eyepiece, too, I never ask for such and such a power, but either specify required equivalent focus, or foci of eye and field-lenses of each eyepiece. Thus I am sure of getting pretty nearly the power I want, and by measuring focus of field-lens it is easy to check the accuracy with which your order has been carried out. As formerly pointed out by Mr. T. K Mellor in the "E M.," half-focus of field-lens is the equivalent focus of eyepiece, if an ordinary Huyghenian. Consequently, ratio of focal length of object-glass to this half-focus of field-lens is equal power of eyepiece.

I thank Messrs. R. J. Ryle and S. B. Gaythorpe and "U." for their replies, *re* Reducing Intensity of Sun's Light. I also have found that nearly every eyeshade of the common form which I have ever examined had the pimple in the centre referred to by Mr. Ryle. I used to get very good views of solar phenomena with a 2in. telescope, using a terrestrial eyepiece, power 40, with an ordinary eye-shade; but even this suffered after a time from the "pimple," which interfered with good definition. I intend to try the plan of a coloured glass placed at *inside* end of draw tube, and will let your readers know the result. Mr. Gaythorpe is right: It was in Chambers I met with the statement about perforated stops. May I ask for the opinions of your astronomical readers on one or two other matters, which I have met with recently. Both Webb ("Celestial Objects," p. 160) and Denning ("Telescopic Work," p. 308) state that the great American refractors fail to show any companions to Vega nearer than the well-known one. Last year I had the privilege of an evening with the South Equatorial at Dunsink Observatory (Cauchoix famous object-glass 11¾in. aperture) and, observing Vega, I could see most conspicuously a second *comes* nearly as bright as the first. I estimated the pos. angle as ± 295°, and distance from Vega about half that of the other. I do not think it could have been a "ghost."

Again. What is the colour of Rigel? Denning says pale yellow. To my eyes it is as white as Sirius, Vega, Altair, or α Cygni—exactly the colour of an electric-arc lamp unshaded, and, except for diffraction rings, very like one when viewed in the telescope. I should like to hear the opinions of some others on the subject.

I must have been unfortunately placed for seeing the Perseids. Many correspondents report a good display. Here during the week ending August 14, the nights were for the most part clear, and I was at the telescope till about 12h. each night, but the meteors seen were few and small, and most of them not Perseid. May I remind your correspondent who theorises upon the relations established by Joseph between the Pharaoh and his subjects, that in Gen. xlvii. 21, instead of "he removed them to cities," the Septuagint and Vulgate versions, the Samaritan Pentateuch, and Knobel, Olshausen, and Dillman read "he made slaves of them"—a portentous difference of meaning, but one turning on the very slight difference between the letters Daleth and Resh in the Hebrew original. The testimony of the Septuagint and Samaritan agreeing is very weighty evidence on account of their antiquity, the one dating 200 to 300 B.C., and the other very much earlier, whilst we are not at all certain that the Massoretic text from which the English Bible is translated is at all times to be relied on in minute points dating so far back.

I do not think "W. J. G. F." (42703) has got the right sow by the ear (or fly by the leg). Try again! If the fly were outside, just over the carriage roof, or 100ft. above it, how would it be?—or if it were inside and the carriage without a roof? As to his other problem—the blow of the bullet against one end of the cylinder will be exactly equal in force to the reaction of the spring against the other end, so that (except during the infinitesimal interval between release of the spring and the bullet striking) no motion whatever will result.

Wm. F. A. Ellison.

Monkwearmouth, Aug. 22.

UP "DEVONIAN," G.W.R.

[42753.]—Referring to Mr. Walkey's letter (No. 42697, p. 15) I should like to ask Mr. C. E. Stretton, who has repeatedly stated in "Ours" that Rule 145A is rigidly enforced, whether he does not consider that Warren ought to have been fined for his splendid piece of driving between Didcot and Reading, in gaining six minutes in 17 miles upon book time? Moreover, he had the shocking audacity to come into Paddington 2½ minutes before time!

Oystermouth. Scorpio.

FLYING CRAFT MADE PERFECT.

[42754.]—To all men who take the least interest in this extremely important problem—the navigation of the air—Mr. Wilson's sketch (p. 17) of a proposed flying-machine must be very interesting and suggestive. To me it is especially so, as it proves that he—like me—has recognised the inevitable as regards the safety of the flying-machine of the future. I repeat here what I stated in my letter of August 4: it's by gravitation alone that we shall get safety in the air, and by no other means whatever. Mr. Wilson and myself quite agree again on another very important point in dividing the lifting power, whatever it may be. In Mr. Wilson's case it is screws; in my case it is wings. This is, I would point out, extremely important, and of great significance as well; for it points most definitely and unmistakably to the fact that we are slowly but surely advancing towards the desired end. We are at last settled on the right track, and the goal can not be missed. To Mr. Wilson, I think it will be of some interest, when I say that for this last 37 years I have had ideas of flying-machines by the score, or rather by scores, come under my notice by mechanics of all nations—Russian, Australian, German, French, American, and last, but not least, English, ancient and modern. But Mr. Wilson's design is the first that has contained the least semblance of the element of safety, and I for one heartily congratulate him on breaking the record in this line, so far. But at this point my praise must end, and I will, with Mr. Wilson's permission, point out the serious faults contained in this, despite these same faults, best, far and away the best, design for a flying machine ever published to the world. In pointing out the first, and in every respect the greatest, fault, I must again refer to my letter of August 4. In that I remarked we must follow nature in principle always, and in form where we can, or words to that effect. Now, to anyone who may study the subject closely, it will be seen Mr. Wilson has not done this, as the bird uses, first and most important, the mechanical principle of the paddle (double-acting); second, and next in importance, the screw (also double-acting); third, and least of all in point of importance, the aëroplane. Now, if we look at the sketch we see at a glance that Mr. Wilson has made the totally unpardonable mistake of leaving out the paddle, far and away the most important of the three, and thus crippled, his machine will be asked to imitate the bird. Is it likely that it will ever do it? The bird has life—the machine has not; the bird has instinct—the machine has not; and yet the machine is treated less generously than the bird. How can we, any of us, hope to improve on nature in this fashion—to even dream that we can improve on the handiwork of that great Power that designed the wondrous mechanism of our own bodies, is, to say the least, showing a sad want of thought and common intelligence. At the same time, I do not for a single moment expect Mr. Wilson or anyone else to make a perfect flying-machine right away. A perfect flying-machine is not going to spring up in a day. I don't pretend to say mine will be a perfect machine; but what I do say is this. I claim boldly before the world that my flying-machine will, when it comes forth from darkness into the light of day, contain the germs of a perfect flying-machine. It will be built on the principle that every flying-machine that may in the far-off future ever leave this solid earth will be built upon. No matter how beautiful it may be made, no matter how grand the lines, or how bright and harmonious the colours, or how splendid may be the interior fittings and arrangements, they will one and all be built on the very same principles that will be embodied in my little rough machine, because, as (referring again to my letter of August 4) I have already said, there is only one way that the work can be possibly accomplished upon. I cannot make a perfect flying-machine; but I claim this much, honestly and fearlessly before all men, that it is possible not only to fly safely through the air with a machine that shall be made in accordance with the principles of nature, but also to carry unlimited weight about from one part of the world to another, through that thin, unstable, yet powerful element. Having said this much, I will proceed to point out in detail the true reasons why Mr. Wilson's machine will never fly twenty miles through the air. Let us, for the sake of argument, say that the screws would act on the air with sufficient effect to lift the machine into the air. The first thing we should find would be that it was perfectly unsteerable, except when going either dead against the wind or in direct line with it: in any other direction it would be unmanageable, as the wind would act the same on the rudder that it would act on any other part of the machine—namely, blow it with it. We must bear in mind a sailing ship at sea has two elements to help it; we shall have only one, and that a very unstable one at times, while at others a very strong and turbulent one. Again I would fain point out to Mr. Wilson that the aëroplanes, placed where they are, will be a great source of danger. My plan is to leave out the aëroplanes altogether. At first we can get on better without the principle of the aëroplane than with it. We can introduce that later on when we know more of our machine; but let no man make a mistake on this important point. The double-acting paddle we must have.

Thomas George Challis.

[42755.]—Mr. Desmond (letter 42673, p. 580) is quite right when he says that the whole secret of flight lies in ⅛in. These two small appendages called balancers (the baltares of Linneus) are not unlike two pieces of flat hair ⅛in. long, with a ball at one end and jointed to the body of the insect at the other end. Then comes the perplexing problem. When these balancers are hindered or interfered with in their vibrations or removed, the insect at once falls to the ground—in other words, the steering and balancing actions in the act of flying are effectively destroyed. The size of the knobs or balls varies from the diameter of a lilliputian pin down to fractions of that size, and from ⅛in. in length down to fractions in the very small insects, and the weight from the 500 hundredth of a grain to almost infinite fractions of that weight. Within these dimensions, incredible as it may appear, is inclosed the whole secret of the problem of flight; but, fortunately for aëronauts and students in connection with the subject, there are only two classes (the Diptera and Hymenoptera) that withhold the secret so effectually from us. These balancers are found under the wings, and vibrate in their natural recess nearly at right angles to the body. There is no doubt that their functions are to act as dampers of the vibrations of the wings, and of governing the balance in the different phases of change of plane of the wings in the action of flight. I find in one of my notes a statement "that the wings and balancers always move or vibrate in unison." But this cannot be true, for if only one be removed flight is not destroyed, but only when the two balancers are stopped. Although it makes violent and audible exertions, it can no longer fly, not until the balancers are again set free, and yet we can with impunity clip off two-thirds of the wings without destroying the steering or balancing actions, thereby showing the excess of lifting power is two-thirds of its own weight possessed by the insect. Again, it is a very common sight to see two flies flying (like one) together. If by some means (too long to describe here) we stop or destroy the wings of the upper one, on being released or set free the under one will carry its mate on its back in a protesting and triumphant manner. We have again, in this case, the evidence of the fact that it carries twice its own weight almost vertically—yes!—and steers and balances itself and load out of reach, and, if out of doors, to a great distance. Naturally, the inevitable question arises: When that balance is destroyed, can it be restored? We reply: Yes, it can be re-established artificially. (I will explain how it is done later on; and I believe I am the only one who knows how to do it). As to the statement that insects move their wings 100,000 times while birds give one flap of the wing, that is another of those many erroneous assumptions that disappear in the light of investigation. In the instrument figured in the Report of the Aëronautical Society for 1870, the tracings of the wing never exceeded 200 per second, although it was striking all the time for freedom. My own observations are that a fly, say, a bluebottle, basking in the sunshine on a cold morning, and flying leisurely across a ray of sunlight, moves its wings at a very low rate of speed, so low as from 8 to 12 vibrations per second, and travels from 2 to 3ft. in the same time. In fact, one can see every stroke separately, and mentally count the number in a given time; but these can no longer be counted or seen when the insect is disturbed, and, if alarmed, the number of vibrations may rise to 80 per second, and travel 10 or more feet in the same time. Almost from the first of my studies of the subject I perceived the fact that the problem of flight was more of the nature of the balancing tricks of the rope-dancer or the equilibrist or the cyclist, &c., than of actual great power. In conclusion, we have not the slightest doubt that flight can be successfully accomplished at small expense, if capitalists would only come forward and help the investigator and practical man to settle once and for ever the problem of aërial navigation, one of the most stupendous and far-reaching consequences to the civilisation and salvation of the whole human race.

Louis Senecal.

WILSON'S AERIAL SHIP.

[42756.]—A correspondent asks for further details with regard to Mr. Wilson's design on p. 17, of August 18. He will find full details, properly illustrated, of exactly this idea in a book called "The Clipper of the Clouds," by Jules Verne.

Robur.

GREGORIANS AND NEWTONIANS AS TO DEFINITION AND CONVENIENCE IN USE.—NOVICE OR MASTER?—COLOUR OF γ^2 ANDROMEDÆ.

[42757.]—A short time ago your correspondent Mr. Ell. Hay, requested of me the details necessary for the conversion of an 8½in. Newtonian into a Gregorian. A week or two after above request, and, indeed, before the essential parts of the information had time to be given, we find him giving us what we are supposed to take as a carefully-made "practical" comparison of the altered and unaltered forms of the telescope, and this from what purports to be from his own handiwork! By his own showing, he at least made it appear that this was his first experimental attempt at making a Gregorian, and, indeed, in respect to the proper figuring and testing of the small speculum, which he seemed to understand was most essential, he has just but applied for instructions, which time has not as yet permitted him to get—at least, through the medium of your pages. Even if his information has been expeditiously gathered elsewhere, have we not here a most phenomenal case of *expertness* in picking up what is well known to be a difficult part of the business, and of *pertness* in parading the work and conclusions of a learner against those of *experts* of long experience?

Are we, therefore, to take his crude and apprentice-made trials as legitimate evidence of certain points regarding which he goes against theory (indeed, plumes himself on the divergence)?

But while no intelligent constructor takes this view of theory and practice, we find even Mr. Hay's practice, on which he pins so much faith, totally out of correspondence with that of men who, although not clever enough perhaps to compass the whole art of making a perfect Gregorian (i.e., such a one as should be a fit criterion with which to make trials of comparative excellence) in the short space of a week or two, like your gifted correspondent, have left records to indicate the meaning and the results of every step they took.

Briefly, your correspondent's "practical" (?) conclusions were these:—

1. The Newtonian when altered to a Gregorian had no loss of light.
2. The definition remained unaffected by the change.
3. The expense incurred was the only benefit (?) derived from the experiment.
4. The Gregorian form was found inconvenient to observe with—in fact, a "torture."

As to (1) we may allow his remark to pass, for although personally, in common with many observers, I have found a slight defect in this respect in the Gregorian, Tully, who for this very test made of one aperture (6in.) a Newtonian, a Gregorian, and a Cassegranian, found no difference in light in any one of them.

As to (2) the reasoning, from at least our point of view is most absurd: of two possible conclusions, one is, that he, with all his acknowledged want of theoretical training and practical experience in Gregorian making (a more difficult undertaking than for perfect work, as far as the Newtonian can take advantage of it), manages to make, and that against time, in a "knock 'em off" style, in a week or two, a Gregorian which is *found equal to* the production of a maker acknowledged to be first-class, who worked on the Newtonian model.

Could one wish for better *à fortiori* evidence than the above of what the Gregorian might attain to in excellence when made by competent and experienced hands?

The other possible conclusion is that Mr. Hay's mode of setting about the alteration has to some extent vitiated the large speculum, and that his interference has done more damage to the Newtonian form than to the Gregorian.

No one of any experience will doubt, I think, that the perforation of a speculum of any possible material, subsequent to the figuring of it, will act more or less deleteriously. Indeed, the advice he got from all was in this direction.

Now as to the relative amount of the above vitiation in the effect it has upon the performance of the two forms implicated, the following clearly explains:—With the Newtonian of 60in. focus, a given degree of disturbance of figure will at that distance produce a certain wandering of the rays, which at, say, ten times the distance from the speculum, we need not be told would be ten times greater. But the Gregorian application of the same large speculum does *just this very thing*, for the ultimate union of the reflected rays is at 633in., nearly, instead of 60in., the focus being lengthened by the action of the small speculum. In this way whatever disturbance of image results in the Newtonian is, in our example, ten times greater in the Gregorian. Still, we are told (in 42669) that the definition is equal in both, so that our only possible conclusion from this aspect of things is that the Gregorian conditions must in essence be much more capable than those of the Newtonian of giving a well-defined image, when, even after a disturbance which tells so much more seriously upon the Gregorian, that telescope is still found *equal* to the Newtonian, which theory plainly proves to have suffered much less. Again an *à fortiori* argument, and with either choice of possible conclusions, the advantage remains with the Gregorian decidedly.

But this is not all, for past letters of your correspondent profess ignorance up to that time of the proper Gregorian eyepiece, and we have no indication of his having used in his comparative trials this essential adjunct in suitable construction and perfect adjustment, on both of which, as we all know, so much of the performance depends. My poor belated instructions as to above proved too late for your record Gregorian builder, although I spared no pains to make them full and thoroughly practical, believing, as I then did, that I was helping a *bond-fide* constructor and conscientious experimenter. My confidence was, I confess, somewhat shaken in the validity of the proposed trial, when I found (in 42516) my querist "aiming at" and attempting to measure the speculum hole to hundred-thousandths of inches in a case where he had been told precision of this attempted degree was only of use for theoretical purposes, and his "aimed at" number all the time of *no apparent* relation to the theory. He had been specially told that this diameter allowed of some latitude in actual practice, so that the "aim," after all, did look something like a quiz. His invitation that I should personally inspect his more or less imaginary "Gregorian-Newtonian," which invitation he knows I cannot avail myself of, goes but a small way to remove the opinion I then formed.

The third head—the expense—has nothing to do with the issue, for no true scientist either grudges such expenses or brags of them afterwards.

The fourth head—the convenience or otherwise of the two telescopes respectively in regard to use, and more especially his peroration about the "torture" of observing with a Gregorian, with his authoritative "warning"—may safely be left, I think, to a slight comparison of his particular views with those of a few men whose scientific training, skill in practical optics, and experience in observing may, after all, be deemed at least equal to similar attainments possessed by your eminent contributor, if he will generously allow it to be thought so. In the views I shall quote, and which were indeed promised to "A. W. B. M. D." some time ago, the matter of *definition* is in most cases mixed up with *convenience in use*, and my quotations are not necessarily in any particular order as to date, &c.

"With regard to the form of reflecting telescope, it is now pretty generally agreed that when the Gregorian ones are well constructed, they have the advantage of those of the Newtonian form. One advantage evident at first sight is that with the Gregorian telescope an object is perceived by looking directly through it, and consequently is found with much greater ease than in the Newtonian telescope, where we must look in at the side. The *unavoidable imperfections of the specula common to both* also gives the Gregorian an advantage over the Newtonian form. The Newtonian telescope was *still inconvenient*, notwithstanding the contrivance (the finder) of Huygens. The telescope of James Gregory, therefore, soon obtained the preference to which, for most purposes, it is justly entitled." — Barlow. (This author was highly skilled in all optical matters, and was also a careful observer.)

"John Hadley, Esq., who was so successful with the Newtonian, appears afterwards to have constructed this form — for a long series of years the Gregorian was *the most efficient telescope*" (i.e., until the achromatic was invented).—Potter. (As a practical maker, besides being a scientist and also a skilled observer, the above author claims respect.)

"It is in great favour with many observers from its *compactness* and the *convenience*."—Parkinson. (Parkinson's treatise on optics is as a recent work, still one of the best in our language.)

"This telescope is found in practice very preferable to Newton's, and in general to Dr. Herschel's whose construction is only fit for very large instruments. In the first place, it is more *convenient* than either; it has *one more solid advantage*, which is this: the specula never can be worked perfectly true, so that the mirrors correct each other, if they are properly matched."—Coddington. (The above is the opinion of the founder of our modern system of analytical optics.)

"One *convenient* form of the reflecting telescope is that of Gregory—this form of the instrument is preferred."—Chambers' Optics (a standard college treatise).

"Another class of reflecting telescope was invented by Dr. Gregory in 1660; *but they were not made till some years after the Newtonian.* The Gregorian reflector is, however, *preferred* to the Newtonian, and is most commonly used."—S.D.U.K. (Above was written by Pritchard, who had a most extensive knowledge of and experience in the use of all manner of telescopes and microscopes.)

"It *is* (not *was*, observe) the construction almost universally adopted in reflecting telescopes of small size," which, being a modern estimate, means anything somewhere under a foot.—Deschanel's "Nat. Phil.") (This is from one of our best modern treatises on the subject, and shows the truth of Dr. Caplatzi's remarks about Gregorians being still much used on the Continent, although the late fashion of resuscitating the Newtonian in England has temporarily caused a difference with our *amateurs* at least.

As the Cassegrainian, so far as observing posture is concerned, exactly agrees with the Gregorian, we may take Dr. Robinson's remarks on the former in the *Proceedings* of the Royal Irish Academy:—

"An error of the large speculum can be corrected by figuring the small one to meet it. This is of much importance in large instruments. I say this from experience. The adjustment of the specula is more easily verified than in the Newtonian. *The observer is near the ground*, hence more easily sheltered, *and he finds his position easier*, while the Newtonian requires a *complex apparatus to support him, expensive and bulky.* Neither is the field of view so flat in the Newtonian."—Dr. Robinson (from *Proc.* Royal Irish Acad).

"The Cassegrainian (or Gregorian) *gives great facility for the location of the observer.*"—Sir G. Airy, Late Astronomer-Royal (from Royal Society Correspondence).

(The mention of Airy's practical preference for the compound over the simple reflector needs no comment, and his theoretical preference is well known.)

"I am at a loss to conceive why Sir J. Herschel thinks a Cassegrainian or a Gregorian will cause such physical exhaustion of the observer. The eye-end is on a *less sphere* than a refractor, and I never heard that the Struves, Bond, or any who use a a refractor find such a difficulty. On the other hand, I know by experience the climbing of long ladders, or even walking up and down stairs, for a long night's work is really fatiguing.—Dr. Robinson (in R.S. Correspondence).

"Sir John Herschel objects to the labour of observing with a Cassegrainian (or a Gregorian); but Struve, Bond—in fact, everyone who employs a refractor, has the same labour, and I am not sure whether moving up and down ladders with all the clothing necessary for a night's work is not more laborious."—The late Earl of Rosse.

(Having had more experience than most observers of both the instruments he mentions, we can scarcely call his opinion in question.)

Rosse's large telescopes, from mechanical necessity alone, short of expense still more lavish than their eminent constructor ventured upon, could scarcely, even with the most modern appliances, have been fitted up in a way suitable for other than the simple reflector in its original form. This is the proper function of the Newtonian. Herschel's predilection for the form of instrument so famously used by his illustrious father we can easily understand and make allowance for.

Lastly, if it be permissible to mention my own poor experience of several years' standing, I may state that I have used all sorts and sizes of telescopes short of giants, but prefer the achromatic and the Gregorian. For planetary definition I have always found the Gregorian excellent, and, when there is light enough, the resolution it gives of minute, close double-stars is also very fine. It is when accuracy as to place is needed that the Gregorian falls short, for it is not well suited for mounting with divided instruments of precision. But still less is the Newtonian. Taylor's new photo.-visual achromatic is, in my opinion, almost a perfect telescope; but for the amateur, it, especially in large sizes, is not to be thought of.

Evidently Mr. Hay does not know how to observe directly at high altitudes—he possibly bends his neck straight backwards. An evening in some of our public observatories would soon put him in the way of observing easily at all altitudes. He mentions the addition of 18in. to the height of his Newtonian stand; but if that stand is of the usual type of such pieces of ordnance, an additional height of 4ft. or 5ft. would scarcly be enough to enable him to get comfortably at his Gregorian eyepiece, without stooping down on his knees in the position in which one looks up a chimney, *à la* the professional sweep. The lowness of Mr. Hay's stand is no doubt the main cause of his "torture," but are not all makeshift plans and "alterations" always of this nature?

Lastly, respecting the remark in 42669 that "I deny having hinted at (*sic*) a yellow and blue star together would result in green discs," I still deny having given in 42048 the slightest ground for that assumption. The answer to his query in 42669, "If the discs are not sea-green, will he explain what sea-green has to do with it?" is this:—With B practically yellow and C a deep blue, and as I

could only use one spectrum place (viz., λ = ·00001908 of an inch) in computing the effect of star colour upon separation, I, as the merest tyro will observe, used sea-green as the mean colour to be computed with—the colour, in fact in which, with a low power, the unseparated pair is seen as a coloured star. After separation one disc is yellow, the other blue, and green discs are not in it; nor is there any mention in my letter of such *visible* discs whatever, either single or double! The sea-green, I fear, is in the eye of the critic—see? H.

P.S.—The above having been written some time ago contains no reference to the kind and flattering remarks of "Balolo," "A. S. L.," and Mr. Stielow. Space prevents my doing more than thanking them at present. I may, however, add that "A. S. L.'s" explanation in 42718 has my perfect concurrence. Lastly, I desire to thank most heartily your eminent correspondent, Dr. Schroeder, for his most acceptable gift of his Gregorian articles in the *Central-Zeitung für Optik und Mechanik*, 1898.—H.

THE MEDIAL TELESCOPE.

[42758.]—INVENTED by L. Schupmann, professor of the Technical School at Aix-la-Chapelle. The difficulties encountered in the construction of large astronomical telescopes for the finest observations have hitherto proved almost insuperable, owing principally to the properties of the materials employed. Though not exactly of the same nature, they affect both reflectors and refractors alike. Specula over 2ft. of aperture suffer in their *form* on account of their weight, imperfect support, and exposure to changes of temperature, as well as from the deterioration of their surfaces. Their principal merit lies in the fact that they give perfectly colourless images. Whilst the refractor is fairly free from some of these defects, it has others not less injurious to really fine and delicate observation. As the chief among these is the coloration of the images they produce, which sadly interferes with good definition. Though various means have been employed for producing *achromatic* objectives, these have not yet proved entirely effective or sufficient for getting rid of the secondary spectrum—at any rate, in *double objectives*. By the employment of three lenses of suitable glasses and radii, it is now possible, thanks to the studies of Profs. Abbe and Schott, of Jena, to construct almost perfectly achromatic objectives, that is to bring together not only the middle yellow and the coloured edge rays, but all the rays from which white light results. Unfortunately, some of the glasses required for this purpose cannot be produced in pieces sufficiently large for constructing objectives of any considerable size; nor are the chemical properties of these glasses stable enough to insure permanent success. Another disadvantage is that they absorb nearly half the light. A third means for producing colourless images is found in the Dialyte—a type of telescope first indicated by Rogers.

Such a type of telescope you obtain by cutting at right angles to the optical axis the *crown lens* of the double o.g., and then to remove the *compound* left of it back to the original focal plane. The effect of thus dividing the objective is that you thereby greatly increase its focal length, because the *half crown* lens does not so rapidly bring the rays to focus as the *whole*. Now here is the improvement introduced by Prof. Schupmann. In his telescope he receives the rays after they have passed through the flint of the compound part object on a *concave* mirror, which returns them to a focus in front of the half o.g., or in the original focal plane. The telescope thus produced partakes of the nature of the reflector and refractor, and this is why he calls it a *medial* telescope. Having ascertained the dispersion of the compound flint-crown part in the daylight, he can, of course, obtain the same dispersion simply with a flint-lens of much smaller size. It is difficult to make the matter clear to the general reader without figures. I have ordered his book, and may be able shortly to supplement this short note taken from a review, with the Editor's permission. The first rough model of the telescope in question was made in 1893. A short time since a properly worked out instrument was obtained by the aid of Messrs. Reinfelder and Hel, of Munich. Its performonces may be seen from the following data:—Aperture 4½in. (12 centimètres), magnifying power 210. Perfect achromatism. Extremely sharp pictures. Double stars like π Aquilæ 1·6" are easily separated. Stars of $\frac{1}{15}$ magnitude, like the companion of α Tauri, clearly visible. The inventor has taken out patents in Germany and the United States of America. Nothing is mentioned about England. A. Caplatzi.

METEOR.

[42759.]—A MAGNIFICENT pear-shaped fireball, with short luminous train of large sparks in straight line behind it, passed over Chorlton-cum-Hardy on Sunday, August 27, at 10h. 10·5m. p.m. I was walking in a south-westerly direction when arrested by the sudden illumination of the surrounding district with a light decidedly more intense than that of full moon. The direction of flight was from N.W. to S.E. When first seen the meteor was near Deneb Cygni, and travelled to Aquarius, where it suddenly disappeared about the Ecliptic without change or noise. I waited five minutes, but heard no detonation. Apparent size was half the apparent diameter of moon, and much brighter; colour, bright yellow; duration of passage, 4½ seconds. Air very clear, stars bright. J. L. Whittle.

THE DELUGE.

[42760.]—GEOLOGY does not enable us to fix a date without a 10, or perhaps 20, per cent. error. It only enables us to say "5,000 or 6,000 years ago." The date in our English Bible, copied from the Latin and modern Jewish, is too short. But they are well known to be artificially shortened by the Rabbis in our first century. My date of 3102 B.C. is, therefore, simply from the Hindoo story of the Kali-Yuga, because it agrees exactly with the Arab date of Abulhassan Kuschiar (Herschel's "Outlines," 926), and with the Samaritan copy of Genesis (the fullest copy, being the only one that gives double entries of all the lives), if we read the generations each half a year longer. The statement that "Shem, being 100 years old, begat Arphaxad" plainly means that this birth was in Shem's 101st year. So with all the others we ought to add, on the average, half a year.

What Mr. Monck calls "the existing text" is not existing for the Greek Church, or any Asiatic people. What he calls my date is simply the commonest date. Again, what he calls my theory of the Deluge is Halley's and Newton's theory. It is not Whiston's at all. He attributed it to a particular comet's approach, not to a comet's downfall on the earth. It is true we have only Whiston's statement that Newton took Halley's theory; but he honestly says that it was Halley's, and not his own. Whiston, we must remember, was Newton's successor at Cambridge by Newton's own choice.

ERRATUM (p. 40).—For "salve-toothed," read "sabre-toothed." E. L. Garbett.

[42761.]—HITHERTO all letters on this subject have studiously avoided any reference to the Creator of the Universe as the probable cause of the Flood. Natural causes cannot explain everything. Let us take the Bible version as written by Moses in chapters vi. to viii. of Genesis. This version was probably written about one thousand years after the Flood occurred, when all were dead who had survived that great calamity. It is very unlikely that the description given in Genesis was handed down through generations until Moses wrote the Pentateuch. It is still more unlikely that he should evolve such a stupendous fiction out of his own imagination, although this latter seems to gain most credit nowadays. It is very improbable that a man of his intelligence should write a fiction full of inconsistencies and seeming impossibilities without making some attempt to explain them or to justify his statements. The very simplicity of the narrative is the most conclusive proof that Moses wrote just as he was inspired to write, without any exaggerations or additions of his own. Now, if we are to believe him, the dimensions of the ark were 300 cubits long, 50 cubits broad, and 30 cubits high. Taking a cubit as 18in., that gives a length of 450ft., a breadth of 75ft., and a height of 45ft. Surely none can assert that that was a small vessel. Can we doubt of its being sufficient to accommodate eight persons and about 200 to 250 pair of quadrupeds (a number to which all the various distinct species may be reduced) together with all the subsistence necessary for their long incarceration? I fail to see where the difficulty of storage-room comes in, for, with three stories to treble the floor-space, there should be room enough and to spare for all that the ark was meant to accommodate. Another point which has caused much diversity of opinion was the impossibility of Noah collecting two of each species in the limited time he had at his disposal. A very reasonable objection if he did collect them; but he didn't. If we refer to Chap. v. 20 v. we shall read as follows:—"Of fowls after their kind, and of cattle after their kind, of every creeping thing of the earth after his kind, two of every sort shall come unto thee to keep them alive." There we see they came voluntarily unto Noah, led thither by Divine guidance, directing their steps in obedience to an impulse not their own, but emanating from the mind of the God who made them. Some sceptical-minded people are sorely perplexed as to where to find sufficient water to form a universal deluge. It might be of some assistance to them to know that there is enough water suspended in the atmosphere to cover the surface of the whole globe to the depth of above 20ft. It may be here remarked that such a quantity of water could not descend in the form of rain to cover the earth in forty days. Perhaps not, if we gauge it by our English rainfalls, but in all probability it fell in cataracts. This is not at all an uncommon occurrence in some parts of the globe. Travellers may form the truest notion of what I mean who have seen those prodigious falls of water, so frequent in the Indies, where the clouds do not break into drops, but fall with the terrific violence of a torrent. Such an abnormal rainfall could very well cover the earth if it continued without intermission for forty days and forty nights. Now, Moses assures us that the waters prevailed 15 cubits—that is, 22ft. 6in., above the highest mountains. If we cannot accept his testimony, let the mountains themselves be appealed to for the truth of this assertion. Examine the highest eminences of the earth, and they all with one accord produce the spoils of the ocean deposited upon them on that occasion; the shells and skeletons of sea-fish and sea monsters of all kinds. The Alps, the Apennines, the Pyrenees, the Andes, and Atlas and Ararat—every mountain of every region under heaven from Japan to Mexico—all conspire in one uniform universal proof that they all had the sea spread over their highest summits. Search the earth, and you will find the moose deer, natives of America, buried in Ireland; elephants, natives of Asia and Africa, buried in the midst of England; crocodiles, natives of the Nile, in the heart of Germany; shellfish, never known in any but the American seas, together with entire skeletons of whales, in various other countries; all of which are a perfect demonstration that Moses's account of the Deluge is incontestably true.

Again, was it some strange freak of fate or a guiding providence that drifted the Ark into the regions of Armenia, a region particularly well calculated for the reception of the patriarch's family and for the repeopling of the world. The soil of the country was very fruitful, and especially of that peculiar locality where Noah made his descent. The region styled Araratia was also very high, though it had fine plains and valleys between the mountains. A country of this nature and situation must, after the Flood, have been soonest dried, and consequently the soonest habitable. And it also seems in an eminent degree to have contained every requisite for habitation.

As modern research proves the truth of these assertions, does it not lead one to recognise the presence of some omnipotent, though unseen, force controlling the destinies of men even now as in the days of Noah? Why is science so antagonistic to religion? Because religion is opposed to natural laws? Surely not, for is not the story of the Deluge supported by the most elementary facts of experience. Yes; and there are others no less remarkable; but it would be an unpardonable digression to enter into them here. This subject, if accorded the depth of thought that it well merits, will prove to be not such a preposterous fiction after all. Leonard Kelly.

THE MOSAICAL DAY.

[42762.]—HAVING had occasion lately to make a study of Chaldean astronomy, I believe I have a good reason for stating that I have found an explanation of that crux of Biblio-scientific controversy—viz., the meaning of the Mosaical Day, as expressed in the first chapter of Genesis.

Considering the primitive condition of science of any kind in those early days, the Chaldeans seem to have been gifted with almost a divine intuition of mathematics, so far as they were able to go with the arithmetical system they had invented. All primitive people reckon by fives and tens; but the Chaldean scientists used fractions (or aliquot parts), for which the decimal system was inapplicable. They therefore established the duodecimal for their calculations. As, however, the decimal was in general use, it was necessary to combine the two. This they did by taking the common denominator, 60 (5 × 12), as their base. Dividing the radius of a circle into sixty parts, and these again into sixtieths, they obtained the minutes and seconds of arc. The radius, as a chord applied to the circumference, divided the circle into six parts, which × 60 gave 360 parts (or degrees). For the measurement of time they invented the gnomon, and as their calculations were all made from the vernal equinox, they divided the daylight—i.e., from sunrise to sunset, into twelve parts or hours, and these were divided by 60 for minutes, and again by 60 for seconds, of time. The whole day was reckoned from the time the shepherds folded their flocks; as the religious Jews do even at the present day. Thus the evening and the morning were one day. The social official year consisted of twelve lunations (355 days). Differences in their measure of time and occurrence of the Equinoxes led them to the discovery of the precession, which they either purposely or ambiguously reckoned at 30 seconds per century. This gave them 43,200 years to complete the cycle. The Zodiac was first started from the Equinoctials and Solstitials (four points). This fell into their system, and was then divided into twelve parts, to which were given the signs; the cycle, 43,200, being divided into these twelve signs gave 3,600 years to each, and these were subdivided into 600 and 60 as measures of astronomal time. Here, then, were two distinct measurements, each having the same denominations. For astronomical purposes they had recourse to a very singular method—viz., that of reckoning

the solar year as one *second* in the life of the universe. The 3,600 years as cosmic *hours*, and the whole cycle of 43,200 years as one *day*. Here, then, I consider is the origin of *the day* as used by Moses in his description of the Creation.

It must be considered that Moses was a Chaldean by descent, that Abraham had lived in one of their principal cities—Ur. Tradition played a chief part in their knowledge of the past, and there can be little doubt that Moses was instructed orally in all Chaldean sciences. He would thus apply the Chaldean method of time measurement, and for his then purpose would naturally use the chronological or cosmic notation. Thus the "day" in this sense would be the cosmic day of 43,200—or 86,400—ordinary years. He might have used this to express the greatest number he was acquainted with, or it might mean indefinite time. Anyhow, the method so far falls in with the reasoning, that I think it might be accepted as a sufficiently good explanation until a better is forthcoming—and so combine the two—i.e., the literal "day" and the cosmical "day," as to obviate the necessity for any further controversy on the subject.

Clapton, N.E. Jas. D. Hardy.

WURDEMANN'S DIVIDING ENGINE.

[42763.]—It would, I feel sure, be exceedingly interesting to many of your readers, certainly at least to myself, and possibly of great use to not a few, if you could kindly supply us with a detailed description of the engine which you figure on p. 31. The brief outline there given serves only to whet the appetite for more. For years I had wished to obtain a description of a dividing engine, and on first catching sight of the illustration in question I was full of expectation, which, alas! was not gratified. I only trust that it may be in the near future. C. D.

SMALL ENGINE.

[42764.]—Mr. Gibson's sketch of a small engine (p. 43) has no explanation that in any way agrees with the drawing. I venture to think 99 per cent. of your readers cannot understand him. Where are the flywheels (plural)? G. A. Haig.

RETURN STROKE.

[42765.]—Perhaps it has not been the privilege of many of "ours" to have seen the return stroke (we read so much about) during a thunderstorm, therefore it may be interesting for them, that whilst I was watching a severe storm, slowly, yet extremely forcible, wending its way down one of our Highland glens, where, owing to the high rocks, the re-echo is too terrible; when it was at a distance of about a mile and a half from me there was a vivid flash right underneath the cloud, and almost instantly there arose from the midst of a cornfield, about 200 yards from where I stood, a brilliant zigzag *spark*, about 20ft. long, and went right up, not so quick but the eye could follow it just for an instant. L. R. C.

A FLY PROBLEM AND ANOTHER.

[42766.]—In answer to "W. G. J. F.'s" question at the end of his letter (No. 42703, p. 16), if no gravity were acting the recoil of the spring would drive the cylinder, say A, backwards for a certain distance (= *c*), until the bullet impinged on the other end, when the blow would bring it exactly to rest at that point. In the case cited, however, gravity would prevent it going quite so far, and the impact would impart a small velocity towards the centre, which, together with gravitation, would carry it (if I am right) exactly to a point $-c$ on the other side of the centre, after which it would oscillate to this distance on each side *ad infinitum*.

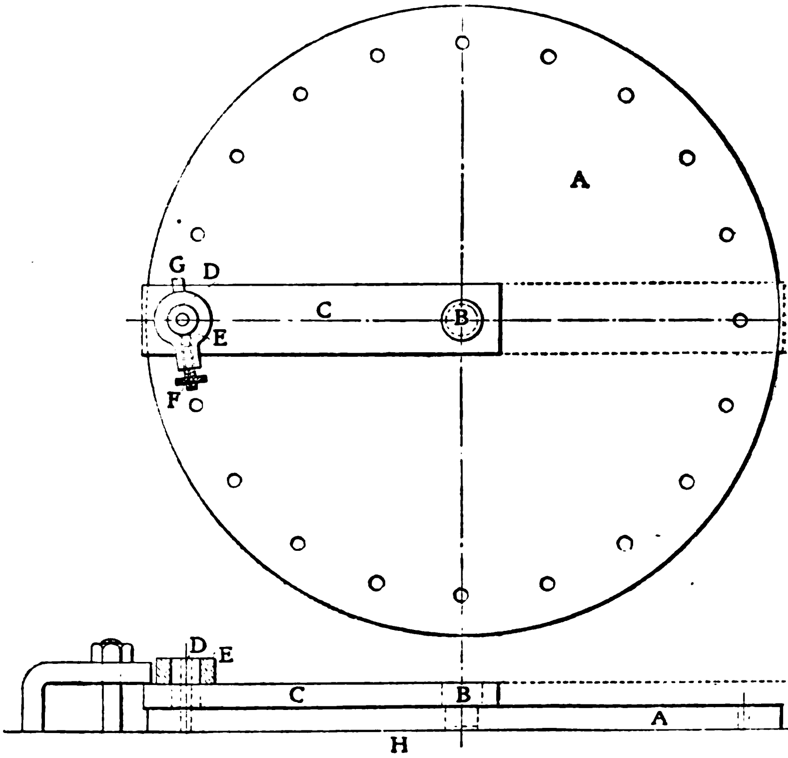
Oystermouth. Scorpio.

A SPACING DEVICE.

[42767.]—Many of your readers have occasion to use a spacing device now and then, and they may like to see the following, which I found in the *American Machinist*, contributed by Mr. C. O. Schellenbach. In his description he says:—

The accompanying sketch shows a spacing device which has recently been used to good advantage for dividing and drilling a number of holes in a circle. It is a simple appliance, and may be of help to those who do not possess a dividing machine. Referring to the sketch, C is a straight piece of bar machinery steel, of sufficient thickness to get a proper bearing for hardened bush, D, the bore of which is made to receive the drill to be used. Bar C is drilled from the required radius to receive pin, B, which is turned to fit into plate A.

A sharp scriber fitting the hole in bush D is now used to mark off the circle of holes. The preliminary spacing is done in the usual way, with dividers, in order to secure the approximate distance from centre to centre of holes. Bar C is then clamped, as shown in elevation. The first hole is drilled; a snug-



fitting plug is then inserted into the hole, and the outer end of adjusting screw, F, is set against the plug, and adjusted until the hole in bush D corresponds with the next division. The bar C is again clamped, and the second hole is drilled. The plug is then placed in the second hole, and the former operations are repeated until the entire circle is drilled.

It will be readily seen that the distance between all holes will be alike, except the first and last hole. These may or may not be alike, as all depends, of course, on the first setting. Supposing that the distance then taken with a micrometer should be $\frac{1}{16}$in. greater or less than the other holes; this would show that the spacing had gained or lost $\frac{1}{20}$ of $\frac{1}{16}$in., or about ·0031, on each hole. The distance is then taken with a micrometer caliper from the end of adjusting screw F to the measuring point G. The adjusting screw is set in or out the required amount, as the spacing indicates. Bush D is then pressed out and a larger bush inserted. This bush should be hardened, the hole lapped, and the bush ground on the outside.

A rose reamer is used for the second operation, and the holes are reamed as they were drilled. The first reaming may not be as close as desired, because of the reamer having more to cut on the side of each succeeding hole. The distance may be taken as before, and a third bush inserted and the holes reamed a second time, as this insures the best results. It will be noticed that screw F is fitted into swivelling block E, which fits snugly to bush D. It is obviously necessary that the measuring points should swivel, in order to keep the measuring screw in line with the chord of the arc. The block E must, of course, be swivelled to suit the number of holes to be drilled. The device shown is only intended for drilling for a given circle; but, if need be, bar C may be slotted and plug B squared to fit the slot and adjusted for any reasonable size circle, and clamped by nut and washer. To use this device for a given number of holes, I would suggest that the adjusting screw be tapped into the side of the bar, as near the bottom as possible, and that the bar be made wide enough to give a broad bearing on the plate. The device is applicable to plates of large diameter, and may be used on an ordinary drill-press.

I forward this rather more to elicit criticism than for anything else, as the device may be well-known to your readers.

Wilmington, Del. J. M.

PRINCIPAL AND INTEREST.

[42768.]—I need hardly point out that interest existed long before the time of Benjamin Franklin, add did not therefore originate with the electric spark from his kite; but I wish to call attention to a few of the consequences of lending money without interest, which I presume Mr. Garbett (p. 579, Aug. 11) advocates. In the first place, I think most persons recollect loans that were made and not repaid, and I suspect that the man who continued to lend without interest would soon find himself short as regards his principal. In the next place, a man might often have occasion—perhaps unexpectedly—to use some of the money which he had lent. He goes to the borrower, who, we will suppose, is honest and solvent, but he has not the money now, and he can only raise it by a forced sale of something belonging to him at an under-value, or by borrowing from a third person. The third person is applied to. He can lend, but not without inconvenience and loss, arising from a forced realisation. He cannot, for example, raise £100 without selling £110 worth of stock at that sum. Naturally he says that if he has to do this the borrower must pay him £110. Is there anything unreasonable in this?

If £1 in a year's time is of equal value with £1 now, then so is £1 in two years' time, in 20 years' time, or in 100 years' time; and a loan of £100 now on condition that my personal representatives are to receive the same sum in 500 years is a perfectly just, fair, and legitimate transaction, in which neither lender nor borrower is unduly favoured.

Let me turn to the case of a retail trader. I suppose Mr. Garbett would allow him to charge more for his goods than he paid for them, since otherwise he would have no means of livelihood. But what about payment? If it is all the same whether I get £1 now or £1 in 100 years, his customers can take their own time to pay, and the retailer may carry on business for thirty years without receiving a single penny. What, then, becomes of his means of livelihood? Perhaps the people who sold him goods, and who supplied him with provisions, clothes, and house accommodation will be as ready to give him credit as he is to give credit to his customers. We should then have universal credit, no Statute of Limitations, and no bankruptcies. I think, moreover, that we would have no payments, for, since payment might be postponed indefinitely without inconvenience, most persons would postpone it for a more convenient season.

Lending or advancing money at an uncertain rate of interest is the same thing in principle as advancing at a certain rate. When I invest money in railway or mining shares the rate of interest is uncertain, because the profits may either increase or diminish. The uncertainty is greater or less with different shares—for example, with those described as Preferred or Deferred. The capitalist generally is in the same position. He advances money at an uncertain rate of interest. His success or failure depends greatly on chance—i.e., on matters which he can neither foresee nor control, and partly on his own skill and energy. He may realise a higher rate of interest than the man who merely invests his money in marketable securities, but he may also utterly fail.

I find nothing in the New Testament declaring this use of capital unlawful. We are indeed in one passage exhorted to lend, hoping for nothing in return; but this evidently refers to charitable loans, and is a form of almsgiving. On the other hand, in the parable of the Talents Ευπορια seems distinctly approved of, and though the capitalist is only acting as an agent, the successful agent is thanked and rewarded by his employer, while the agent who has made no profit is censured and punished. That interest or profit, therefore, should indicate the Mark of the Beast

seems to me in the highest degree improbable. I think, indeed, that our present laws give the usurers too great an advantage, and I gave evidence on that subject before the moneylending committee, which Mr. Garbett did not. But the use of anything must be distinguished from its abuses. W. H. S. Monck.

WHO MADE THE SCREW-PROPELLER A SUCCESS?

[42769.]—In this matter (p. 40) we are simply seeking the facts. To speak from memory when so many years have passed away is apt to mislead.

I therefore send you reprints from the *Nautical Magazine* of 1876 ("The Screw-Propeller"), and from *Engineering* of 1879 (March 5), which perhaps you will be good enough to reissue at your convenience. They speak for themselves, and the several stages of the progress may be verified by any one who desires to do so. Justice.

[We may utilise these reprints when more space is available.—Ed.]

MICRATOMIC ETHER.

[42770.]—The term "atom," which means something not further divisible, has been used to denote the smallest possible portion having the chemical properties of a so-called element. It is not new to suppose that the so-called elements are in reality compounds; and the term "micratom" is here used to denote parts of which such elements may be formed. The term "molecule" may denote a single chemical or element atom or a combination of two or more similar or different atoms.

The term "ether" is applied to a hypothetical medium or atmosphere occupying space, and numerous hypotheses have been put forward, discussed, and even mathematically elaborated as to the constitution and properties of such an ether; it will, however, be at present sufficient to refer to some which have been assumed to be consistent with the undulatory theory of light or radiant energy.

The hypothesis that the ether is a peculiarly perfected jelly cannot be said to have been shown to be probable, notwithstanding the intense imaginative mathematics bestowed on it. The jelly ether is supposed to pervade everywhere—even where matter exists—and to be incompressible and perfectly elastic; but existing knowledge indicates no reason for regarding perfect incompressibility and perfect elasticity as other than incompatible. Any conception we can at present form of elasticity involves the necessity of compression for bringing the elasticity into play. In some mathematical investigations it is virtually admitted that the jelly ether may not be absolutely incompressible; that, however, is an admission that the theory in its present form is imperfect.

To assist in the theoretical construction of an ether, attempts have been made to imagine a combination of rigid, that is, incompressible, mechanical parts and motion, to yield actions such as are due to elasticity, and such attempts show a feeling of the incompressibility difficulty. For this purpose arrangements of the gyroscope, or so-called gyrostat, have been proposed; there is, however, nothing whatever of a resilient or elastic-return action in the gyroscope. If a gyroscope has the position of its axis altered by the action of an external force, it remains with its axis in the new position on the action of the external force being discontinued, and does not return.

Various schemes have been proposed comprising vortices, simple and complex; but whilst the mere idea of a vortex seems to have had fascination, none of such schemes appears to have been, as yet, worked out to a condition of persuasive probability.

Where there are a number of theories to choose from, those involving intense or complex motions, such as those of gyroscopes or of vortices, ought certainly to be rejected in favour of any, if there be any, not requiring such motions.

Apart from the theories of the structure or constitution of the ether, the ordinary undulatory theory of light has been admitted to have difficulties, or at least to be incomplete. In 1853, Macquorn Rankine proposed what he termed the oscillatory theory of light, which he supported with very complete mathematical treatment, and which he believed avoided some of the difficulties of the ordinary theories. He supposed points distributed (presumably uniformly) through space and matter to be capable of oscillating, the oscillations constituting the transverse vibrations of light, and being transmitted from point to point.

The great difficulty with undulatory theories of light is to explain how undulations or vibrations, which are strictly transverse, can be propagated longitudinally, and that at the amazing velocity of 186 miles in one thousandth of a second. It is no doubt this difficulty, as to which scientific textbooks are strangely silent, which is sought to be overcome by the numerous hypothetical or imaginatively created ethers that have been put forward. It is easy to throw a succession of undulations along a string, and thereby illustrate the combination of transverse vibrations with longitudinal propagation; but the string consists of parts, each one fixed to those next it on each side, and if there is no elongation or construction between the parts, the vibration of each part cannot be strictly transversal. The undulating string may serve for a rough illustration, but is not a strictly accurate representation. The fact that sound-waves and waves in water, which consist of alternations of pressure or head, are propagated longitudinally without actual longitudinal translation (excepting to a very limited to-and-fro extent) has no doubt led to the too-ready acceptance of similar views about light undulations. The established fact that tranverse vibrations are concerned in light undulations makes the case extremely different from those of sound and water waves.

Another difficulty of the undulatory theory is how to explain the fact that undulations differing very greatly in wave length and in frequency are all propagated at the same velocity. There are nearly twice as many vibrations in violet light as there are in red light. Towards solving this difficulty no analogical aid is derivable from the phenomena of water-waves or of sound. The velocities of water-waves of different lengths are not the same. Sounds of different pitches—that is, of different numbers of impulses—are propagated at the same velocity; but whilst differences in numbers of impulses does not necessarily imply differences in wave-length, the sameness of velocity implies sameness of wave-lengths.

It is an accepted axion that action at a distance is impossible—that is, that one particle of matter cannot act on another at a distance except through some medium or intervening transmitter or carrier. This axiom has probably, although quite inconsequentially, led to, or favoured, the idea that perfectly void space does not exist, and that a plenum pervades everywhere. It seems impossible to prove or to disprove the existence of perfectly void space, and it is not necessary to do so, in connection with the matters now being considered. Ordinary matter seems to move in the ether as in void space, excepting the actions on it transmitted through the ether; and the particles of the ether, if it consists of discrete particles, may move as, or approximately as, in void space, although something much rarer than the ether may occupy the space. It is imaginable that there may be two or more grades of ethers.

If the ether consists of discrete particles in motion, it so far resembles a gas, and the accepted kinetic theory of gases may be more or less applicable to it. In a gas the component molecules are separate from each other, and are constantly in motion in the space (as we may call it) between them. The energy of the gas consists of the kinetic energy of the motion and of the heat energy or internal motion of the molecules, the latter being the sum for the several molecules of the motions of or between the parts of which each molecule is composed. The condition of things in a gas are complex. There is a continual exchange of heat between the molecules which to some extent takes place by radiation—that is, by means of the ether. There are exchanges by convection—that is, with the heat carried by the molecules in their motions, and by conduction between molecules which come into contact or collision. As a whole the exchanging or transferring of heat between the molecules of a gas takes place differently from the transferring of heat or like energy of radiation by means of the ether.

It has been suggested that the ether is a gas of extreme tenuity, but not otherwise differing from an ordinary gas, and consisting of molecules separate from each other, and darting about in all directions. It has, however, been strongly argued that such a molecular gas, however attenuated, could not be entirely like the ether. A molecular gas may have different temperatures and different states of dilatation at different times. Radiant heat is transmitted through either without any indication of the ether itself being heated—that is without there being changes of internal heat or motion between the parts, of each particle of ether, if such particle has parts. Unless the density of the ether in material bodies differs from what it is outside of them, the density or state of dilatation of the ether is believed to be uniform throughout the universe.

In the micratomic hypothesis, which it is the object of this communication to suggest, molecules or chemical atoms are compounded of different numbers of micratoms, the number being probably in no case very small. This hypothesis tends towards simplification, and not to the complication involved in gyroscope theories, or vortex theories, or contradictory elasticity — incompressibility or jelly theories.

The micratom is capable of oscillations such as are comprised in Macquorn Rankine's oscillatory theory, the oscillations representing radiant heat or energy; but being indivisible it is not capable of variations of internal heat or motion between parts of it. Nor has it what may be referred to as chemical properties, such properties being exhibited only in molecules, and depending on the various numbers of micratoms combined in different molecules. Micratomic ether is thus a kind of gas without those molecular properties of a molecular gas, which, as already indicated, render such gas, however attenuated, incapable of serving as the ether. The micratomic ether or gas may, however, quite well have some of the properties of a molecular gas; in fact, analogy suggests the great probability of such being the case.

According to the kinetic theory of gases, now universally accepted by scientists, the molecules of a gas are continually moving or darting about in all directions. Collisions take place—probably irregularly—and the extents of the movements between successive collisions probably vary; but the number of molecules in even a very small space is so great that the average velocity and the average space or free path, deduced from reasonable assumptions, and from ascertained pressures and densities, are regarded as giving results as accurate as if the velocities and spaces were uniform. Thus the velocity of a molecule of hydrogen has been calculated to be 6,097ft. per second.

Assuming, then, that the micratomic ether is, so far, like a gas, its micratoms will be continually moving or darting about in all directions, their velocity obviously being that of light—186,000 miles per second. The oscillations constituting radiant energy will be communicated from micratom to micratom by the collisions or quasi-collisions, and will, of whatever extent or frequency, be propagated with the velocity of light. In this hypothesis, therefore, there is nothing difficult to understand in the fact that violet light is propagated at the same velocity as red light. Lucretian.

MOTOR CYCLES.

[42771.]—I notice the point is raised about validity of patent for long bolts to cylinder. I believe it was taken out as applied to explosion engines, which, of course, would be a new application of old idea; only advantage in them is ability to use thinner cylinder walls, which is better for lightness and for cooling quickly.

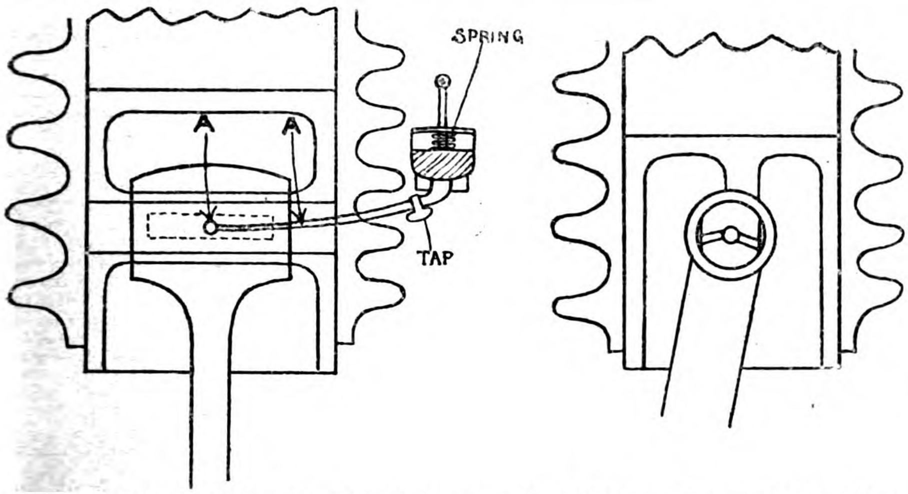
As regards articles appearing, I merely wished to call attention of writer to differences of sizes in two drawings.

I had an opportunity of seeing and examining some motor tricycles last week at Aston. There was a good array, in which some half-dozen prominently figured, and as one is claimed to be an English-made article throughout, I was anxious to compare it with the French-made article. The racing was good, and some exciting finishes resulted in wins for Dion motors, mainly because they were ridden by track experts, and winning machines had special path racing tires, which, for track purposes, had a decided advantage.

This racing, however, is of little use to the general public for judging merits of a machine for road purposes, as people do not want to be summoned for furious driving every time they use machines. I noted some points on these machines some of our interested ones might like to hear about.

The first thing that strikes you is the position of the engine which is placed in the front of the back axle, the makers claiming a better distribution of weight resulting. This was tried by French makers some years ago and given up, the reason being not far to seek. In order to place engine in front everything has to be cut down as narrow as possible, several bad features being introduced thereby, that more than counterbalances any supposed advantage. Having to be kept so narrow, results in valve-gear, cam, and foot having to be placed inside crank-case, one of the flywheels being omitted for this purpose, the side bearings being also cut down to a limit which must be detrimental to their durability. The reason for this is to get clearance for heels when pedalling, also room for chain.

In event of anything happening to valve-rod foot—a common occurrence by the way to all tricycle motors—the engine has to be all uncoupled, taken out of the frame, and crank-case taken apart for a trivial examination. It was owing to trouble of this kind Mr. Stocks was unable to complete his 24 hours record ride, as it would have taken too long to execute repair even had he the necessary duplicate parts. Utility must come first, and with all classes of engines and machinery every part must be made accessible, even though engine may look like a wart on back of tricycle. Again, with engine in front a two-speed gear is next to impossible, as it would come in way of heels so much when pedalling unless frame was lengthened, which would be immaterial in a motor vehicle. A two-speed gear is necessary for anyone who is riding for pleasure, especially in a hilly country like Devon, Yorks, or North Wales. A larger engine would be useless, as present engine, 2¾in. diam. by 3in. stroke, giving 2·25 brake horse-power (actual), is as large as is ever required, and with larger engine vibration would be unbearable. With small engines run at high speed vibration is not so noticeable, then to get power for hills gearing is required. There is one ghastly-looking French attempt that I sincerely hope will not become popular, apparently designed by man in throes of seasickness looking at steam-winches reducing gear on Channel boats.



A, oil-hole shown in front section, with a hole on each side drilled at a slight angle in side section, which come out at two small plates. The ribs are the ordinary things to allow air to cool in cylinder.

In spite of opinion of writer of articles, I think a clutch would be an immense boon riding in traffic, where you are obliged to make a forced stop; after pedalling wearily to start again, the same thing occurs again two minutes after, thus making a fair portable treadmill of a machine intended for pleasure. The carburetter on one machine fills the whole of the front part of the frame, and is divided into three parts—one containing battery, lower part working supply of spirit, and upper part supply of spirit in reserve tank, enabling fresh spirit to be run in when required, a float being provided in lower part to indicate level, the air to be carburetted being drawn in through tube when float-wire works. The mixing valve is on back part of carburetter, of fair size, with gauze for preventing back explosions placed between the two valves, the inlet-pipe being carried direct off side of mixing valve-box to engine being a better arrangement than where inlet-pipe was carried through carburetter and generally contracted in size. This was first introduced in the "Gaillardet" motors some time since and has proved very satisfactory.

The clutch on pedal-gear is placed on crank bracket, which is better than being in axle gear-box, as in latter case, machine has to be wrecked to get at it. Objection is chain running all the time, which is true; but there is little or no work on it, though if not provided with gear-case or chain brush, the dirt is carried right into gear-box, which is decidedly bad.

The differential gear-box and spur-wheel case is of large size, enabling use of wheels of ample proportion, which is a great advantage. The differential gear, or balance, as it is sometimes called, is of the flat spur-wheel type, which is claimed to be easier set and adjusted, and wear better than bevel-wheel Stanley type, the axle being covered with single sleeves, as Stanley's, which looks incomparably better, and is quicker for tightening bearings than the double-bridge pattern. The workmanship on the machine appeared to be first class, the finish of details having a substantial English look in character, which will compare favourably with French, which, though ingenious, with few exceptions is usually of the tin-pot variety. It is satisfactory to see *English* makers are waking up to the fact that within the next few years there will be a boom for motors greater than the cycle boom of a year or two back, and it is to be earnestly hoped the public will not remain apathetic as at present, having the impression generally that by waiting they will get something much better—in what way they do not know, but they will wait until the last minute; and it behoves the English Mechanics particularly to see that when demand comes the motor does not bear the legend "made in Germany," though this is the general way we support home industries.

Monty.

[42772.]—I WOULD like to call your attention to a small detail in the motor cycle now being described, which is, how is the *top* "brass" or steel bush of the connecting-rod going to be lubricated, since it cannot be got at without uncoupling the engine casing?

The designer (as such I take him) says that the crank case must not be filled with oil above. Is it ⅓ or ½, or else the oil will splash on the cylinder walls and cause a stink. This being the case, how is the bush to be lubricated? True it does not want much; but steel to steel, and in the piston it must get pretty hot when running, and of course sing out. This is important. I was cycling in Yorkshire a short time ago, and I came across a "De Dion" cycle, and had a chat with the owner whilst riding.

The engine had the "bagpipes" very bad, and inquiring what was the cause, the rider told me it was the connecting-rod top bush. He could not lubricate it for the reasons mentioned, and said this was the *second* bush, whithin a *year*, which they had sent over from the makers in France, and he would soon want another. The gudgeon, thanks to being the hardest, was not cut so very bad. This, I believe, is the drawback to all vertical machines of this type, and a nuisance, in fact, to nearly all vertical engines, simply because the makers think it not worth troubling about.

I send you a sketch of an idea of my own, previously brought out I suppose. 1st. A mark must be made on one of the cog-wheels, the driver preferably, marked so that the engine can be turned on either the top or bottom centre, exact (the bottom-preferred).

Referring to the sketch, A is an oil hole drilled through the gudgeon to half-way, as shown (front section), about ⅛ diam. or less. It has two holes, one on each side of it, drilled at a slight angle (side elevation), which come out at two small plates (to give the oil a chance), one each side of gudgeon, as shown. Through the cylinder wall, and opposite the hole, there is a brass (or iron) pipe ⅜in. diam., internal screwed. To the end of this (front section) is screwed a lubricator, with a spring attached to piston, something after the type of the "Kingfisher" oil cup, but with this *important* difference—that the piston can be secured at the top of its stroke till wanted. There is also a small tap to regulate the flow of oil. When the cup is filled with oil from the crank case, the tap can be opened, and the piston let loose, with the result that some of the oil gets where it is wanted with a rush, most impact. Otherwise, I think the motor is as complete as it can be, considering the object in view of the designer. This I think is clear enough to your readers.

O. Q. A. Por.

[42773.]—SOME time ago "The Writer of the Articles" was kind enough to say that he would arrange with a respectable firm for making patterns for the engine, &c., which he so ably describes. I fancy that there must be many who, like myself, are anxious to making a beginning, or, at any rate, to have the materials ready for work during the coming winter; and I am sure we should be most grateful to "The Writer of the Articles" if he would put us in the way of obtaining the castings, &c.

R. M. G.

AHAZ'S DIAL.

[42774.]—As the "return of the shadow" on that dial was an event I had the rare good fortune to witness here in England one day in 1848, I may tell "Little Bookham" it had nothing to do with magnetism, as suggested in letter 42721. It was not till many years later that I was aware it had happened. There was no sundial near me in 1848; but the sudden shift of the shadow, forward or backward, about 22½ degrees of our measure certainly took place on every dial in Hampshire that day. It was an atmospheric effect, and I will leave your readers to explain it.

E. L. Garbett.

25, Claremont-square, N., Aug. 26.

POULTRY AND EGG CULTURE.

[42775.]—WITH an "incubator" immense quantities of chickens can be reared with perfect safety if you have a proper "foster mother." You can rear them all the year round with a very little care every day. I have seen eggs hatched in December 1,100ft. above sea-level, and all the chickens lived through the winter in the foster-mother.

G. A. Haig.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96154.]—**Dry Cleaning.**—Try with finely-ground starch (rice or potato, not wheat). Brush all dirt out possible; spread on table, and sprinkle starch; fold up into square, powdering liberally between each fold. Put away for several hours, and then open and dust. The starch absorbs grease and dust. Shake well.

REGENT'S PARK.

[96298.]—**Steam Launch.**—I am afraid an answer of sufficient clearness would take up too much valuable room. If the inquirer will publish his address, I will endeavour to assist him.

TRYTOAID.

[96327.]—**Forge Bellows.**—It depends mainly on the nature of the work to be done what sort of bellows is best suited. I fancy that for general work the old-fashioned blacksmith's bellows is best; for a portable forge, the circular bellows or the fan. The querist should endeavour to see the fan at work, and so form an opinion for himself.

T. H. B.

[96328.]—**Flesh-Formers and Heat-Givers.**—See some books written by Dr. Edwin Lankester about the '50's, and works published by J. and A. Churchill, New Burlington-street, W. Mere tables of flesh-formers and heat-givers are not of much use, because their real value depends on what the human economy can assimilate.

T. L.

[96333.]—**A Monkey Puzzle.**—A. Drysdale, p. 43, has given no exact definition of the meaning he assigns to the expression under discussion, unless, indeed, he intends the words of his reply in lines 24-28 to represent his definition—viz., "he must not see opposite sides of it, but he must also be successively at all *points* of a circuit, &c." If this is so, I am afraid he has only fulfilled my forecast; his definition is certainly useless. The word "circuit" is not a scientific term with an exact meaning. Does it include only circular orbits or all closed curves? Must the curves be plane curves, or may they be curves in space, such, for instance, as we might get by slightly distorting a wire circle in a plane outside its own? Further, how can a man who is of three dimensions be "at a point?" The definition is ambiguous. Some of his remarks seem to suggest that he restricts the meaning to cases of revolution in a circle, about the centre of such circle. If so, the man, for example, could not go round the monkey in an elliptical orbit. But when he says "the man could only go round such objects as were in his plane," he makes a meaningless statement. The man, being three-dimensional, cannot be in a plane, nor can he be said to have any plane; neither can the monkey. It is interesting to note that Mr. Drysdale, though he has puzzled himself over the matter, can arrive at no conclusion on the special cases he quotes in lines 15 to 18 of his reply. This alone is sufficient to show that he attaches no exact meaning to the expression. An example of one of these special cases is given by the revolution of the earth about the sun, for the latter body revolves on its axis in about 25 days, therefore, on his own showing, Mr. Drysdale is uncertain whether the earth does or does not go round the sun. Again, he says, "The moon goes round the earth's axis in 28 days." But does this tally with his ideas when we remember that, in a sense, they both revolve about their common centre of gravity? At the end of his letter we read: "The man cannot go round unless he himself is in motion." In motion relative to what points? I would ask. Strict absolute motion is meaningless. Motion is only conceivable when referred to some points considered as fixed. In "terrestrial motions," so called, we consider points on the earth's surface as fixed. In dealing with the Solar System, we assume the sun's centre as fixed, and also some "fixed" star, whose "proper motion" is insensible. In the broadest view of stellar astronomy, where the idea of solar motion is combined with the proper motions of "fixed" stars, we have no theoretical fixed points, and have to assume fixed points on the supposition that the mean of the proper motions of all the stars is a minimum. All this is purely conventional. It follows that when we say A revolves round B, we may (by selecting other fixed measuring points) say, with equal truth, that B revolves round A. As I have said before, Mr. Drysdale may give any meaning he chooses to the expression A goes round B; but, if he wishes to be understood, he must give an exact definition of his meaning. This he has not yet done.

C. P.

[96344.]—**Straw as Stone.**—If the "invention" has been patented, it will be easy to find particulars of the manufacture by obtaining a copy of the specification; but "straw" is in this country rather too valuable, I should think, to convert into artificial stone.

W. B.

[96346.]—**Steamship.**—Query incomprehensible.

The loaded vessel displaces just its own weight in water. Might possibly find some information in Mackrow's work; but it is not clear what is wanted. L. M.

[96385.] — **Electric Fish.** — Thanks to J. McKernan (p. 582). The fish are only flat pieces of tin, and lay on bottom of water-tank, and adhere to ordinary fishing-rod with hook; no wires attached to fishing-rod. How is water charged with electricity? W. H.

[96439.]—**Quadratic.**—To MR. H. S. BURGESS.—In solving "Antario's" equation, I found the roots of the ultimate biquadratic to be:—

$$\pm\left(\frac{1,215}{10,000}\sqrt{-1}\right) - 5\tfrac{3467}{10000}$$

Does this very small cofficient of $\sqrt{-1}$ imply that the equation is anywhere near having four real roots—or, rather, that your quadratic is anywhere near having four real roots?

Oystermouth. SCORPIO.

[96439.] — **Quadratic.** — Thinking "Ontario" may like to have the other three roots of his extraordinary "quadratic," I have amused myself by obtaining them. Taking Mr. Burgess's cleared equation—

$$81y^4 - 720\ y^3 - 9,596y^2 + 8,620\ y + (380)^2 = 0,$$

and dividing by $y - 4$, we get the cubic—

$$81y^3 - 396y^2 - 11180y - 36100 = 0$$

One root of this is found by trial to be—

$$y = 15{\cdot}582241125 \ \ldots\ldots\ldots\ \text{(II.)}$$

Whence by division the quadratic—

$$y^2 + 10{\cdot}69335y + 286{\cdot}017 = 0,$$

and the roots of this are—

$$y = \pm(\cdot1215\sqrt{-1}) - 5{\cdot}3467 \ \ldots\text{(III.-IV.)}$$

where $y = x - 2$. It is curious to note that each of these four roots satisfies one, and one only, of the four forms which the original equation takes as the signs of the radicals are varied—e.g. (II.), only satisfies the form—

$$\sqrt{(x+3)} - \frac{\sqrt{(x-2)}}{\sqrt{(x+3)}} = \frac{11}{3}.$$

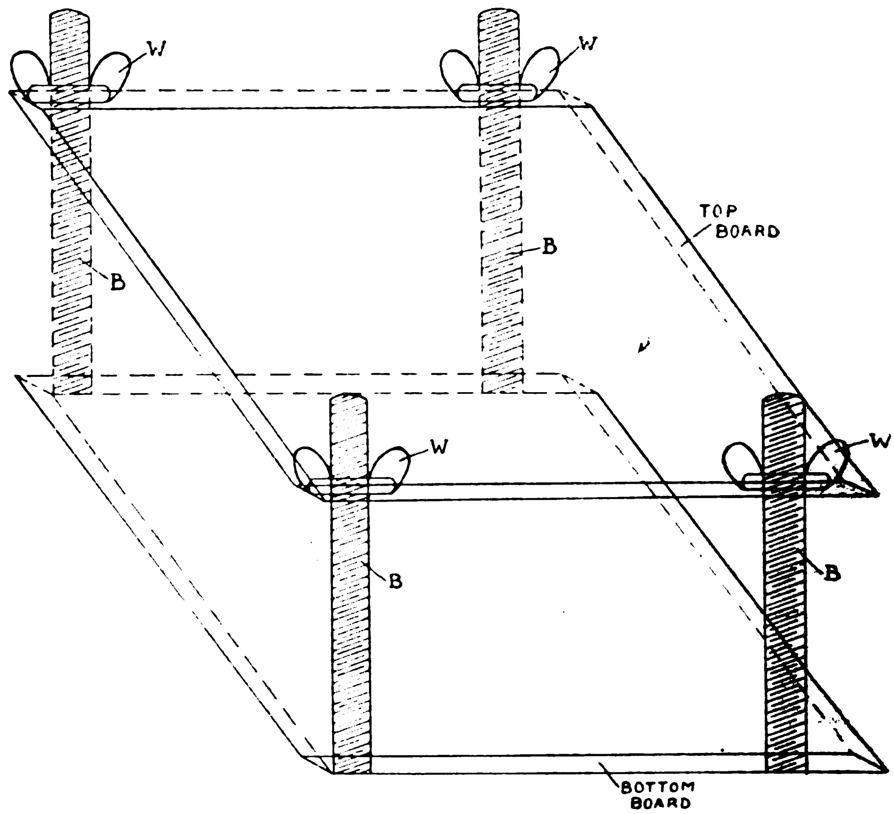
Oystermouth. SCORPIO.

[96446.]—**Saccharin as a Food.**—"With reference to an article in a previous issue on the subject of the use of saccharine and its prohibition in many countries, it should be understood that the prohibition in question is enacted for fiscal reasons only. That saccharine in itself is perfectly harmless is a well-established fact, as it passes through the system unchanged, and that it is an excellent substitute for sugar as a condiment, and is of unquestionable value in certain diseases such, for example, as diabetes and in obesity, as vouched for by many of the highest authorities in this country and abroad."—*Family Doctor*, Aug. 26, 1899. I suspect that answers the question, and may be useful to "Regent's Park." B. D.

[96452.]—**Meal Powder.**—I give extract from an old book which I possess. "To meal gunpowder, brimstone, and charcoal, use a mealing table made as follows: It is of elm, with a rim round the edge 4in. or 5in. high, and one end is a slider, which runs in a groove and forms part of the rim; so that when you have taken out of the table as much powder as you wish, with a copper shovel, you may sweep all clean out at the slider. When you are going to meal a quantity of powder, do not put two on the table at once; but when you have put in a good proportion, take a muller and rub it therewith till all the grains are broke; then sift it in a lawn sieve that has a receiver, and that which does not pass through the sieve, return again to the table and grind again, till you have it all fine enough to go through the sieve." I would not advise querist to make fireworks, or he may find the Excise authorities on his track. I do not think it is allowed in this country. A. DRYSDALE.

[96460.] — **Dissolving Amber.** — I had not noticed that you referred to a special recipe. On turning to this, I find it is from a well-known correspondent. It is just possible that 36oz. of pure spirit would dissolve a little of the 2oz. of amber, if this were previously roasted and powdered; but the result would be no better than if the amber were left out, because roasting takes all the hardness from the amber. The recipes given by our friend are, I am afraid, mostly taken from books, and jumbled together without any practical knowledge at all. S. BOTTONE.

[96462.]—**Wimshurst.**—Thanking Mr. Bottone for his suggestion of reason of failure of paraffin-wax plates, I am sorry to say I cannot attribute my non-success to the causes mentioned by him. In the first place, I have tested the resistance between two adjacent sectors with 200 volts, and this comes out at 210,000 megohms. From front to back of plate, it is too high to measure. With regard to tips of brushes getting insulated with wax, I got over this difficulty by shellacing a path for neutralising



brushes to run on. I do not agree with Mr. Bottone's remarks about hollow glass supports not working, for I know of a machine working perfectly with varnished glass tubes. In my case, I have glass tubes filled with paraffin wax. I think there must be some cause for failure other than those mentioned by Mr. Bottone. G. GREENHAM.

[96467.]—**Inclination of the Pole.**—I have to thank "F.R.A.S." for the trouble he has so kindly taken to supply the useful table of the various inclinations; but if he will please refer to the original question he will see that this does not answer the purpose. What I wanted was some explanation of the original cause of the various angles of inclination. Why are the poles not all at right angles to the various orbits? Bodies thrown off from the sun would have different orbits and different inclinations of their poles according to the distance from the sun's equator; but this is only conjecture on my part. J. R. J.

[96478.]—**Poultry.**—Very common where fowls are confined in small runs. Begin in spring. Caused by pecking at wounds from vermin, generally found round head and neck, and in pecking at nits. Pull feather quills out, watch at some distance out of sight, when the sun is shining, and look for the pickers. When found, remove at once; place in a coop by themselves for a fortnight. If, after they have come out, and still have tendency to repeat evil, place with hen that has had feathers on neck cut short and covered with mustard mixed stiff with vinegar, or other hot substance. The taste of mustard generally cures all but the most inveterate feather pickers or pluckers, and if it fails, kill them at once. Steps to be taken to rid of vermin or nits should be taken. Have prepared powders for the purpose. REGENT'S PARK.

[96469.]—**Indiarubber Stamps.**—In reply to the above query, I beg to say that the class of rubber used for moulding purposes and making into rubber stamps is what is termed "mixed sheet"—that is, pure rubber with sulphur mixed in; and it can be obtained from rubber merchants in various thicknesses. I might state that the method of working the rubber in making the stamp is as follows:—A piece of the "mixed sheet" rubber is first cut out to fit roughly over the mould; the rubber is then slightly heated on one side by holding it against a fire; it is then pressed into the depression of the mould as much as possible (the mould being previously well dusted over with French chalk to prevent the rubber sticking). The mould with the rubber is then transferred to a press, and a simple press for making a few rubber stamps can easily be made by obtaining two square pieces of hard wood, then boring a hole through each corner, and invert a bolt through each corner, and the press is completed. Springs can be put on each bolt to improve it, and wing-nuts, which can then be screwed down with the hand. I inclose a sketch of the press, and shall be pleased to give more details if required. After the mould and rubber is screwed down tight in the press, the rubber, press, and mould is transferred for curing the rubber, which is cured at 145° C., and this can be done by the amateur by contact with a thick iron plate, such as the top of a stove, or in a hot current of air rising from a fire or gas-flame, and to gauge the heat, of course, a chemical thermometer is necessary, that will show high readings, such as 145° C.; but for a small job, however, the proper heat can be gauged by experimenting with small pieces of rubber. Of course, it must be understood that pressure is required when curing, in order that the rubber is forced into all the depressions of the mould. I have described simple apparatus for making a few stamps; but should "G. A. L." or any other reader require any other particulars I will give them the same. W. H. B.

[96468.] — **Indiarubber Stamps.** — A vulcanising apparatus, with lamp and thermometer, such as dentists use, is required for this, and, besides, an iron chase, in which the types are confined. The types are oiled in the usual manner, and the mass is then poured over them. The stereotype plate is not allowed to become dry, but is laid upon a plate of vulcanised caoutchouc. Both plates are then pressed between iron plates, the caoutchouc being pressed in this manner into the stereotype plate. A few sheets of paper are laid between the caoutchouc and the iron plate to prevent the first from sticking to the latter. The whole is then brought into the water of the vulcanising apparatus, and, after the cover has been screwed down, heated to 152° C. (305·6° F.) When it has become cool, the forme is taken from the apparatus, and the caoutchouc is carefully detached. The plate is then cut up so as to obtain the different names, and these are glued to handles. Vulcanising with pure sulphur: Caoutchouc will absorb merely melted sulphur—melts at 113° C. (235·4° F.) It will require a long time before the operation is finished. To hasten, it is necessary to increase the temperature from 150° C. to 170° C. (302° F. to 338° F.), and keep it there for two hours. Not to go much above this temperature, as the caoutchouc acquires hard properties, and not soft as vulcanised. Solvent for rubber: Bisulphide of carbon in connection with absolute alcohol, and anhydrous oil of turpentine. Absolute alcohol made by taking highly-rectified spirit of wine (95 to 96 per cent. alcohol), place in flask previously filled one-fifth full of blue vitriol, which has been strongly heated to pass blue colour to white. This absorbs last traces of water from alcohol, and in doing so gradually assumes its original blue colour, while the alcohol above it has become absolute. Vulcanising with sulphur and mechanical means is by mixing rubber and sulphur by mechanical means, mixture heated to 150° C. and 170° C. (302° F. and 338° F.) If temperature accurately regulated, a homogeneous product is obtained. Kneading rollers also used. Sulphur, in the form of powdered roll or flowers, but with latter, as sometimes sulphurous acid adhere to them, it is necessary to wash them with water and dry completely. REGENT'S PARK.

[96471.]—**Loan Amortisation.**—Referring to my query on this subject, I beg further to illustrate it by the subjoined table, showing the gradual extraction of the loan by the payment of 4½ per cent. interest per annum on 44 years. How does this compare with some of our building societies, as, for instance, above it is stated that for an advance of £1,000, capital and interest is extinguished by a payment of £7 per month for a term of 20 years—i.e., by 240 single payments of £7 each. According to the subjoined table, the difference in favour of the amortisation loan is greater than the whole capital, for whilst this kind of loan only costs £1967·57 in 44 years, an ordinary loan would cost the borrower £1,980 + £1,000 = £2,980, in order to fully liquidate it. X.

Year.	The capital amounts to	In the case of a Loan on the principle of Amortisation, there is to pay:			On the ordinary loan system:	
		On account of capital, 1 per cent. under addition of the interest on the annulled portion of the capital.	Interest at 3½ per cent.	Total.	The capital amounts to	There is to pay interest at 4½ per cent.
	£	£	£	£	£	£
1	1000·00	10·00	35·00	45	1,000	45
2	990·00	10·35	34·65	45	1,000	45
3	979·65	10·71	34·29	45	1,000	45
4	968·94	11·09	33·91	45	1,000	45
5	957·85	11·48	33·52	45	1,000	45
6	946·37	11·88	33·12	45	1,000	45
7	934·49	12·29	32·71	45	1,000	45
8	922·20	12·72	32·28	45	1,000	45
9	909·48	13·17	31·83	45	1,000	45
10	896·31	13·63	31·37	45	1,000	45
11	882·68	14·11	30·89	45	1,000	45
12	868·57	14·60	30·40	45	1,000	45
13	853·97	15·11	29·89	45	1,000	45
14	838·86	15·64	29·36	45	1,000	45
15	823·22	16·19	28·81	45	1,000	45
16	807·03	16·75	28·25	45	1,000	45
17	790·28	17·34	27·66	45	1,000	45
18	772·94	17·95	27·05	45	1,000	45
19	754·99	18·58	26·42	45	1,000	45
20	736·41	19·23	25·77	45	1,000	45
21	717·18	19·90	25·10	45	1,000	45
22	697·28	20·60	24·40	45	1,000	45
23	676·68	21·32	23·68	45	1,000	45
24	655·36	22·06	22·94	45	1,000	45
25	633·30	22·83	22·17	45	1,000	45
26	610·47	23·63	21·37	45	1,000	45
27	586·84	24·46	20·54	45	1,000	45
28	562·38	25·32	19·68	45	1,000	45
29	537·06	26·20	18·80	45	1,000	45
30	510·86	27·12	17·88	45	1,000	45
31	483·74	28·07	16·93	45	1,000	45
32	455·67	29·05	15·95	45	1,000	45
33	426·62	30·07	14·93	45	1,000	45
34	396·55	31·12	13·88	45	1,000	45
35	365·43	32·21	12·79	45	1,000	45
36	333·22	33·34	11·66	45	1,000	45
37	299·88	34·50	10·50	45	1,000	45
38	265·38	35·71	9·29	45	1,000	45
39	229·67	36·96	8·04	45	1,000	45
40	192·71	38·26	6·74	45	1,000	45
41	154·45	39·59	5·41	45	1,000	45
42	114·86	40·98	4·02	45	1,000	45
43	73·88	42·41	2·59	45	1,000	45
44	31·47	31·47	1·10	32·57	1,000	45
			Total	1967·57	Total	1980

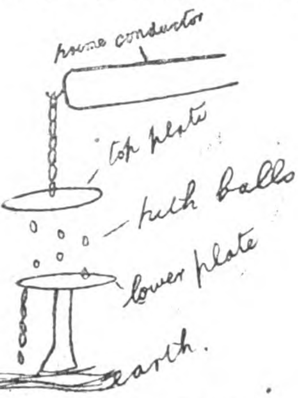
[96479.]—**Bunsen Burner.**—Perhaps data may enable you to judge. Bunsen has two cones, inner one a mixture of air and gas which cannot be kindled, because rate of passage is more rapid than rate at which flame can travel in it. Combustion occurs in outer cone, where speed is diminished. When gas supply to a Bunsen is checked, the velocity of issue of air and gas becomes so far diminished that it no longer is greater than rate at which flame can travel in mixture. Consequently flame passes down the tube of burner and burns at jet from which the coal-gas issues; hence the checked combustion will give rise to much acetylene, detected by its odour, &c. The temperature of the hottest portion of the ordinary Bunsen flame in the centre of the outer cone is stated to be 1,500° C., whilst at the same point in the solid flame the temperature is said to be about 1,600° C. In order to use the hotter flame, it is essential to cover the orifice of the tube with wire gauze to prevent flame from flashing back, &c. REGENT'S PARK.

[96480.]—**Preserving Flying-Fish.** — Solution of alcohol 95 per cent., 8 parts, distilled water 2 parts, makes good vehicle to steep them in. Should have proof alcohol discharged by under part to the interior. May be desirable to remove soft parts. A transparent simple varnish will keep outside right. REGENT'S PARK.

[96482.]—**Insects in Floor.**—In reply to this query of A. J. Scott, I think from his description that the floor he speaks of is infested with dry-rot in an advanced stage, and I might say that the prolific cause of dry-rot is dampness, or dampness combined with warmth, which is a still more active germinating agent than damp alone, the heat being insufficient to evaporate the dampness. The dark stagnant air to be found in practically airless cellars and basement rooms such as he speaks of is just the place to nourish the growth of the fungus. Other causes of the rot are the stagnant air under the floors of the ground—floors where the vegetable soil is not removed, and there are many other causes, all of them in the main being owing to dampness. Stagnant air and bad ventilation is the cause of this. The wood must not only be dry when put in, but must be kept dry if it is to be prevented, and this is an impossibility if the house into which the floor is put is damp, as the air condenses and the wood absorbs the moisture. To exterminate them, as far as I am aware, there is only one remedy, which is to cut away for at least a foot over every part where the fungus is visible. This should be thoroughly done, and all remaining wood, also new wood that is put in, and surrounding brickwork, should be covered with a solution of corrosive sublimate; and great precaution should be used when using corrosive sublimate, as it is a deadly poison, and it is therefore advisable to add a little colouring matter to the solution to show what parts have been painted. I might say that one particular cause of dry-rot is by reason of floors being covered with linoleum, the linoleum preventing any fresh air reaching the floor; consequently the floor and even the linoleum is completely rotted in a very short time. It would take a very long article to describe all the causes of dry-rot and the methods of preventing and getting rid of it; therefore I should advise A. J. Scott to see some practical man on the subject as early as possible, as it is a thing which spreads in all directions (even in the air), and which in a short time plays great havoc in destruction. W. H. B.

[96488.]—**Pitch of Worm.**—Pitch = diameter of pitch circle of wheel, instead of the circumference; it is called the pitch per inch. To find number of teeth in wheel of given diameter and pitch per inch, multiply diameter of pitch circle in inches by the given pitch per inch. To find diameter of the pitch circle to contain a given number of teeth of a given pitch inch, divide number of teeth by the required pitch per inch. Pitch per inch in diameter bears the same ratio to the circular pitch as diameter to circumference. A diametrical pitch of 1in. corresponds with a circular pitch of 3·1416in. To find circular pitch, divide 3·1416 by given diametrical, and to find diametrical pitch divide 3·1416 by given circular pitch. The outside diameter of wheel over top of teeth is found by adding two parts of diametrical pitch to the pitch diameter—e.g., a wheel of 48 teeth, eight per inch pitch, is $6 + \frac{2}{8}$th = 6¼in. diameter outside. The depth of teeth of small wheels usually equals three-fourths pitch. REGENT'S PARK.

[96489.] — **Wimshurst Experiment.** — It is possible that there may be sharp points on the wire which allow the electricity to escape. I prefer a brass chain best. To make pith balls, &c., dance, have two metal plates, one below the other, at a



distance of some inches; connect top with machine and lower with earth, as in sketch. On working machine the balls will dance. I have done it with a roughly made old-fashioned cylinder friction machine, giving 1in. spark. A. DRYSDALE.

[96492.] — **Parachute.** — Possibly data may assist. Gravity: The square of the number of seconds × $16\frac{1}{12}$ = the distance, in feet, a body will fall in a given time. Momentum: The weight in pounds by the velocity in feet per second gives the momentum of bodies. Air is about 840 times lighter than water. The pressure of the atmosphere supports water at the height of upwards of 32ft., or 33ft. nearly. The height of a homogeneous atmosphere is nearly 33 × 840, or nearly 27,720ft. Circumference of cover of parachute about 16ft., with a small hole in the centre to allow the compressed air to escape and prevent oscillation is, I think, usual. Force of gravity near the surface of the earth: Bodies allowed to fall freely, force of attraction being constant, communicates to them equal additions of velocity in equal intervals of time. At the end of one second velocity of body is 32·155ft., at the end of two seconds 2ft. and so, or velocity acquired by falling body is equal to product of time of body's fall in seconds by $32\frac{1}{6}$ft., putting $32\frac{1}{6}$ for 32·155 expressed by equation—

$$v = t \times 32\tfrac{1}{6}.$$

Space described by a falling body in four seconds is equal to the square of the time × by space described in one second. In general, the relation of the space S in feet and the time t in seconds is expressed by equation—

$$S = t^2 \times 16\tfrac{1}{12}.$$

Resistance of a fluid to moving bodies d = density constant, and in places where value of $2g = 64·3634$, and putting K for $\frac{K\,d}{2g}$ it takes the form—

$$R = K\,A\,V^2$$

or—

$$R = K\,A\,(V \pm v)^2$$

Dubuat and others call H the height due to the relative velocity V, or V ± v, consequently—

$$H = \frac{V^2}{2g} \text{ or } H = \frac{(V \pm v)^2}{2g}$$

and putting K′ = Kd give formula as R = K′ A H. Mass in terms of weight. Let λ denote latitude of place, h its elevation above mean sea level, g_1 = 32·1695ft. per second, being value for λ and h = 0, and R = 20,900,000ft., being earth's mean radius, then—

$$g = g_1\,(1 - 0·00184 \cos. 2\,\lambda)\,.\,\left(1 - \frac{2\,h}{R}\right)$$

for latitudes exceeding 45° cos. 2 λ is negative, and terms containing it as a facter have signs reversed sufficiently accurate. g = 32·2ft. per second nearly. Body of weight W acted on by unbalanced force, F, the change of velocity in the direction of F produced in a second will be—

$$\frac{F}{m} = \frac{F\,g}{W}$$

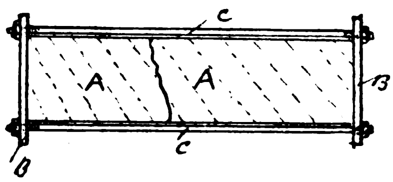
whence—

$$m = \frac{W}{g}$$

m is constant. g and W vary in the same propor-

tion at different elevations and different latitudes. The density of air varies at different distances from earth's surface—e.g., about four times rarer at seven miles than at surface, at 14 miles it would be 16 times, &c. The rarity augments in a geometrical progression, the altitude in arithmetical progression.
REGENT'S PARK.

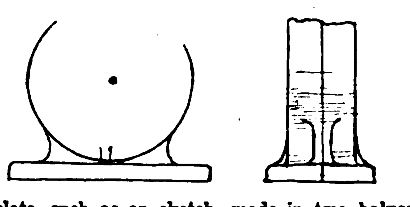
[96495.]—**Oilstone.**—After having tried glue, &c., with very qualified success, I hit upon the following idea: — In sketch, A A represent the



broken pieces of stone, B B are two pieces of ¼in. iron ⅝in. broad, with two ¼in. clearing holes in each, and C C are two long ¼in. bolts. After screwing the nuts hard up, grind the faces of stone on an ordinary grindstone or coarse emery cloth. It is scarcely worth while putting so much labour on a cheap stone; but with a Turkey it is different, and of course if it has broken very obliquely this arrangement is no good. W. EWART GIBSON.

[96497.]—**Magnetic Effects.** — Resistance of metals: Copper 1, gold 1·29, zinc 3·52, iron 6·08, lead 12·29, antimony 22·23, bismuth 82·13, gas carbon 2037·00, silver 0·94, aluminium 1·82, platinum 5·67, tin 8·27, Ger. silver 13·10, mercury 59·55, graphite 1106·00. Conductivity, specific: silver 100, zinc 27·76, iron 15·50, Ger. silver 7·19, graphite ·0852, copper 94·2, platinum 16·61, lead 7·67, mercury 1·58, retort carbon ·0463. Magnetic field: The influence of any magnet extends all round it, so that if at any point the pole of a smaller magnet were placed, it would experience a force varying with its distance from the larger magnet. The fact that the magnetic influence pervades a space is expressed by saying that the space is a magnetic field, the strength that would be exerted on a unit pole at any point being called the intensity of the field. Hence the intensity of the field at any point is measured by the force with which it acts on a unit magnetic-pole placed at that point. In absolute measure the unit of intensity is that at which a unit-pole is acted on by the force of a degree. If F be the force acting on a pole of p units, where the intensity of the field is H, then $F = pH$. Then the unit is the quantity of electricity concentrated at a point capable of repelling a similar quantity of electricity at another point at the distance of one centimètre with a force of one degree, or with a force which would give the mass of one gramme the velocity of one centimètre per second in one second. REGENT'S PARK.

[96501.]—**Oil and Gas-Engine.**—The dimensions are suitable, only you would require a small



bedplate, such as on sketch, made in two halves along with crank chamber, whose bolts would, of course, keep it together. W. EWART GIBSON.

[96505.]—**Lithia.** — Some thirty years ago I had a bad attack of gravel, and, after having been set right by my doctor, I asked him what I could take to prevent a recurrence, in some convenient form for travelling abroad. He advised granulated effervescent citrate of lithia, which I have never since been without. When I have felt any uneasiness about the kidneys, lumbago-like pains in the loins, or rheumatic aches and pains in any part of the body, I have taken, at once, a teaspoonful in a third of a glass of water—a refreshing, pleasant draught—and I feel sure that my life has been lengthened and made much less painful from a timely use of it. One to four doses, at or before meals, have generally been sufficient, though it has been required three times a day for a week on several occasions, to clear the blood. I should never advise this or any other medicine to be taken habitually, in order that its full effects might be felt when needed occasionally. I believe Bishop was the first to introduce this form of medicine, and have always taken his, to be sure of getting a given quantity of lithium. I presume there are other reliable makers, but advise the querist, as I have done many before, not to purchase the article loose, but in a bottle, with a reliable maker's seal to the cork, for once I got for citrate of lithia at a druggist's a similar-looking article which was proved by analysis to contain "not a trace of lithium."
EDWARDS.

[96505.]—**Lithia.**—The natural alkaline waters of the celebrated Neuenahr Spa are considered very effective. They can doubtless be procured through chemist's stores. Write for English prospectus to "The Direction" of the Spa at Neuenahr, near Remagen on Rhine, Germany. X.

[96505.]—**Lithia.**—Without entering into the question as to whether lithia is really any more efficacious in removing the uric acid tendency from the system than soda or potash, &c., it may be broadly stated that the best mode of administration is in the form of certain natural mineral waters, as, for example, Huel Seton water (Cornwall), Baden-Baden, Carlsbad, Aix la Chapelle, Bilin, &c. The salt usually prescribed is the carbonate.
S. BOTTONE.

[96509.]—**Resistance Coil.**—To MR. BOTTONE. —Rather an awkward job, since 2lb. No. 22 is about 240 yards long. However, wind your wire in a tight spiral round a ¼in. mandrel, drawing off from time to time what you have spiralised, until you have done the entire length, which will then measure about 16 yards. Arrange this zigzag fashion between the upper and lower bars of a square frame (which should be faced with slate), stretching it slightly between studs on the upper and lower bars. Put terminals at each end. A ½H.P. windmill will require vanes about 4ft. long. For illustrations, &c., write to Messrs. Duke and Ockenden, millwrights, Littlehampton, Sussex.
S. BOTTONE.

[96510.]—**Coppering Carbons.**—Pitch is very good, and is best applied with a hot iron. It will dissolve in oil of turpentine, but remains sticky for a long time. You will find bicycle enamel better for small, neat jobs. S. BOTTONE.

[96512.] — **Electric Lighting.** — The cheapest and best way is by means of a small dynamo driven either by oil, gas, or steam-engine. Cost of total plant, inclusive of lamps and shades, would come out somewhat as follows:—Dynamo, £2 10s.; gas-engine, £4; lamps, shades, and wiring, 15s.—say, £7 5s. Read my book, "Guide to Electric Lighting," and do not allow anyone to bamboozle you into buying a battery to light your lamps with.
S. BOTTONE.

[96512.]—**Electric Lighting.**—You would do better with a ½B.H.P. gas-engine and a small dynamo. You could then light four or five incandescent lamps. To light only two by a battery of cells would be troublesome and unsatisfactory.
Dudley. WEBSTER MICHELSON AND CO.

[96515.]—**Model Steamer.**—Engines should be powerful enough to drive boat, if the boiler is large enough; but you will not get much speed out of it. Another tube will only increase the quantity of steam generated at a given pressure, and the safety-valve should be a little larger, but no stronger—i.e., it should blow off at the same pressure. A short tubular stuffing-box is only required in addition to the bearings. TRYTOAID.

[96518.]—**Charging Accumulators.**—Proceed methodically. It takes 2·5v. to charge each cell; hence with 6v. you can only charge two in series properly; but as you have 60 ampères at your disposition, you may be able to charge several sets of two in series at once. To know how many, you must ascertain from the makers of the cells what the fair charging is. Suppose you find it to be 12 ampères, then 12)60(5. You could therefore arrange the cells in five parallel sets of two in series. Without knowing the ampère-hour capacity of the cells, it is impossible to say how long they will take to charge; but either by a voltmeter or by a hydrometer, you can ascertain whether each cell has received its full charge. The voltmeter should indicate 2·25 volt, the hydrometer should read 1·19.
S. BOTTONE.

[96518.]—**Charging Accumulators.** — The best arrangement for charging the four [motor-car cells with your plating dynamo is two cells in series 2in. parallel. The voltage required would then be five, and the number of plates in each cell would determine the quantity. The charging must be continued until the solution in the cells becomes milky, and gives off gas freely.
Dudley. WEBSTER MICHELSON AND CO.

[96518.]—**Charging Accumulators.** — Two cells in series is the greatest number that the dynamo will charge; but you can add as many more in parallel as 50 ampères will supply, allowing about 5 ampères for every square foot of positive. For cells in series you, of course, only reckon the area of one cell. For example, suppose each cell contains 1sq.ft. of positive then with two in series you require a current of 5 ampères, as the total current passes through both cells. If, now, you add a second pair of cells in parallel with the first two, the same voltage will suffice to drive the current through them; but the current will be divided between the first pair and the second pair, giving at 5 ampères only 2·5 ampères to each pair —that is to say, the current supplied must be increased to 10 ampères, and so on. It is necessary to have at least 2·5 volts at the dynamo for every cell in series. The time required for charging will be rather greater than the capacity in ampère-hours divided by the charging current. When fully charged the sp. gravity of the electrolyte will have risen to about 1·19, and the plates will gas freely. A fully-charged cell will show a voltage of 2·5, and 1·9 volt is the lowest limit to which a cell should be allowed to discharge to. W. J. G. F.

[96519.]—**Water Power.**—Of course, with the same head the shorter pipe will discharge more water and give more power than the longer pipe. A 4in. pipe 100ft. long with 10ft. head will discharge 341·32 gallons per minute, the same pipe 1,000ft. long with 10ft. head 98·60 gallons per minute. A turbine of 80 per cent. efficiency would, roughly speaking, develop 1H.P. with the shorter pipe, ¼H P. with the longer. W. J. G. F.

[96519.]—**Water Power.**—The velocity of a flowing liquid depending like that of a falling body, on gravitation, a stream issuing 4ft. below the surface of a liquid mass or head, will have double the velocity of one issuing at one foot below the surface. At the depth of 9ft. the velocity will be treble, at 16ft. fourfold, at 25ft. fivefold, and so on, and is independent of the irregularities of friction, &c.; the velocity equals the square root of the depth of vertical column of water. Actual velocity compared with theoretical, as 64 to 100. Head of water in feet × ·433 = pressure in pounds per square inch. Pressure in pounds per square inch × 2·31 = head of water due to pressure. Contents of pipe: square the diameter in inches, result will be weight of water in one yard of pipe. One-tenth of the amount will be number of gallons one cubic foot of water = 62·425lb. One gallon = 10lb. One H.P. = 33,000lb., raised one foot high per minute. REGENT'S PARK.

[96520.]—**Velocity of Light.**—In space this is exactly the same for all kinds of light. Otherwise the eclipses of Jupiter's moons would be coloured. But it is believed that in refracting bodies the colours have some difference of velocity.
E. L. G.

[96521.]—**Speed of Falling Chain.**—This is the way I would attack "J. F. B.'s" problem. Let m = mass of unit length of chain. At the end of the time, t, before the end of the chain has reached the bottom of the pit, let there be a length, s, of the chain in motion, and let v denote its velocity at this particular instant. The chain is leaving the upper coil at the rate of mv units of mass per second, and the velocity with which each particle is being started is V. The rate of generation of momentum in the chain leaving the upper coil is therefore mv^2 units per second. The force or tension in the chain where it leaves the upper coil is therefore also mv^2. We have then a length, s, of chain of mass, ms, acted on by an upward force, mv^2, and by a greater downward force—viz., its weight, mgs. By the second law of motion—

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\therefore mgs - mv^2 = ms \times \text{acceleration}$$

or— the acceleration $= g - \dfrac{v^2}{s}$

We must now find an expression for the acceleration such that $g - \dfrac{v^2}{s}$ may be equal to it throughout the motion—i.e., at any instant of time. Let a be the actual acceleration of the chain, and then $v = at$, and $s = \frac{1}{2}at^2$.

$$\therefore \frac{v^2}{s} \left(\text{in the expression } g - \frac{v^2}{s}\right) = \frac{a^2t^2}{\frac{1}{2}at^2} = 2a.$$

$$\therefore g - \frac{v^2}{s} = g - 2a = \text{constant} = a,$$

or $a = \dfrac{g}{3}$; or the chain descends with uniform acceleration equal to one-third of that due to gravity in an unconstrained particle. Now—

$$v^2 = 2gs.$$

Substituting— $v^2 = 2 \times \dfrac{32 \cdot 2}{3} \times 580,$

or $v = 111 \cdot 6$ft. per second. In other words, the velocity of the chain would constantly increase until its end reached the bottom of the pit. Thereafter the chain would continue to fall with the constant velocity of 111·6ft. per second. The tension in the chain is at a maximum at the point of departure from the upper coil; from that point downwards it diminishes. D. J. CARNEGIE.

[96523.] — **Water Lifting.** — The simplest, cheapest, and most assured as to avoidance of clogging is by a centrifugal pump driven by the steam-engine. A 3in. c.p. costing, say, £12, including foot-valve and grating, using, in this case, 4in. suction or force pipes, would do the work most effectively. The pipes would cost about 2s. per foot of length, including jointing materials. They must be laid well underground to avoid water freezing; a means for draining them when not in use should be provided. Revolution of pump disc about 1,500 per minute. H.P. required about 5. The pump should, of course, be placed near the engine, and driven by a belt, and the vertical

section height should not exceed 15ft., the pipes having a regular rising gradient from the foot-valve in the pump, and perfectly air-tight. A self-acting check-valve on delivery-flange of pump, with a small outside charging pipe and cock between its upper and under surfaces is advisable.
M.

[96523.]—**Water-Lifting.**—Does "Redburn" require a cheap makeshift apparatus to raise this quantity (p. 46) once, or an efficient pumping plant for raising the quantity at daily or weekly intervals?
TRYTOAID.

[96550.]—**Mensuration.**—Let n = number of sides, r = radius of ⊙.

$$\text{Area of inscribed hexagon} = \frac{n r^2}{2} \sin. \frac{360°}{n}.$$

$$\text{Area of circumscribed hexagon} = n r^2 \tan. \frac{180}{n}.$$

$$\frac{n r^2}{2} \sin. \frac{360}{n} = \frac{6 r^2}{2} \times \cdot 8660 = 2{\cdot}5980\, r^2.$$

$$n r^2 \tan. \frac{180}{n} = 6 r \times \cdot 5774 = 3{\cdot}4644\, r^2.$$

$$3{\cdot}4644\, r^2 - 2{\cdot}5980\, r^2 = 813\text{sq.ft.}$$
$$\cdot 8664\, r^2 = 813$$
$$r^2 = 938{\cdot}4 \text{ approx.}$$
$$\therefore r = 30{\cdot}63.$$

$$\text{Area of } ⊙ = (30{\cdot}63)^2 \times 3{\cdot}1416 = 2947{\cdot}63\text{sq.ft.}$$

Lasswade. J. WIGHT.

[96528.]—**Chemical Action.**—The sodium of the $Na_2Mn_2O_8$ and the hydrogen of the H_2SO_4 would replace one another, forming permanganic acid and sodium sulphate. The effect of adding the mixture to sewage would be to deodorise the harmful products of decomposition.
W. J. G. F.

[96528.]—**Chemical Action.**—When sulphuric acid is added to a solution of sodium permanganate, sodium sulphate and permanganic acid are produced; but this latter splits up immediately into hydrated binoxide of manganese and free oxygen gas. If the above mixture were made previous to its addition to the town sewage, little good would accrue, since most of the oxygen would have escaped in the form of gas. Were it possible, however, to effect the mixture at the time of the addition, it would greatly assist in disinfection.
S. BOTTONE.

[96528.]—**Chemical Action.**—On mixing sulphuric acid with potassium permanganate in aqueous solution, oxygen is liberated:—

$$4KMnO_4 + 6H_2SO_4 = 2K_2SO_4 + 4MnSO_4 + 6H_2O + SO_2.$$

It is impossible to state definitely what would be the exact action of the mixture on the sewage, as it would depend on the composition of the latter, temperature, pressure, &c.; but, broadly speaking, all organic matter easily capable of oxidation would be destroyed, the carbon being oxidised to carbon dioxide, the hydrogen to water, and the nitrogen to nitric acid, which would, of course, combine with the various bases present to form nitrates.

Trin. Coll. Oxon. J. M. W.

[96529.]—**Duffett's Battery.**—Depends entirely on the size of the battery. I have known a three-pint cell to give 2 ampères for 24 hours right off. Yes, there is a good bit of local action; the same cell would be practically spent if left uncoupled for four days and nights.
S. BOTTONE.

[96530.]—**Alternator.**—To MR. BOTTONE.—It is extremely doubtful whether you would get alternators by different makers to run together in parallel. Apart from the question of varying cycles, there is that of the difference of crests and curves. It would certainly be necessary to use a synchroniser. The use of a synchroniser is to ascertain when the machines are running in step with one another.
S. BOTTONE.

[96533.]—**Liquid Fuel.**—Slit sprinklers, in vogue years ago, are stated to be good in their way; have average oil consumption of 6·4lb. per H.P. per hour, and 5 or 7-fold evaporation, according to experiments by Noble and Guleshambarov. However, they waste steam and oil, and best adapted for countries where oil is cheap. Pipe sprinklers have also their admirers; work more economically than slit sprinklers. The first, require 6·6lb. of oil per H.P. per hour, while the latter require from 4·4 to 5·5lb. Consumption of steam much less, not more than 4 to 6 per cent., whereas slit-sprinklers use 6 to 8 per cent. The stopping up of the outlets of the slit sprinklers applies in a less degree to the pipe sprinklers. The principal advantage of pipe-sprinklers consists in the spherical flame which fills up the cylindrical fireboxes of marine boilers better and heats them more equably than does the stream of the slit sprinkler. They save the walls of the boiler, and render, when properly fitted, firebricks at back of firebox unnecessary. Nozzle sprinklers: One of the simplest is that of Sadler's; consists of two small bronze nozzles screwed on to opposite ends of a T-shaped malleable iron pipe. Another T-shaped pipe is screwed into third orifice of the first; the horizontal pipe of this admits the oil, while the perpendicular end admits the air. The steam-pipe, before reaching the sprinkler, is conducted into the furnace, and forms a winding pipe here, through which the steam is passed to get superheated. The oil and air enter the sprinkler through the same orifice and in the space between the nozzles. The furnace is lined with fireproof brick. The oil and steam supplies are regulated by separate taps or valves.
REGENT'S PARK.

[96535.]—**Crucibles for Silver.**—Heat new crucibles to a bright red heat, and throw in some scraps of hard Bohemian potash glass. When nearly melted, smear round inside of crucible thoroughly, and remove surplus glass.
TRYTOAID.

[96536.]—**Crucibles for Silver.**—When desired to prepare crucibles to withstand extremes of temperature, mixture of siliceous sand, ground flints, calcined clay, graphite, or powdered coke. The most infusible prepared from clays containing largest proportion of silica, and in which the amount of lime and oxide of iron is small. Add siliceous sand, graphite, or powdered coke to clay in proportion of one-fifth; if, in the case of the two latter, a larger amount were used, although the infusibility of the concrete might be increased, the carbonaceous matter would be liable to become consumed, and the crucible gradually destroyed.
REGENT'S PARK.

[96537.]—**Electric Lighting.**—To MR. BOTTONE.—(1) Absolutely indifferent; usually put on the positive. (2) No, because the cells take up the excess.
S. BOTTONE.

[96538.]—**Gravity.**—This must be felt instantaneously at all distance. Otherwise, the motions of heavenly bodies would be very different.
E. L. G.

[96542.]—**Nordrach Treatment of Consumption.**—In the *Nineteenth Century Magazine*, for January, 1899, there appeared a paper by Mr. J. A. Gibson, describing his experience as a patient of the treatment at Nordrach, where he remained many months, and where he was restored to health. In the number of the same magazine for February Dr. Coghill, physician of the hospital for consumption at Ventnor, criticised Mr. Gibson's statements, thinking him influenced by gratitude to exaggerate a little, and giving some particulars from his own hospital for comparison. In the March number, Mr. Gibson replies, and gives further information, and many particulars to facilitate the building of sanatoria in this country. All three articles, I think, should be of much interest to a "Consumptive."
T. S. P.

[96542.]—**Nordrach.**—I expect much the same as that of Mr. Just at Pangborn, which consists of curing by natural means—i.e., by bathing, light and air, earth-energy, and a natural system of diet. Here, too, the open-air cure is carried out on an elaborate scale by sleeping in the open, or in partly closed sheds—often, in fact, on the bare ground out of doors; by sun-baths and earth packings, and wonderful are some of the cures said to be effected without anything in the shape of drugs, and for every kind of ailment. Write for prospectus to Mr. W. Just, Pangborn, Post Stapelburg, Harz, Germany.
X.

[96543.]—**Sundial.**—If I were "Nauticus" I should try ordinary cement. I have made two sundials. The dials are made entirely of ordinary cement mixed with fine gravel; when it has dried it is as hard as slate, and then painted with white paint. The styles are brass pins, and are fixed on the dials when the cement is wet. When the cement is dry they are perfectly solid. "Nauticus" might try cement or cement with fine gravel mixed.
TANNER.

[96543.]—**Sundial.**—Melted sulphur and Portland cement are both good. Clear out holes, set pins central, and run with the sulphur or cement.
TRYTOAID.

[96544.]—**Lard Refining.**—Melt by aid of a saline or steam bath in an enamelled iron vessel, and add gradually 1oz. powdered alum and 2oz. chloride of sodium to every 50lb. of fat under treatment. Heat continued above 212° F. until scum ceases to rise to the surface, which contains all the organic and other impurities, and must be skimmed off as fast as formed. Fat then strained through bolting cloth into clean stone jars and left to cool. Next spread on circular stone slab, top surface of which is slanting from the centre, or slightly conical in form, and provided with a stone roller made to revolve by suitable gearing. As the roller or muller revolves over the fat, cold water is allowed to trickle upon it, and this dissolves the saline impurities remaining in the fat. Afterwards the fat is heated until all water is expelled by evaporation. When cold, fat will be found to be very white and pure.
REGENT'S PARK.

[96545.]—**Rubber Rings.**—If the rings are not too far gone, let Mr. Dow soak them in a dilute solution of ammonia (obtained by adding 1 vol. of ·880 ammonia to 2 vols. water) till they become soft. The process is hastened by squeezing them at intervals between the fingers. I can personally recommend this recipe, as I always use it for softening rubber stoppers that have become hard. It is, however, useless if the rubber has become quite brittle. Rubber articles should be stored in airtight tins, or at least in the dark.

Trin. Coll. Oxon. J. M. W.

[96545.]—**Rubber Rings.**—Solvents for rubber: Of 100 parts of rubber in bisulphide carbon 65 to 70 parts, benzol 48 to 52 parts, oil turpentine 50 to 52 parts, caoutchine 53 to 55 parts, ether 60 to 68 parts; softening would take less time. Bisulphide of carbon is very volatile and poisonous. If quantities of rubber are dissolved or softened with oil of turpentine, a simple method is to pour oil turpentine, with about 10 per cent. of its weight of English sulphuric acid, into a well-closed tank, and allow it to stand till used. Sulphuric acid forms sediment at the bottom of vessel, from which can be drawn off the oil turpentine. Instead of sulphuric acid, melted calcium chloride can be used. If rubber in small pieces is placed in boiling linseed oil it can be dissolved or softened; but besides the altered rubber, solution will contain dissolved other products. The machine for cutting up rubber is one with cylindric cutting-drum, something akin to the wood-planing machine. The periphery of the cylinder formed of sharp knife-blades inclined towards the superficies. Rubber (cubes) pressed by a lever against cutting cylinder revolving at high speed shreds the material. To prevent heating of knives or planes a jet of water falls on knives, &c. See W. T. Braunt on "Rubber and Its Working."
REGENT'S PARK.

[96545.]—**Rubber Rings.**—Perished rubber can never be satisfactorily restored, especially when required to stand steam pressure. It can be ground up and mixed with fresh rubber and sulphur to make an inferior vulcanised rubber.
TRYTOAID.

[96546.]—**Motor Batteries.**—Fresh sawdust well moistened with a strong solution of salammoniac, to which a little glycerine and solution of zinc chloride have been added, will start the batteries afresh, provided the carbon contacts are clean and good. Say, salammoniac 1lb, water 5 pints, glycerine half-pint, chloride of zinc ¼lb.
S. BOTTONE.

[96550.]—**Mensuration.**—The smaller and larger hexagons being exactly as 3 to 4, and their difference 813in., this is also the area of one-third of the inner hexagon. Dividing it by $\sqrt{\frac{3}{4}}$, which is ·8660254, we get 938·77154 for the area of a square the radius of your circle. Multiplying this by 3·14159265 gives 2949·2446 for the circle's area.
E. L. G.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

A NEW ice-breaker is expected at Cronstadt for use in that port during the coming winter. It has been built at Abo.

IT is an unexplained fact that glowworms are much more brilliant just before an approaching storm than at any other time.

QUERIES.

[96551.]—**Motor-Cycles.**—I should like to ask if the writer of the articles on "Motor Cycles" now appearing in "Ours" would be kind enough to give us a design for the fore-carriage of a tandem quadricycle, and also steering arrangement for same, before concluding his articles?—AJAX.

[96552.]—**Cigarettes for Asthmatical Patients.**—Can any of your readers inform me how to make the cigarettes sold by chemists for the cure of asthma, &c. If so, I shall be greatly obliged.—W. RITCHIE.

[96553.]—**Astronomical.**—Will some scientific reader kindly answer the following? In solving the astronomical triangle when Lat. is south and sun's Dec. is north, is it not correct to use for colat. 90° + lat. and for polar dist. 90 − dec. Is there any other way giving same result?—JANCIS.

[96554.]—**Magnetism.**—In remagnetising a compass needle of theodolite, can one use a horseshoe magnet or is a straight bar-magnet better? I find a straight bar loses its magnetism.—JANCIS.

[96555.]—**Equations.**—Will a mathematician kindly give a student the solution of the following simultaneous equations?

$$\frac{2}{3}x^2 + \frac{3}{5}yz = 6\tfrac{3}{4}$$
$$\frac{3}{5}y^2 + \frac{5}{7}xz = 7\tfrac{1}{2}$$
$$\frac{5}{7}z^2 + \frac{7}{9}xy = 11\tfrac{2}{3}$$

—J. HARDING.

[96556.]—**Oil and Gas Engines.**—Would someone oblige by telling me what proportion of a motor cylinder's capacity should be left for the compressed gases when the piston is in? Whether there should be a difference when using coal-gas, petroleum vapour, or the vapour of petrol, and why is this particular compression the best?—ISIS.

[96557.]—**Window Cases.**—Will any reader kindly inform me what are the best ferns to grow in a case about 2ft. 6in. in length, also if there are any special methods of treating them?—PARIS.

[96558.]—**Injector.**—Can any reader explain why injector will not force water into boiler when working? It will feed boiler when engine is not working, but when engine is working no water can be forced in with injector. Boiler is 4H.P.—W. H.

[96559.]—**Billiard Table.**—Can anyone tell me how to put a new cloth on a slate table 12ft. by 6ft. with indiarubber cushions?—G. A. H.

[96560.]—**Electrical Work in Australia.**—Can any reader tell me if there is much electrical work in Australia, and could I work my way out? Any hints will oblige—ELECTRIC ENGINEER.

[96561.]—**Perspiring Hands.**—Could any reader state a remedy for perspiring hands, as perspiration interferes greatly with violin-playing?—A READER.

[96562.]—**Lantern Screen.**—Will any reader kindly give hints for making an opaque screen about 7ft. square to roll up? I want a recommendation both of a good fabric to hang smoothly, and of a satisfactory dead-white surfacing material, not liable to crack or fall off.—BOOKWORM.

[96563.]—**Belting.**—Given the diameters and distance from centre to centre of two unequal pulleys. Required, formula to determine necessary amount of driving belting open and crossed.—C. J. CHARNOCK, Sereda, Russia.

[96564.]—**Organ for the House.**—Will some fellow reader of "Ours" tell me if bellows 48in. by 24in. will be large enough to supply wind to a manual organ of six stops and Bourdon pedal, small scale? Great to be 4ft. wood stopped, 8ft. open metal (to tenor C), and a 4ft. metal through; Swell: 4ft. stopped, wood, 4ft. metal open, and 2ft. metal open; Pedal: bottom twelve notes with remainder coupled to Great. Would that be a good specification for a practice organ for the house?—PIPE ORGAN.

[96565.]—**Dynamo for Nickel-Plating.**—I have a dynamo with cogged-ring armature, wound for 50 volts and seven or eight ampères. The fields are wound in four sections. Can I use this for nickel-plating if I run slow, so as to reduce the volts, and connect the four sections of the fields in parallel, so as to reduce their resistance?—ISIS.

[96566.]—**Motor-Cycles.**—I have been very interested in the articles appearing in the ENGLISH MECHANIC on "Motor Cycles." Having a Beeston motor-tricycle, with tube-ignition, I am now thinking of altering it to electric, and should be glad to know if I may expect more power and speed from it when so altered? The gear is 12 and 88, and 26in. wheels. I can travel about sixteen miles an hour; but it does not go so very fast down hills. I think this is because one cannot alter the time of ignition with a tube. I think of having one of Blake's coils and dry cells. Are magneto-igniters any use for tricycles? I also find the oil gets out between the top of case and cylinder. I have not a valve for the compressed air and the gas that gets by the piston to get out, and it seems to me that that forces the oil out. I cannot have valve fitted on the oiling-screw, as I have the tube from the oil-pump or spare tank fitted there. Would a length of ⅜ tube screwed in case, and carried above motor (so that oil should not get out) do? Where should it be fitted to case?—T. L. SPENCER.

[96567.]—**Dry Pile.**—To "SIGMA" or MR. BOTTONE.—Will you kindly inform me whether it is possible to construct a dry pile, in contact with a metal plate, of sufficient intensity to render fluor-spar luminous when dusted on it? If so, will you add how many tinfoil and manganese series would be necessary for the square foot for a slowly-acquired, but permanent, effect (vide Sprague's "Electricity, &c.," 1884, p. 50)? Also, if the effect could be obtained by a substitute for the manganese? We have no "E.M." in this colony.—SIDNEYITE.

[96568.]—**Palms.**—I have a few beautiful palms, and when I take them from the greenhouse into the drawing-room for a few weeks the points of the leaves turn brown and wither, necessitating their being cut off. The room is large, and apparently airy enough for them. Walls and carved work are painted white, with silk panellings. Will any reader of "ours" kindly give their opinion as to the cause, and if there is any cure?—L. R. C.

[96569.]—**Phonograph for Recording Music.**—I have an Edison's home phonograph, and would like to be informed how to take the music of a Burmese band generally consisting of six players. The floor space occupied by them when at play will not exceed 4ft. by 3ft., and yet I cannot get faithful records, the sound reproduced being very low compared to the original. Is a special room necessary to take such records, and if so, please inform me how to make one? Also what machine would you recommend me to produce a much larger sound than that generally given out by a home phonograph?—MG. HPAW, Moulmein.

[96570.]—**Wheat Roots.**—What is the average length of a wheat root grown under ordinary conditions and extraordinary conditions—i.e., where the root travels in search of water?—J. R. J.

[96571.]—**Electro-Motor.**—To MR. BOTTONE.—I have a Siemens H girder dynamo giving an output of 2½ ampères at 25 volts. The armature I have at present is solid, and I intended to replace with one built up of laminations, as the solid seems to get so hot after working some little time. Would it be any advantage to have a tripolar armature in place of the H type? If so, I suppose it would require a three-section commutator. And would the beginning of one coil and the finish end of its neighbour have to be connected to one section of the commutator? Could this machine be worked as a motor, as I wanted to work a grammaphone by motor instead of clockwork, and what battery power would be required? I suppose I should require a resistance-coil to regulate the speed.—E. EVANS.

[96572.]—**Spark Coil.**—Would Mr. Bottone please say if the following would be best for a double-cylinder oil-engine spark coil? Core, 8in. by 1in. diam.; primary 1lb. No. 18, three layers; secondary, 1½lb. No. 32 d s c.; condensor, 100 sheets foil 5in. by 4in.—SPARK COIL.

[96573.]—**Steamy Windows.**—I would be greatly obliged if any of your readers could inform me through your paper of a way in which frost and steam can be kept off windows.—S. WATSON, Toronto, Canada.

[96574.]—**Jets.**—I shall be much obliged to any reader who may furnish me with, or refer me to, proofs of the following facts:—(1) That a liquid column becomes unstable and tends to break up when its length equals π times its diameter. (2) That the state of maximum instability is reached when the length of the column equals 4½ times its diameter.—SURFACE TENSION.

[96575.]—**Small Dynamo.**—Would someone please give full particulars for making a small dynamo to light a four-volt two-ampère lamp? I wish to drive it either by clockwork or by a falling weight, as suggested last week by F. D. C. Baly, on. p. 38. The lamp is to be fixed before a clock, and I want to light it up at nights for about a minute now and again so that I can see the time.—CARLIOL.

[96576.]—**Induction Coil.**—I want particulars of length or weight, and also thickness, of primary and secondary wires for making an induction coil to use for giving a spark for wireless telegraphy, and also a battery to work same? I want a spark long enough to be effective for experimental purposes across a large room.—CARLIOL.

[96577.]—**Seltzogene.**—We have a seltzogene de Fèvre for making soda-water. When the lever at the back is pressed down the soda-water escapes from underneath it as well as from the spout in front. I should like to know how to repair the leakage at the back?—G. G. B.

[96578.]—**Subterranean Topography.**—Has any work been published ever upon the subject of interior cavity and cave formation, and what is the proper term to designate the study of this science or subject?—ESTIGEOLOGY.

[96579.]—**Chemical or Stylographic Paper.**—How is paper prepared which, with a stylo or special pencil, gives indelible writing, &c.? I see in the new invention for printing without ink (where electricity is brought into use) that the paper (printing) has to be previously prepared. I wonder with what chemicals?—SCRIBE.

[96580.]—**Speculum Polishing.**—In the "E.M." of June 18, 1897, there was a letter from Mr. Clarence Stirling, in which he says that he had found out a far superior material to emery for speculum grinding, and that he would give particulars about it in the "E.M." in a future letter. Would some reader of the "E.M." let me know what this superior abrasive is, or the date of the "E.M." in which the information was given?—A. R. C.

[96581.]—**Steam Whistle.**—A whistle 7in. diam. by 4ft. 6in. long sounds a certain note. As a variation in the diameter, I understand, has the effect of slightly altering the pitch, what would be the correct length of an 8in. whistle to give the same sound? I would be glad to have a rule or formula expressing how the relation between length and diam. modifies the pitch.—W. H.

[96582.]—**Medical Coil.**—To MR. BOTTONE.—I have constructed a shock coil as given by you some months ago in the "E.M.," ⅝in. core, 6in. between the heads, and wrapped with No. 28 gauge wire d.c.c. as primary; then insulated and divided into six sections with 1½oz. of 36 gauge d.s.c. in each section as secondary. Please say what battery I shall require and amp. power. I am thinking of using bichromate cells. I should like a good strong shock if possible. Also please say how I am to join up the coils to battery. Must I use the primary coil in series with the others? I have joined the ending of one secondary coil to the beginning of the other and brought to a terminal, six terminals of which are crescent-shaped in touch with a switch. The armature of coil is ⅝in. from end of coil. Is this too far, please? German silver spring 4in. long with platinum contact points.—ALBT. A. HARLEY.

[96583.]—**Tips.**—I have some rods of iron very similar to stair-rods, on the heads or ends of which I want to put a piece of rubber to stop the iron from scratching. How shall I put the rubber on without having an overlapping, and yet be so fixed as to be firm? The rubber to be ⅜in. in width and ⅛in. in thickness.—F. NEWTON.

[96584.]—**Removing Rust.**—I should be glad to know the best way of removing rust from the wrought-iron railings around a vault in a churchyard, which have been neglected for many years and are now badly corroded. The railing-bars and gate-posts are fixed in a stone curb, and the bars are rather light. The design is complicated, so that filing or rubbing would be rather difficult.—FILIAL.

[96585.]—**Motor-Cycle.**—Would the "Writer of the Articles" or other kind friend reply to following? Where should be the position of piston when exhaust commences to open on a Leon Bollée motor tricycle? Should exhaust-valve open as wide as it is possible? Shortening valve-rod opens valve wider, and also opens it earlier. Any other information respecting the working of this motor would be very welcome, as it does not give good satisfaction. The compression is good; ignited by hot tube.—A. TURNER.

[96586.]—**Liquid Air and Magnetism.**—As the properties of liquid air are under discussion, I should like to draw attention to the possible effect of a strong magnet on liquid air, or on the liquid after most of the nitrogen has escaped in the form of gas, such as a liquid containing 70 per cent. of oxygen. Now, in such a liquid the percentage of nitrogen is generally the same in every part of that liquid—that is, the atoms or molecules of nitrogen are equally distributed through the liquid in question. That this is the effect of some affinitive force which is not very strong may perhaps be inferred from the fact that liquid air is sometimes obtained in two liquids of different percentage composition. Now, what is the effect of a strong magnet on enriched liquid air? Are we able to vary the percentage of liquid oxygen in that part of the enriched liquid air adjacent to the magnet? Some of your numerous scientific readers may be able to throw some light on this question.—S. F. ELLWAND.

[96587.]—**Speed Indicator, &c.**—I am sorry to see my query (No. 96232, p. 452) has got among the "Unanswered," as there was a matter of business involved in it. Surely some of your North-country readers would be able to tell me at least the principle of the instrument by which the speed of the experimental train at the moment of applying the brakes was ascertained, as a large number of these trials were made on the North-Eastern Railway. Curiously enough, Mr. Michael Reynolds, in his interesting and exhaustive account of them, gives minute details of everything except this. The latter part of the query (re planimeter) could, I should have thought, be answered by any steam engineer. Perhaps "Regent's Park" can help me.—SCORPIO, Oystermouth.

[96588.]—**Wool Grease.**—A few years ago a patent was taken out for a rubber substitute stuff named as above. Can anyone give me the common names in trade terms of the above? Also, may I ask what is "wool pitch"? Is it a pitch, or a grease known as Yorkshire grease?—B.

[96589.]—**The Keyword Interest.**—Referring to the frequent use of this expression in the Dreyfus trial, will any of "ours" kindly explain what is meant by the keyword system of secret writing?—B. H.

[96590.]—**Motor-Cycles.**—Would "Monty" or "Writer of the Articles" appearing in "E. M." kindly oblige, if possible, by answering the following questions? I intend making a motor-bike somewhat similar to the one made by A. Garreau, so would be much obliged for any information given. (1) Would it be advantageous to alter the shape of ordinary diamond frame or size of wheels when building complete motor-bike? (2) What gauge of tube would be necessary to stand the vibration? (3) Would tandem tires do for wheels? (4) In regard to motor, would the one already being described in "E.M." do, or would it be better to reduce the scale to about ⅔, giving a cylinder 2in. bore? (5) Would this size of cylinder give enough power for travelling over moderately hilly country roads, the hills all being surmountable by a person on an ordinary bike (using a moderate ratio of gear for motor transmission)? (6) Is it necessary to have a flywheel for motor? Would not the momentum of bike, if the crank were balanced, cause the motor to act just as well? (7) What would be the best form of power transmission? My idea was to use the method seen on chainless bikes, only reversing the positions of gear-wheels. Would the advantages of ball-bearings for crankshaft motor compensate for extra trouble in making, &c.? Also, how would they stand the wear, &c.? (8) What is the amount of spirit and oil used on an average in one hours' run by a 1¾H.P. motor; also the cost, reckoning spirit at 9½d. per gallon, including waste from evaporation, &c.? Also oil used for lubricating, and current consumed from accumulator, the motor running at full power all the time? I have noticed several readers besides myself asking for information about motor-bicycles, they already possessing bikes, and would like to attach a motor, or, like myself, intend making a complete motor-bike. Any information given will, I am sure, be very much appreciated by all intending mobikeists and—F. R. D.

[96591.]—**Black Enamelling Small Metal Articles.**—Desire to black enamel small brass articles, similar to buttons and the like. Will some of "ours" kindly let me know modus operandi? Also what to use to enamel same.—W. J. P.

[96592.]—**Phonograph.**—I have read the articles and the correspondence on the grammaphone with great interest, but think the usual phonograph as seen at bazaars, entertainments, &c., a much superior instrument, and should like to know if an amateur mechanic possessing a good lathe and a slide-rest could construct such a machine with some amount of success. I have Gillett's book on the Phonograph, which appeared some years ago in the "E.M.," and think the instructions very clear, but before commencing should like to know if the instrument described has been actually made, and with what success. I see the shaft, which I should get out by an experienced firm, has a thread of 80 to the inch. Is it really so minute as this? As the articles appeared some years ago, it is possible that a better machine has supplanted the one described. Could anyone tell me if this is so? Another point which puzzles me is that the guide-rods are made of mandrel-drawn steel, which is said to be

only sold in 13in. lengths, and is supposed to be perfectly straight. What is mandrel-drawn steel? I should be glad to advertise my address to anyone who would be willing to enter into communication with me on the subject.—AMATEUR MECHANIC.

[96593.]—**New Storage Battery.**—Can any of your readers give any information about a new storage battery—Leightner (or Litner's) patent—which is said to be a great improvement on all others?—S.

[96594.]—**Ship's Tonnage.**—Will any kind reader explain the meaning of steamer's net and gross tonnage, tons burden, how it is taken, by measurement or weight? Also, please explain the horse-power, 500 nominal and 3,000 effective; which do they work at the Indian services of steamers?—ALGO.

[96595.]—**Foreign Books.**—Will any kind reader name any suitable books and dictionaries on engineering, published in Spanish and Portuguese?—ALGO.

[96596.]—**Waterproofing Textile Fabrics.**—Would any of our brother readers kindly inform me the composition of a solution for making muslin, calico, and cloth fireproof, and not spoil the colour of the material?—AJAX.

[96597.]—**Paint for Hot-Water Cistern.**—Will anyone inform me of a paint or other substance suitable for painting the inside of an iron cistern which contains boiling water, to prevent corrosion of the metal, and to stand well? Will be much obliged for information.—HAMISH.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** **Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, August 30, and unacknowledged elsewhere:—

WATTY.—A Reader.—William E. Tanton.—E. R. Dale—E. Wilson.—J. Sutcliffe.—Hear Both Sides.—Turner. H. Bevan Swift.—Britannia Co.

N. D. P., Oyzal.—Do not remember it; but as you say a firm was recommended to supply the tools, it was probably some other paper in which you saw the article.

ANXIOUS, Coventry.—Put a little oil round the stopper, warm the bottle, and tap the stopper sideways with a stick gently. It is usually sufficient to warm the bottle by holding it in the hand; but if that won't do, put it in the oven.

PROGRESSIVE.—Presumably you mean the cell described on p. 526, July 24, 1896. See the index of Vol. LXIII. It is much the same as a chromic-acid cell.

ED. MURRELL.—As you say, "the Scriptures are verified, and the wisdom of the world is foolishness," and the present system of astronomy is all wrong; but really, the weather has been too hot to think it all over calmly.

NON-SCIENTIFIC.—There are colleges and institutions where agriculture is taught, and there is no space at present to ventilate such schemes as you propose.

SUPERFLUOUS.—You can find all that is known about the removal of superfluous hair in the back volumes. Do not understand what can be meant by "on this really important subject there seems to be so little light thrown."

M. C.—Question too indefinite. See p. 191, last volume—the large telescope at the Paris Exhibition—and the indices generally under siderostat, coelostat, &c.

MOLD.—Please see Hints to Correspondents No. 4, above. The materials can be obtained at any of the shops keeping materials for dentists.

TOLO.—To what does the query refer—"melody coupler" for what?

JAMES D. HOYLAND.—Have no further information about the bifocal lens than that given on p. 5, Aug. 18.

D. M.—The appointments are made after competitive examination. Particulars can, no doubt, be had from the Civil Service Commission, Cannon-row, Westminster.

E. HITCHCOX.—The award has been made, and it is useless to quarrel with it on the point of a difference between "cart" and "van."

ISIS.—Bonney's "Electro-Plater's Handbook," published by Whittaker and Co., White Hart-street, Paternoster-square, E.C. (2) Ignition coils have been described many times.

P. M. STAUNTON.—Will look into the subject and the invention, and will probably publish a notice of same.

W. J. D.—Please see the back numbers. The question has been answered many times.

J. A. B.—Please see Hints to Correspondents No. 4.

L. E. S.—Several replies about cockroaches on p. 472, July 7.

A. W. P.—Apply to the Secretary of the Society. 2. They are appointed after examination. Apply to the Civil Service Commission, Cannon-row, Westminster.

FRANK.—Without particulars it is impossible to even offer an opinion as to the utility of the brake.

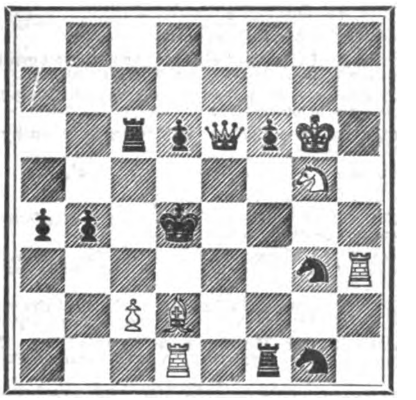
ENQUIRER, W. B.—You will find all that is known about liquid air in the back numbers.

CHESS.

All communications for this column to be addressed to THE CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1690.—A PRIZE PROBLEM.

Black. [9 pieces.



White. [7 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Sept.* 11.)

Solution of PROBLEM No. 1688.—By F. HEALEY.

Key-move, Q-K 2.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1688.—Correct solution has been received from Quisco, T. Clark, Richard Inwards, Whin Hurst Oracle, J. E. Gore, Rev. Dr. Quilter, F. B. (Oldham), Hampstead Heathen, (who adds, "Either this 'Hampstead Heathen' is a great fool, or this is the cleverest problem I have ever seen in the 'E.M.' It was hours before that key-move struck me. It looks so unlikely, and yet the moment you see it the whole thing is obvious. The key-move is wonderfully well hid."

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1	6	13	26	52 insertions.
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	1	6	13	26	52 insertions.
	£ s.	£ s.	£ s.	£ s.	£ s
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Eadie's, Perry's, B.S.A., Lloyd's, and Components' Fittings; Frames and Machines. Highest grade; no rubbish; low prices.—Below.

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De Dion Motor Castings. 1¾H.P.; also 2H.P. Motor Castings. Latest, most perfect.—MOTOR AGENCY Co., Ryley-street, Coventry.

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Vertical Boiler, by Noy, nearly new, 40in. by 30in. 60 tubes, 1⅝in.—Below.

Pair Launch Engines, 3½ by 4, reversing gear, good condition.—Below.

Launch Hull, 30ft., cabin aft.—Below.

Above, together or separate. What offers?—C. S., 19, Herbert-road, Nottingham.

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"Technical Educator," handsomely bound, four volumes complete, 10s. carriage paid, cost 26s.—HOLLAND, Cherry-street, Birmingham.

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For Sale, ¾H.P. **Launch Engine and Boiler.**— S. MARSHALL, King's Mills, Driffield.

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Boards (Planed).—Cutting to lengths and widths a specialty, quotations free. Send sizes wanted.—BURTT, Gloucester.

E. Oppermann, Albemarle-street, Clerkenwell, Engineer and Gear Cutter, established 1862, supplies Raw-Hide Wheels, Worms, Worm-Wheels, and Screw Gear in any material and pitch. Bevel gear planed to correct cones.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 8, 1899.

MOTOR CYCLES.—XVI.

THE petrol tank, Fig. 96, is made of No. 20 B.W.G. sheet brass, the body being bent to shape and the joint made hooked and well soldered. This joint should come on one of the flat sides, so as not to interfere with the fitting of the mountings around the filling hole, and for the cock and union for float supply-pipe. If any difficulty is anticipated in making the hook form of joint, any good tinsmith will undertake to make it at a small price, they usually having a machine for this work. The ends are to be hammered to shape from brass sheet of the same thickness as the body, and will require frequent annealing to prevent the metal from splitting. When shaped up and flanged they may be soldered to the body, in which the filling hole should have been previously cut. The collar on to which the cap covering the filling hole screws is seen in Fig. 97, and the cap itself in Fig. 98. They are both of cast gunmetal. The collar, Fig. 97, is best bored out and driven on a mandrel, when the outside can be easily turned and screwed 1in. diam. by, say, 16 threads per inch. The cap, Fig. 98, is to be screwed to match, and the outside nicely finished off and polished. The collar is secured to the petrol tank by four ⅛in. countersunk rivets, and soldered to make it spirit-tight. For the attachment of the petrol pipe and cock a gunmetal casting from the same pattern as Fig. 97 will be useful. It should be cast solid, and a good quality small cock and union be purchased, the casting being bored and screwed to suit the cock. When finished it may be riveted and soldered to the tank, with its centre 3¾in. to the left of the tank centre when looking from the back of the tricycle, so as to correspond with the position of the float chamber. If not exactly over each other, the copper pipe can be bent to suit.

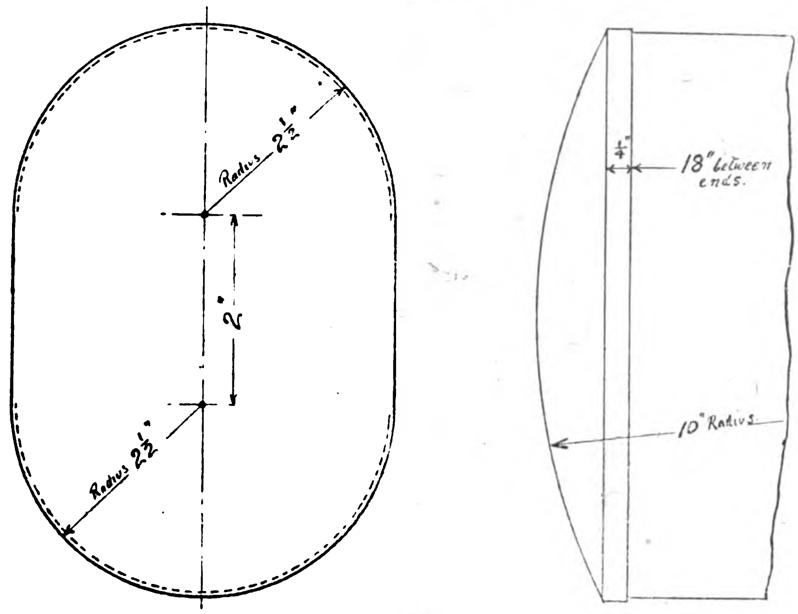


FIG. 96.

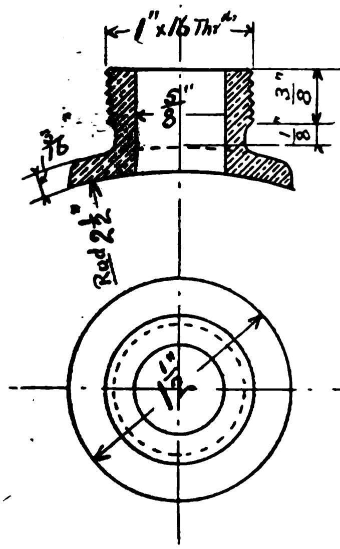


FIG. 97.

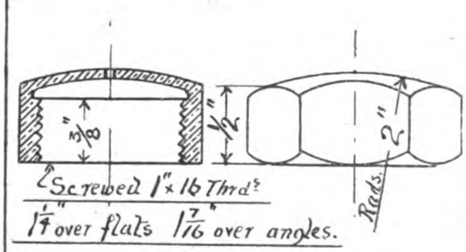


FIG. 98.

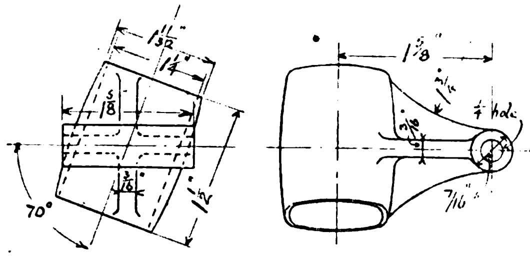


FIG. 99.

The bracket which supports the extension rod from the compression relief cock is shown in Fig. 99. It is to be cast in malleable iron, and brazed to the seat-column of tricycle in such a position that the ¼in. hole in the bracket is truly in line with the centre of the plug of the cock on cylinder head. A length of ¼in. steel rod is then taken, and one end coupled to the plug of cock by means of a short piece of iron or brass tubing slipped half over rod and half over the projecting end of plug, a 1/16in. pin being put through each end of the tubular coupling to make all secure. The other end of the rod should project far enough through the bracket, Fig. 99, to take the boss of the lever, Fig. 100, which is to be brazed on. On to the top tube the malleable cast-iron lug, Fig. 101, is to be brazed. Its position is best determined by putting the gear together temporarily. To do this we shall require the small lever, Fig. 102, in a finished condition. Place it in position in the fork of the lug, Fig. 101 (shown dotted), and pass a ¼in. bolt through fork and lever. Now move the lug along the top tube until the lever, Fig. 102, is vertically over the lever, Fig. 100, on the end of the compression-cock rod, and, having removed both bolt and lever, braze it securely in this position. The handle part of the lever, Fig. 102, is to be on the left of the rider, and, as seen dotted in Fig. 101, is in the position it will occupy when the cock is open. The lever, Fig. 100, is to be inclined upwards, also at 45°, when the cock is open, its small end being towards the centre of the machine. The upper and lower levers are coupled together by a ¼in. steel rod, forked at each end to take the smaller ends of the levers. I would suggest a couple of bicycle brake-rods welded together, or brazed with a long scarfed joint, being used for this part. They can be bought as stampings, and will save a lot of troublesome forging. On to the top tube, in any convenient position such as is given in Fig. 95, the bracket, Fig. 103, is to be brazed. This bracket carries the air and gas regulating levers, Fig. 104. It is of malleable cast iron, the quadrants being for a small pin (X, Fig. 104) on the back of the levers, to bear against, to prevent the levers

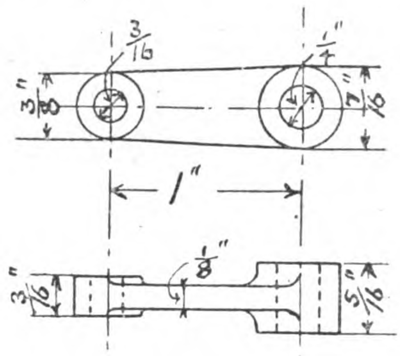


FIG. 100.

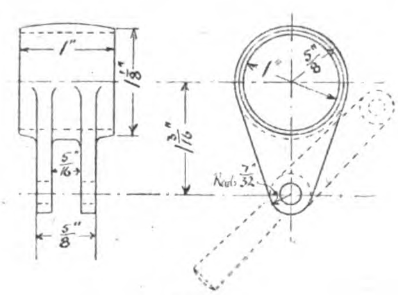


FIG. 101.

moving while running. On these quadrants the best positions for the levers will afterwards be marked. The levers themselves, Fig. 104, are to be of forged steel, a certain amount of spring being given to the thin part between the handle and the central boss. The pin X is riveted in, the edge which

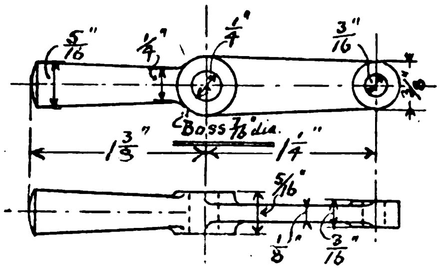


Fig. 102.

bears against the quadrant being wedge-shaped to drop into shallow recesses afterwards cut to receive it. The handles are turned from horn, ebony, or any other material which may be fancied, and secured to the lever by riveting over the end of the ⅛in. pin forged on the lever. Three of these levers will be required, one each for the air and gas handles of the mixture-cock on carburetter, and one for controlling the ignition gear. For this latter another bracket like Fig. 103 will be required, but with only one quadrant on the left. These three levers are coupled to the carburetter-cock and ignition gear-box by ¼in. rods,

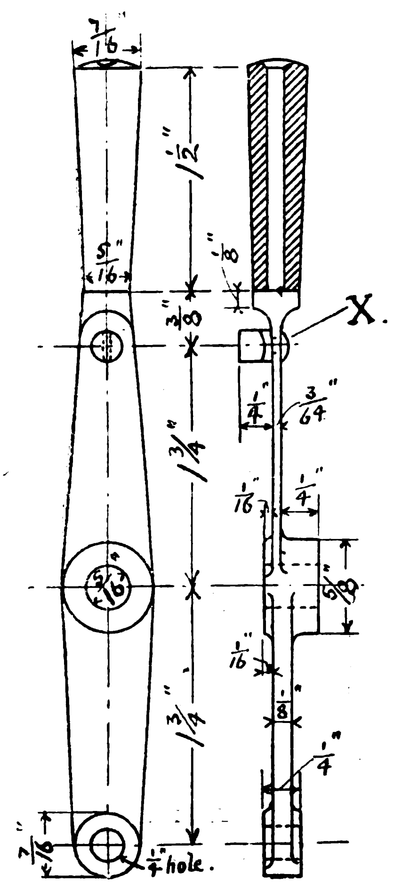


Fig. 104.

forked at each end, made in the same way as those just described for the compression relief gear. They are pivoted to their brackets on the top tube by 5/16in. turned bolts. Fig. 105 is the bell crank lever pivoted to the lower head lug, which changes the downward movement of the brake-rod into a direct pull on the rocking levers situated on the bridge tube over the band-brake. It is forged from mild steel and finished bright

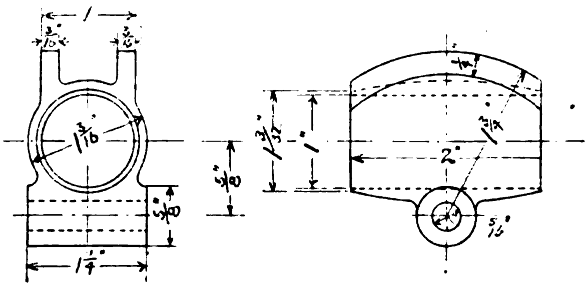


Fig. 103.

all over. At one end it has a boss 7/16in. diameter by 5/16in. through, to which a ¼in. rod, forked at each end as mentioned above, is attached, the other end of the rod being

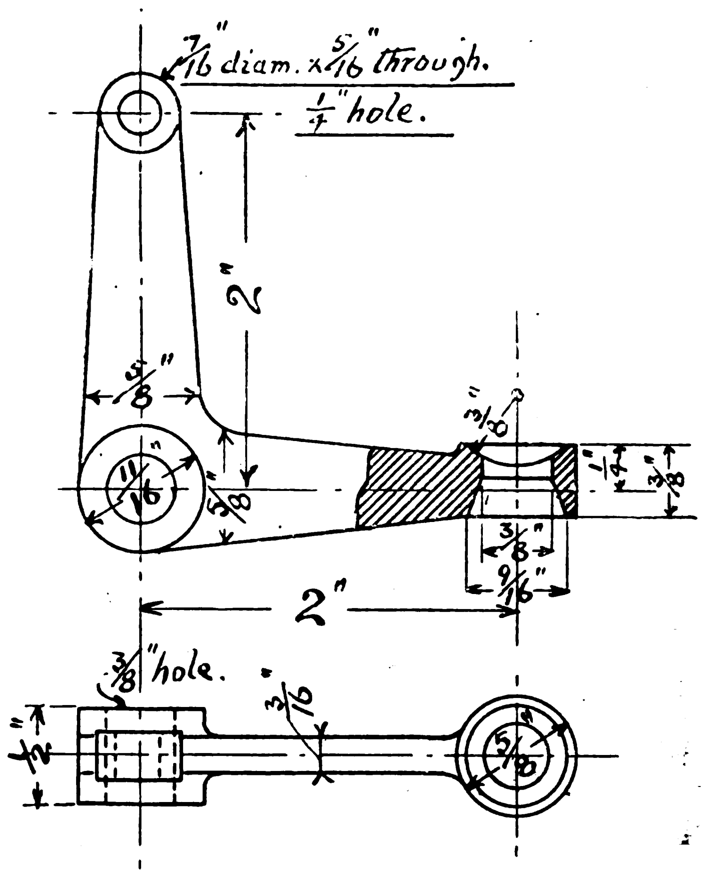


Fig. 105.

coupled to the vertical lever on the band-brake rocking shaft. The other arm of the bell-crank has a round boss, the upper side of which is cupped to a ⅜in. radius. A nut on the brake-rod is turned to the same radius to fit this cup; this nut being prevented from moving when adjusted by a lock-nut above it. By these means the movements of the handle-bar when steering will not strain the connection between the bell-crank and the brake-rod.

All these small levers, rods, and the bolts which connect them should be nickel-plated. The petrol tank and its fittings can also be plated if a very smart appearance be desired. In Fig. 106 I give a diagram of the electrical

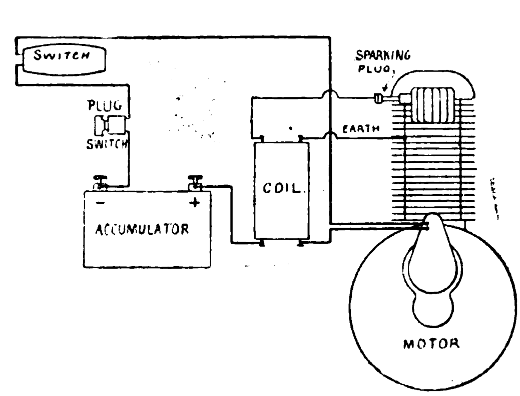


Fig. 106.

circuits. This is not drawn to scale, but merely serves to show the connections. The *thin* lines are the primary wires and the *thick* the secondary. Taking the primary first.

From the positive pole of the accumulator a wire leads direct to one terminal of the primary coil. From the other primary terminal of coil a wire leads to one of the contact springs of the ignition gear on the motor. From the other contact spring a wire is taken to one contact of the handle-bar switch, from the other contact of which the current goes through a plug switch to the negative pole of the battery. The secondary circuit is very simple: One terminal of the secondary of the coil is "earthed" on to the frame of the tricycle, the other terminal being joined to the insulated terminal of the sparking plug. Thus, when the plug and handle-bar switches are "on" and the motor is rotated, the circuit will be completed every second revolution through the two contact springs and the cam in the ignition gear-box, which will cause a spark to jump the gap between the points of the sparking plug, and fire the charge in the combustion space in the engine cylinder.

This article completes the description of the tricycle "built for one." Any small details I have omitted are such as can easily be bought or copied from ordinary pedal-driven tricycles. In my next I shall describe how to use the machine, and how to put right such breakdowns as are most likely to occur.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—III.

WHEN the pressure of the air is exerted on the mercury in a barometer, a certain amount of inertia has to be overcome before the column will rise, and hence the movements of a barometer are always a little behind the changes which take place in the air. Moreover, when the movements of the mercurial column are employed to produce an automatic record of the barometric changes by moving a float or by actuating a lever, for instance, the indications of the instrument are likely to be still more sluggish. The simplest mode of harnessing, as it were, the mercurial column is seen in the familiar wheel or dial barometer, where a float placed in the short leg of the siphon moves a pulley and spindle with a pointer attached. All such attempts, however, to make the barometer do work result in a slowness of movement which, despite great refinements of mechanical construction, is always very pronounced. Owing to this fact there is always a certain amount of suspicion attaching to the records of such instruments, and, although there are a very large number of self-recording barometers wherein the mercury, as it rises and falls, is made to work the recording apparatus, great care is required to keep them in a satisfactory condition.

To some people the temptation to try experiments with meteorological instruments is irresistible, and in those cases where certain types of barometers have got out of order, or are being put to no practical use, there is something to be said for making an attempt to transform them to something useful. The siphon barometer has always been a favourite with inventors and experimenters, since it is possible to insert a glass or ivory float in the short limb, and to this float, which rises and falls with the movements of the mercury, it is possible to make such attachments as shall be the means of securing a continuous record of the variations in atmospheric pressure. For this purpose it is desirable that the calibre of the barometer tube shall be large, and tubes of as large a diameter as 3in. have been used in constructing these self-recording instruments. To the float may be attached a delicate chain, or silk thread, which passes over a wheel, the float being counterpoised by a small weight. The wheel, as in the dial barometer, carries a hand or pointer, and on this there is a small pricker or point which is in close contact with a strip of paper revolved in the usual way by clockwork. The strip of paper which carries horizontal lines for the barometer scale and vertical lines for the hour spaces, may be made to serve for a day, a week, or even for a month. All that is now required is that a small hammer adjusted like the striking lever of a clock may be so arranged that at certain definite intervals it may strike the pointer, and so impress a mark on the paper which is, of course, moving slowly round on the cylinder. In other types of this instrument the wheel becomes a lever beam in which the two arms terminate in arched heads, one limb being twice the length of the other. This difference in the length of the arms is necessary because, as the mercury rises in the short limb of a siphon barometer, it falls an equal amount in the other, and the real height of the mercurial column is the difference between the readings shown by the two legs. A rise of half an inch in the short limb, therefore, really means a fall of one inch in atmospheric pressure. The cord from the float is accordingly attached to the short arm of the lever so that longer arm moves twice the extent, and the result is to record not merely the movements of the float, but those of the barometric column as a whole. In this form of barograph the pointer is also struck by a hammer, and the readings of the instrument recorded as often as desired.

Other successful attempts have been made to secure a continuous record of atmospheric pressure by converting the barometer into a pendulum, which is caused to swing as the mercury, in response to changes in the pressure of the air, flows from one tube to another. By this arrangement the barometer tube is fitted to an L-shaped glass pipe, which, in turn, is connected to a U-shaped tube, a small descending pipe serving to join the two together. The lower end of the U-shaped tube, as in the siphon barometer, is left open, and since the barometer swings on a horizontal axis placed above the centre of gravity, it moves to and fro as the mercury rises and falls. As the pressure increases the barometer swings to the right, and goes to the left as the mercury descends. The U-shaped part of the tube has a recording pen or pencil attached to it, so that the vibrations may be recorded in the usual way on a suitably ruled strip of paper. These self-recording barometers, which thus depend for their motive force upon the displacement of their centre of gravity, are by no means of complicated structure, and are very sensitive to atmospheric changes, and may be considered to be a very reliable type of barograph.

The siphon barometer may also be employed to secure a photographic record of atmospheric pressure, and, similarly to the barographs described above, the mechanism of some of these instruments is not unduly complicated. As before, the motive force is derived from a float inserted in the short limb of a siphon barometer, and, instead of being connected to a pulley and spindle, the float is attached to a lever. As the float rises or falls, the lever is raised or depressed, and at one end of it there is fixed a small circular disc with a tiny hole in it. Behind this disc a lamp or gas-jet may be placed, so that the light passes through the pin-hole on to a strip of sensitive photographic paper wrapped round a revolving cylinder. This paper has, therefore, imprinted upon it a curve or trace which, after it has been developed, clearly shows the variations which have occurred in the atmospheric pressure from hour to hour throughout the day. The details of this instrument similarly to those already described do not present any great difficulties in construction, and with moderate mechanical skill it should not be hard to make a barograph of this kind. Similarly, however, to other meteorological operations in which photography plays a part, the work of developing the records does not find favour with observers, and a large amount of enthusiasm is required to keep the instrument in continuous action.

As already intimated, the great drawback to all those self-recording instruments which depend on floats, pulleys, and levers is found in the fact that the mercurial column is restrained in its movements when it is made to put these attachments in motion. It is for this reason that barographs of this type are not employed at the first-class observatories in connection with the British Meteorological Office. The barographs at these stations, which, for financial reasons, are few in number, are, indeed, constructed on a photographic basis; but the mercury in the tube has no work to do in the way of moving floats or other mechanism. In these instruments, what is done is to photograph the space at the top of the tube, and, since this space decreases or increases as the mercury rises or falls, the result of photographing it is the same as if the movements of the column itself had been registered. The curve thus produced is not a thin line, as in the case where the record is obtained with a style or pencil; but it is a broad band which, of course, changes in width as the space at the top of the tube in enlarged or decreased. Several of these photographic barographs have been working continuously for more than a quarter of a century, and it need hardly be said that for researches into those difficult questions connected with the discovering of periodicities, such records are invaluable.

A self-recording barometer very much in vogue, and of which there are many different types, registers the movements of an aneroid, a lever attached to the upper part of the aneroid working a pen which imprints a record on a strip of paper wrapped round the usual revolving cylinder. So excellently are some of these barographs constructed that with ordinary attention they go for a long while without getting out of order. They are, moreover, so low in price as to be within the reach of everyone, and it is not surprising that these instruments are very popular with private meteorologists who do not wish to be bothered with complicated mechanism. But like so many other self-recording instruments, their weak point is often found in the pen and in the ink, which are responsible for producing a legible and continuous trace or curve, and it always pays to spend a little time in keeping these essential parts in good condition. Commonly the pen is something like a small bird's beak, and is adapted to hold a large charge of ink; while in other instances some form of stylographic pen has been taken into use. But no matter what kind of pen is employed it will require care in filling it, and in maintaining a free flow of ink. Moreover, seeing that all aneroids deteriorate sooner or later, frequent comparison with a verified barometer is advisable if an owner of one of these barographs desires to gain early information of any defect in its working. Given, however, reasonable care and attention, these aneroidographs are admisable for showing at a glance the hourly and daily variations in atmospheric pressure.

On looking at one of the curves obtained by any of these barographs, the first thing which strikes the eye is that there are a series of what may be called hills and valleys, and it is the rate at which the barometer rises to a peak or sinks to a depression that tells the most as to coming weather. It is very well known that a sudden fall in the barometer is a sure sign of coming bad weather; but it is not always realised that there may be a gradual drop to a very low level without anything very unpleasant happening. Conversely, a rising barometer is considered to be a prognostic for fine weather; but a sudden rise is often followed by disagreeable weather, and it is only when the barometer rises to a considerable height by slow degrees that a continuance of fine days is to be looked for. But as illustrating the difficulty experienced in discovering the kind of weather likely to follow any given movement of the barometer attention may be directed to the many different circumstances which may, for instance, cause the barometer to fall. Ordinarily a falling barometer is caused by some cyclonic form of distribution of atmospheric pressure, the barometer readings decreasing from the circumference of the system towards the centre, where the lowest readings are to be found. There is, therefore, in the first place, a fall in the barometer due to the arrival of the front area of one of these cyclonic disturbances in the neighbourhood of the observer, and the higher the velocity with which the vortex is moving forwards, the more rapid will be the fall. Again, the rate at which the pressure decreases from the circumference to the centre will depend upon the steepness of the atmospheric slopes or upon the barometric gradients, so that as the storm passes overhead the rate at which a barometer will fall is ruled by the shallowness or the depth of the vortex. Further, the slope of the gradients is continually changing, and this also has its effect on the movements of the barometer, while an additional effect is to be traced to the fact that the distance of an observer from the centre of the storm is also continually changing.

Even, therefore, in respect of a simple fall in the barometer, there are several points for consideration, and when it is remembered that even those who have the electric telegraph at their disposal to send them at frequent intervals the changes going on in different parts of the country, find it difficult to follow the alterations taking place in the rate of travel and in the gradients of a cyclone, it will be gathered that a solitary observer has a still more difficult task when he seeks to interpret the records obtained

rom a single barograph. If, however, he be content to deal in generalities, he can often arrive at satisfactory results; but at all times he must be prepared to find his calculations upset by those subsidiary storms which even expert meteorologists do not as yet thoroughly understand. The barograph curve, or barogram, as it is called, shows when a depression or cyclone is approaching, and what an isolated observer requires to be told is whether the storm is going to be of strong or weak intensity, and it has been suggested that an observation of the way in which the outline of the curve changes from hour to hour will help him to the desired information. A fall, for instance, of three-tenths of an inch in an hour would produce an abrupt descent in the curve, and its appearance as compared with the base line would be convex; and when this appearance was noticed it would be reasonable to expect that the storm would be violent and of an unpleasant character. On the other hand, when the fall proceeds at a slower rate the curve becomes concave, and, as a general statement, this appearance would be followed by a weak intensity in the coming depression. The lowest point of the kink in the curve, of course, represents the passing of the trough of the storm, and during the prevalence of bad weather it is useful to know when this dangerous area has passed. With a rising barometer curve, similar convexities and concavities are to be recognised, and in this case concavity is a bad sign, while convexity indicates improving conditions. A commencement may therefore be made in interpreting the records obtained from one's barograph by searching for these convexities and concavities.

MILLWRIGHT'S WORK.—VIII.

ENGINEERS now in middle life have witnessed a great revolution in the drives of shafts, as well as in the shafts themselves and their bearings. The early mills had wooden pulleys chiefly, some of which yet survive; then came cast iron, to be in turn now largely displaced by built-up pulleys comprised chiefly of wrought iron and steel. Finally, wooden pulleys have come in once more, completing the circle of changes. Between these, therefore, the choice still lies, and they will often all be seen running in one and the same shop. It is not possible to say in the abstract that one type is absolutely better than the rest. But under certain conditions, one will be better than any of the others, and the millwright must exercise judgment in making his selection.

For heavy drives, in which much vibration is set up, cast iron is more rigid than wrought iron; cast-iron pulleys are more readily made than wrought in small dimensions. But outside these, and for all the general transmission in a shop, wrought iron and steel are preferable, because they weigh less. Being lighter by from 30 to 50 per cent., they stress the shafts and bearings so much less, producing a most important economy when, as is often the case, a single length of shafting has to carry several large pulleys. But apart from this, the wrought-iron pulley is a construction more in harmony with true running than cast iron. A cast pulley is never quite truly in balance unless it is turned inside as well as outside, which is too expensive for ordinary service. Cast iron is not well adapted to withstand the tensile strains which are developed at high speeds, and so broken pulleys are familiar in everyone's experience. Nor is this the worst, for the internal stresses in pulley arms, boss, and rim are generally of a somewhat uncertain character. It is not a little curious that after cast pulleys have been used for three-quarters of a century, observation and experience have led to entirely opposite conclusions as to the shape of pulley arms in England and in the United States. With few exceptions, we use pulleys with curved arms, while they employ for the most part straight arms.

Wrought iron and steel on the other hand are materials eminently capable of withstanding tensile stresses, and sudden fracture would not occur in these. And as the rims are formed of a sheet of uniform thickness the expense of turning is saved, and the pulley is balanced just as made. The differences in these pulleys are only those due to methods of manufacture, which are rather numerous, and which it is hardly necessary to enumerate in much detail. Speaking generally, they comprise a central boss of cast iron, arms of steel or wrought-iron tubes, to which the rim is riveted.

There are other reasons, too, in which methods of manufacturing are concerned why wrought-iron pulleys are preferable in many cases to cast. The latter are stocked in even diameters, entailing then the services of a large number of

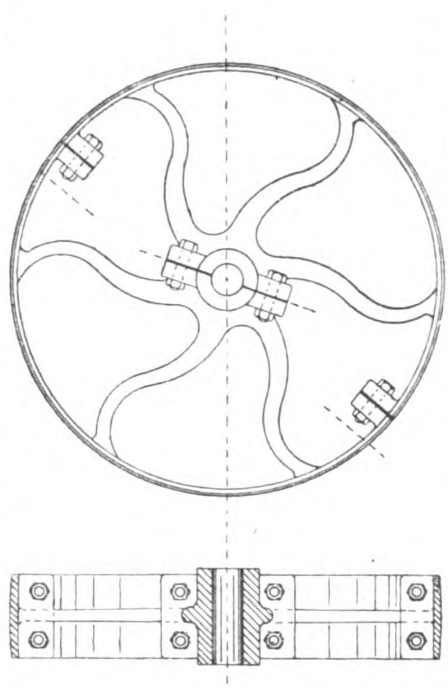


FIG. 47.

patterns. To obtain odd dimensions, which are sometimes wanted, involves extra cost and trouble in the foundry, as they are only produced by some amount of making-up or strickling in the mould. There is no such trouble

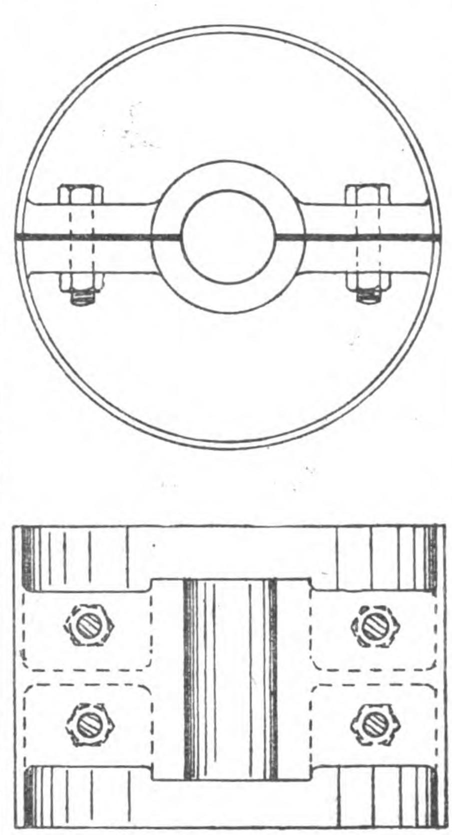


FIG. 48.

with wrought iron, because the rims can be rolled readily to any diameter required.

Another point is, that pulleys not in stock take longer to cast than wrought ones do to build up, and more especially so as diameters increase. Big deep pulleys require a deal of moulding, out of due proportion to the weight of the casting.

Altering the breadth of face of cast pulleys, it may be mentioned, involves no extra trouble beyond that of the difference in the depth of sand to be rammed. Standard rims of maximum depth and standard sets of pulley arms of given diameters are used, and all pulleys of that diameter are moulded therefrom, those of narrow face being stopped-off by ramming the rim up only to the particular depth required. The arms, of course, are detached from the pattern rim, fitting loosely within, so that they can be centred to suit any width of face required.

The pattern rim and arms are both made in

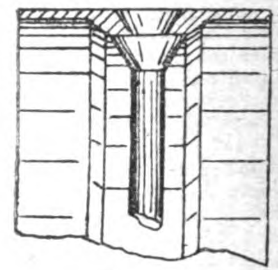


FIG. 49.

cast iron, the first being turned inside and out, with a little taper. The convexity of rim, when such is required, is imparted wholly by turning.

Another important difference in older and recent practice, is the practice of splitting so many more pulleys now than formerly. Splitting is rather a big job on a cast-iron pulley, and enhances the price to a greater degree than it does in wrought-iron pulleys. Splitting is therefore seldom resorted to in cast-iron pulleys, except when imperative. But in the laying out of shops now it is often the practice to employ divided pulleys of wrought iron and of wood throughout, or nearly so. The advantages are very great; for, though when a shop is laid out, there is often no anticipation of important changes having to be made subsequently in arrangements of machinery, yet such do arise with extensions of business and changed conditions of manufacture. Then the trouble begins, for it is no joke to have to shift solid pulleys along their shafts, while the removal of split ones is easily effected.

Another practical point is that splitting a pulley relieves it of tension, which is a great

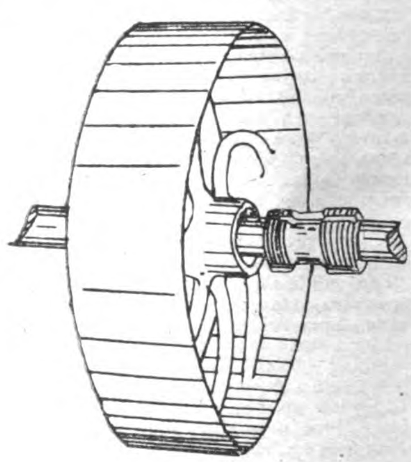


FIG. 50.

drawback to the use of cast-iron pulleys in general. Except by experienced judgment, you can never tell how near a pulley is to breaking.

Figs. 47 and 48 illustrate common types of cast-iron pulleys—large and small respectively. Both are divided; but without the splitting lugs they would remain as illustrations of solid pulleys. The lugs are set as shown in Fig. 47, because the curving of the arms prevents them being brought in line; with straight arms, the lugs would come in line. Fig. 48 represents usual practice in pulleys of a foot and less in diameter.

Pulleys of wrought iron and steel are variously made. Generally, the rim is in a single thickness; but the pulleys of Croft and Perkins have their rims constructed of a rolled section, which imparts a double thickness of metal to the central portions into which the arms are riveted, Fig. 49. This increases the rigidity of the rim and the

thickness through which the arms are countersunk, without adding much to the weight.

Although the screw-boss pulley system of Smith and Grace is well known, it would not do on that account to pass it by unnoticed, for everyone may not be acquainted with it. Briefly, it consists in this—that, instead of boring pulleys each to suit one size of shaft only, the pulley boss is screwed tapered, and the shaft is gripped by an elastic bush bored to suit the shaft, and screwed outside to enter the pulley boss. It was a bold innovation to abandon the time-honoured key and the driving fit, but results have justified it. It is very much on a par with the abandonment of the keyed coupling in favour of the gripping type. The screwed boss system not only avoids the disadvantages of keying—always an unmechanical arrangement when applied to work of this kind—but it also affords greater facilities for effecting rapid changes in the positions of pulleys, as well as for the transference of pulleys from one shaft to another of the same or of a different diameter.

In all sizes of shafts, varying from 1½in. to 6in. only four series of bushes are required; that is, the pulleys in that range are screwed to but four

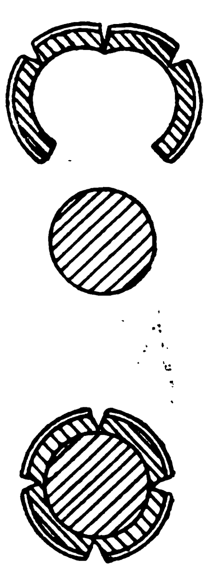


FIG. 51.

different sizes, and all the small variations in the diameters of shafts are made in the bushes. One series of bushes ranges from 1½in. to 2in., the next from 1¾in. to 3in., the next from 2¾in. to 4½in., the last from 4½in. to 6in.; so that one pulley may be used in any shaft from, say, 1½in. to 3in., by simply changing bushes.

The bushes are split in four and loosely-hinged, so that they can be opened to lay round the shaft; after being closed, the screwed boss of the pulley is run over them. Fig. 50 shows this, and Fig. 51 illustrates the bush in end view, opened in the upper figure, and closed round the shaft in the lower one. J. H.

CUTTER-BARS AND CHUCKING REAMERS.*

THE lathe is of very little use without small tools. First, as a matter of course, come the regular lathe tools; then for chucking and boring we need tools that will cut out stock faster than a common boring-tool. In a shop where the parts vary, and a good many changes are required, tools as shown here are very useful. There have been many improvements in these tools of late years, which make them more durable, and also enable them to do better work. They are also made in a way that allows of quicker setting and adjusting. Fig. 1 is a cutter-bar, as used a good many years ago, and many are in use still in the older shops. The weak points in this bar are, first, in the cutter *a*. The slot is so far down that it does not leave sufficient stock to hold the tit or guide from springing, and with very little strain it will break off. The weak place is shown at *a*, and also in the end view. When this tit breaks off, the bar is of no further use until repaired. In some of the earlier methods the slot in the bar was just the depth of the cutter, and a small set-screw was fitted to hold it, the point of the screw being let into the cutter. This method is not used very much

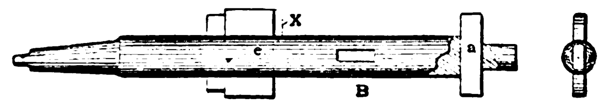


Fig. 1

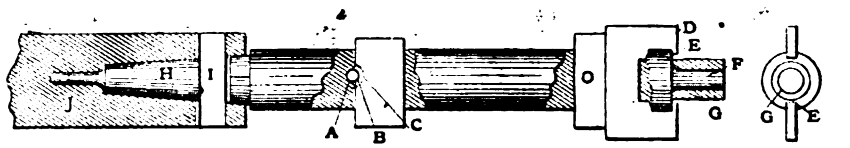


Fig. 2

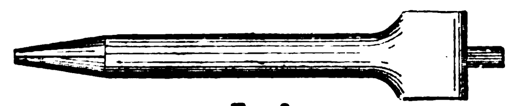


Fig. 3

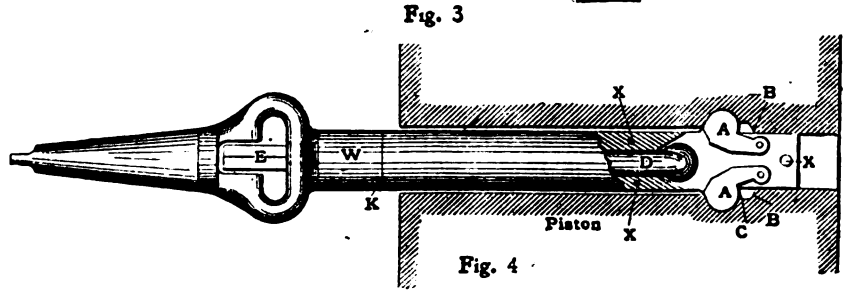


Fig. 4

at present. Another method was to cut the slot deeper, and fit a key, as shown at B and at C, Fig. 1. The objection in this case is that the cutter is not held in a central position. With a heavy and varying cut, it will move from one side to the other and loosen the key. A better way, and now a very common one, is to lip the cutter down on the bar, as shown at *x*, Fig. 1. The cutter may be put in a lathe and bored out to fit the round surface of the bar, or it may be cut out square, and a flat surface filed on the bar, so that the cutter will fit snug. The cutter should then be keyed into the bar and turned up. With this method it is not necessary to plane the cutters, as the steel in the bar is near enough in size to fit in. Where there are a number of cutters to be made, it is a good plan to cut them off, place the lot in a shaper or milling machine, and cut the recess for the bar in all of them at one setting.

In Fig. 2 we have a very strong and substantial bar. It may be used in a lathe or drill-press. By keying it into the lathe or drill-spindle, as shown, it will do very quick work in lathe chucking, or as a counterbore in a drill-press. There are two ways of fitting the cutter shown, both of which are good; but the one at the end is the better of the two, as it is lipped down over the bar, as shown at E. In addition to its being let down over the bar, it is fitted sideways into it. This supports the cutter, and allows of its being forced very hard into the work. It will be noticed that the tit is much stronger in this case than in Fig. 1, as the cutter slot does not come to the end. Another improvement is the sleeve *g*, fitted over the tit F to protect it from wear, and also to allow of changing the diameter of the tit for different work. This sleeve should be hardened and held from turning on the tit by a small pin fitted close up in the neck. In fitting up cutters of this kind care should be taken to fit the key O so that it will have a bearing all the way across, and not on one end, as it is apt to cant the cutter. At A, B, and C, Fig. 2, is shown another and very simple way of holding a cutter. It consists of a taper pin turned round and flattened on two sides. It has a bearing on the bar at *a* and on the cutter at B, while the bar is filed as shown at the dotted line C, for clearance. This allows the pin to hold the cutter hard against the bottom of the slot.

Fig. 3 is an old-style tit-drill or counterbore, gotten up for short, quick jobs. The trouble with it is in the danger of breaking off the tit, as that is hardened with the lips. It is not much used at present, as the shank for driving is of such a shape that it tends to force the spindle of the machine in which it is used up from the square taper. This racks the machine and loosens the parts. Still, there are some of them in use, and will be for years, in the jobbing shop. While some of our modern mechanics will say, "Throw it in the river," the country boy will say, "You give me that drill and our old drill-press, and I will finish up a job just as quick as you can do it in your newfangled, hyfernuten, what-you-call-'em machines. That drill helped my boss to earn dollars when he couldn't afford to buy improved tools, and it taught me to think and plan, and made me a better mechanic than I should have been if I had been raised on an automachine that takes in pig iron and turns out steam-engines."

Fig. 4 is a special tool designed to cut out stock over a check-valve in a deep piston, to allow the liquid to pass the valve. This space is shown at *a*, where the cutter is set out for service. The valve-seat is shown at B. This seat is formed by the cutting edge C of cutter A. These cutters A A are set out for cutting by forcing the rod D down hard between them. The end of the rod is spherical, and this is forced down by a screw thread, located at W, inside of the sleeve. At E we have a square for a wrench. The whole arrangement is used in a drill-press, keyed into the spindle, as in Fig. 2. The cutters swing on small pins, and will drop back in place when the ball is raised, which allows the tool to be taken out of the hole. This device was designed for a special job, and, of course, will not come in for regular work. But it stimulates a line of thought in some other direction, and may help the other fellow out. It is made up in sections, and riveted together at X X X. At K it is jointed together to allow of cutting the internal thread at W. Tools of this class are very expensive, and if the designer of the work on which they are used will look into the tool end of the job, he will save a good many dollars. Sometimes it is necessary to cut a part of a machine in two or more pieces, to avoid the use of such tools. But this is a good thing to do, when we consider the repairs later on. If special machines could be taken to the shop for repairs when out of order, the design would not cut so much of a figure. But the repair bill on a badly-designed machine has often lost the builder an order for a second one.

* By H. S. BROWN, in *American Machinist*.

THE RELATIONS OF PHYSICS AND ASTRONOMY TO THE DEVELOPMENT OF THE MECHANIC ARTS.*

(*Concluded from p.* 59.)

VIII.—Education in Science and Training in Art are Mutually Helpful.

IF science both stimulates the arts and feeds the artisan with necessary physical data; if the laboratory of the investigator and the workshop of the artisan are thus intimately associated together, how is it with the young men themselves who are to become either artisans or scientists? How is it with the education of our youth? Fortunately, laboratory practice, or the teaching of physics by means of systematic personal experimentation in appropriate laboratories has been introduced into all of our best institutions of learning. It is now clearly recognised that the only satisfactory education is that which gives the student both a knowledge of the discoveries of others, and personal practice in the art of discovery. The study of nature is not

* By Prof. CLEVELAND ABBE, U.S. Weather Bureau, Washington, D.C. An Address delivered before the Franklin Institute.

conducted by haphazard methods, but is itself a highly-developed art. The courses in practical arts and the courses of scientific study should not be widely separated, but should be considered as being essential portions of one course of education. In an address delivered in 1883, at Johns Hopkins University, the Hon. S. T. Wallis said that no phrase illustrates the action and reaction of the practical man and the scientist upon each other better than that due to Mr. Huxley: While all true science begins with empiricism, it is true science only in so far as it strives to pass out of the empirical stage into the deduction of empirical from more general truths." The average citizen imagines that the learned man of research is set apart from everyday life. He needs to be reminded daily that the electric light, the incandescent Welsbach, the brilliant acetylene, the ordinary gaslight, are all evolutions which the practical world owes to the physical laboratory; that not only the electric motor, with its halo of mystery, but the ordinary steam-engine, which is but little less mysterious to the uninitiated, and the turbine-wheel, which everyone imagines he can admire intelligently, are wholly the creations of the practical scientists who have given of their knowledge freely to the world of mechanic arts. We must not attempt to separate investigation and education from invention and manufacture. We need to bring them closer and closer together than ever. I may quote from Dr. Wallis the case of a fireman or engineer of many years ago, in the days when the explosions of boilers were more frequent than now, and were an important object of investigation by the Franklin Institute. His boiler had exploded disastrously; he was called upon to give his testimony, and proceeded to state that "no one could know anything about these things except a man who had been brought up in the boiler-room, and that the particular explosion in this case was, undoubtedly, due to the gases in the boiler." When asked what gas, he replied with an air of triumph: "How can I tell? I was not inside the boiler." Fortunately, such ignorant men are not now allowed to have control of boilers and human lives. Safeguards and protective devices of all kinds have been attached to the boilers, and, indeed, all other kinds of machinery; but, after all, the essential element of protection lies in the training and intelligence of the men in charge. It will be a happy day when every university has attached to it a school of mechanical engineering, so that the practical world of action and work may profit all the more by the scientific wisdom and broad learning of university scholars. These crude remarks of mine will, perhaps, have already accentuated the importance of a thorough education along mechanical and physical lines, if one intends to devote his life to the improvement of the mechanic arts. As I have said before, one may, by a fortunate and accidental collocation of ideas, be put in the way of making an important invention or improvement; but the chances are all against this unless one has been pursuing such a course of education and training as will have fitted him to recognise the importance of the ideas when they suddenly occur to him, and to embody them appropriately in the metal and material of which his machine is to be made. Many a bright thought occurs to those of us who have not trained skill in the art of composition, and, therefore, we fail to become poets and musicians; many a man witnesses daily some little operation going on about him, but fails to make it the basis of a new process in the mechanical arts, because his thoughts do not run that way. In general, the most important improvement in machinery originate with those whose daily work familiarises them with the special subject and its needs. It is fortunate that the tendency of the present generation is very decidedly towards the thorough education in physics of those who inherit a liking for machinery, in the belief that thereby they will certainly be better prepared to contribute towards the advance of our arts, and to compete with those who, throughout the world, are revolutionising the progress of civilisation. America holds its own with England and Europe in this respect. The following prominent training schools may be mentioned:—The Sheffield School of Engineering, at New Haven, founded in 1847, but in 1860 changed to the Sheffield Scientific School of Yale University; the Lawrence Scientific School, with its recent addition of mechanical engineering, founded in 1847, at Cambridge, Mass.; the Massachusetts Institute of Technology, founded in 1861; the Worcester Polytechnic, founded in 1865, at Worcester, Mass; the Packer School of Engineering, Lehigh University, Bethlehem, Pa., founded in 1866; the Stevens Institute, at Hoboken, founded in 1868, opened in 1871; the Sibley College of Mechanical Engineering and the Mechanic Arts, at Cornell University, Ithaca, N.Y., founded in 1870; the Case School of Applied Science, at Cleveland, O., founded in 1877; the Rose Polytechnic, at Terre Haute, Ind., opened in 1883. The graduates of these institutions are now everywhere coming to the front in our workshops, in the Patent Office, in the manufactories, and even in our politics, for, of course, the practical mechanic and engineer must be represented in the State and Federal legislatures. I notice that in Germany both merchants and manufacturers have lately united in stimulating the education of mechanics and artisans as an important step towards improving the quality of their goods and the condition of German trade. The manual training-schools, the working men's trade-unions, and other interested parties in the city of Hanover, have resolved to establish advanced lecture courses, in which artisans and apprentices in all trades shall have an opportunity to complete their education in mechanics. Only those will be admitted to the classes whose theoretical and practical knowledge is such as to give promise of success. Great care will be taken to teach young men how to obtain the most practical advantages from the knowledge imparted in the classes. A permanent exhibition of all power-machines and tools will be established. The needs and opportunities of a great technical college were forcibly set forth in 1893, in an article by Dr. R. H. Thurston, Director of the Sibley College at Cornell. After enumerating the large sums of money devoted to the support of educational institutions, he called attention to the fact that technical education in the mechanic arts, strictly so-called, had not—and we may still say *has* not—been sufficiently provided for. The present demand for trained electricians but emphasises the great need of training in every department of the mechanic arts. The provision for culture in literature, history, pure science, and the fine arts is far better; but that for technical instruction, manual training, and the art of doing as well as thinking, still calls for attention. Laboratory or engineering research is especially to be desired. Every piece of machinery that we are using to-day is in itself a field for investigation as to whether it is doing its work with the greatest efficiency and in the best manner possible; but such investigations demand a previous knowledge of the laws of mechanics and familiarity with mathematical methods such as the technical schools alone can give. The passage of a nation from barbarism to modern civilisation occupies a long time, and is always attended with a great increase in density of population, and a great rivalry between individuals competing for success. The interaction between all classes of the community grows more intense; those who are on top struggle to keep their vantage by calling to their aid all the resources of power and intelligence. Experience has demonstrated that in this contest intelligence wins, and that knowledge is power. There can, therefore, be no doubt of the wisdom and statesmanship of the community that improves every possible opportunity to develop the natural resources of its territory and the intelligence of its own citizens. Both in Europe and in America universities and surveys, arts and manufactures, morality and science, health and prosperity go hand in hand. Victory flies to those who are best prepared; peace rests with those who nurture the arts of peace. President Eliot has nobly said: "It is the regular pursuits and habits of a nation in time of peace that prepare it for success in war, and not the virtues bred in war, that enable it to endure peace." From this point of view—the highest that any philosopher has yet attained—we see at a glance the wisdom of those citizens who have encouraged the development of both material and intellectual resources. I join the material and the intellectual together, for neither is of use without the other. If it is the mind that studies nature, it is also the mind that conquers nature. The intellect is developed, strengthened, and quickened in this struggle with nature. A university includes every possible variety of education, theoretical and practical, mechanics and physics, the laboratory and the workshop. It stores up knowledge but only to diffuse it again in perennial streams.

Remarks of Prof. A. S. Mackenzie, Bryn Mawr College, "On the Claims of Abstract Science to a Place in the Franklin Institute.

Prof. Mackenzie:—Prof. Abbe has given us to-night a beautiful example of the value of theory when turned to practice; we all know of his researches on clouds and the clearness of the earth's atmosphere, but to-night he has descended from the clouds and shown his power to provide with a clear atmosphere the subject of the relation of pure science to the mechanic arts. I have listened to his remarks and those of Prof. Mendenhall with very great pleasure, but with a good deal of trepidation, for I fear that what I may have to say will but traverse the ground they have already so fully covered. Perhaps, however, I may be pardoned some repetition, for I believe that too much stress cannot be laid on the importance of the subject upon which Prof. Abbe has chosen to address us, and that progress in the future is to be made only by the theorists and the practical men keeping in the closest touch with one another's aims and needs. It seems to me that the event in the history of the Franklin Institute which we are assisting at to-night is a notable one in its progress, and one which shows the high ideals of the Society, and the broad aims of those to whom its management and direction are intrusted. We learn from the full title of the Institute that its aim is *the promotion of the Mechanic Arts*, and we read of its sections devoted to Mechanical, Electrical, Chemical, Mining, and Metallurgical Engineering as a matter of course. At first thought it might cause surprise that it had a section devoted to theoretical chemistry, and that it was proposing to add a Physical and Astronomical Section; it is, however, but living up to the many-sided character of the man whose name is so intimately connected with it, and whose investigations in the realm of abstract science are an integral part of our studies of to-day; and I think that not until now can the Franklin Institute be said to have reached the standard set by its founders, or to have been quite rounded out in its various functions. The line of progress and development of the society has been a natural one in this new and rapidly-growing country, where the production and improvement of appliances for the rapid development of the country's enormous resources have called to their aid the best thought and energies of its people. As a consequence, the technical side of science has been advanced more rapidly than its theoretical side; it is true we have had a Franklin and a Henry, but the production of such men has been spasmodic, and until quite recently the study of physical science was but nominally existent in this country, whereas now great strides forward are being made, and the names of Rowland, Newcomb, Gibbs, Michelson, &c., are known in every corner of the scientific world. It is more than a coincidence, I think, that to-day the Franklin Institute is forming a section devoted to Physics and Astronomy, and that the physicists of the country meet at New York to-morrow to found an American Physical Society; it proves that at last there is an awakening to the necessity of the study of science for itself, and to the belief that we are fit for better things than to be a nation of shopkeepers and inventors only. To the problems of engineering and technical science in its widest sense the Franklin Institute has in the past devoted most of its energies, and with great and growing distinction; the inventor or thinker to whom a John Scott or other medal of the Institute has been awarded has a recognised standing the world over, and the *Journal* of the Institute is consulted regularly by all engineers who wish to keep abreast of the progress in their special fields, and to follow the newer and more important processes and developments of their chosen work. But surely it is not necessary to add that, insomuch as it has not had among its sections one devoted to the study of physical science for itself, without thought of material gain or useful adaptation, it has lacked that one very necessary part of an advanced organisation devoted to mechanical science. I consider it a great privilege to be present at this auspicious opening of the Physical and Astronomical Section. The able address of Professor Abbe, whose reputation, already so well known, will not suffer from the interesting lecture we have just listened to, has emphasised the absolute necessity of a close communion between the men who are willing to be the devotees of pure science and those whose ideals are in a direction equally valuable, and the results of whose labours are felt directly by each one of us at our every turn. It is upon this necessary working together of these two groups of men that I think we should at this meeting lay stress. A science must exist before applications of it can be made, and hence the two divisions of the great work fall into the hands of two different sets of workers; and the nature of the work and the composition of mind required are quite different in the two cases. Not to the pure scientist belongs all the credit for the making of a science; the mechanic or engineer can, by constant thought and application, so get at the very heart of things that he becomes a co-worker of the theorist and advances our knowledge of the inner workings of nature; for a mathematical knowledge is not essential: it is a help, and a valuable one, and the man armed with this weapon for attacking a problem is at an advantage, provided he does not become lost in his symbols; and it must not be forgotten that Faraday wrought out his great work in the field of electricity without mathematical equipment of the higher variety. It is, however, to the theorist, not to the technical man, that we must look for the advancement of science; but this advance can never be so rapid as it should be unless both theoretical and technical men recognise their mutual dependence. Du Bois Reymond has somewhere remarked that there is no abstruse investigation into nature that does not at some time have its practical application, and, this being so, how essential it is that this investigation should proceed on a clear knowledge of the work done and being done by practical men. Perhaps no better illustration of the value to the theorist of a knowledge of the technical requirements of his subject can be found than in the development of the study of thermodynamics; it was the work of Watt and his successors that led to the brilliant achievements of Carnot, Kelvin, Clausius, Maxwell, Hirn, and others. Our whole knowledge of the laws of energy is almost a consequence of the researches called into being by the demands of engineers to know the principles underlying the working of the heat-engine. The theorist thus receives a constant guidance and check as well as incentive, and is forced to give a reality and definiteness to his

speculations which might otherwise remain in the clouds, and whose full significance would be known not even to himself. But to the technical man the assistance of the theorist is of much greater value. In addition to the direct aid afforded to the engineer by the new principles and discoveries of the thinker must be mentioned the fact that the theory not only guides the engineer in the direction of possible development and improvement, but that it acts as a beacon to warn him from the many directions in which his genius and labour would be barren of results, because he aims at the impossible. There never was a time when, more than now, the technical man must work hand in hand with the pure scientist. It requires the finest theoretical knowledge to devise a telegraph by the aid of which eight or more messages can be sent along a single wire in each direction at the same time, and yet we ordinarily consider telegraphy a purely technical subject. The engineer who would keep up with the pace which science is making must consider himself always in the schools; he must be trying to keep step with the changes in the theory, and with the growth of knowledge as proclaimed from the studies and the laboratories; he must, if he would win distinction, have the training which fits him to seize the idea behind the theorist's symbols and forms, and strikingly apply it to the everyday problems in which his interests and labours lie. The brain of the genius who can fasten upon the practical consequences of an idea brought forth by the mere thinker is one of the very highest order, and he deserves the merit he receives, and the world is quick to reward him in its substantial way, although the world is little able to discriminate, and is willing to believe the scribbler of any magazine article who prophesies plausibly a sudden demolition of the laws of nature which the labours of the greatest thinkers have placed on the most enduring bases. Just now we can see an example of such a thing with regard to the law of the conservation of energy; we are threatened with most improper doings by liquid air, and we have not yet forgotten the Keely motor. It is to the credit of the scientist that he is willing to give his life to the prosecution of learning for its own sake, and that, too, when an understanding and appreciation of his labours must be given to few. How common it is to hear that man who has made some application of value (measured in money or utility) lauded above the originator of the idea. One hears of this or that inventor of the electric lamp or dynamo, but not of Faraday, who made an electric arc fifty years earlier, and produced the electric current by induction and foreshadowed all its applications. One hears of a Hertz or a Marconi, with their electric waves and wireless telegraphy, but how seldom of a Clerk-Maxwell, whose seething brain put forth the thoughts of which these things are but adaptations. How often is Lord Kelvin's name connected with the problem of submarine cabling? One is almost tempted to say that the person of so-called average intelligence gives in his heart greater credit to the inventor of "see that hump?" than to the discoverer of the law of gravitation. Surely equal credit must be given to the originator of an idea with him who applies that idea to the purposes of mankind, and it must come home to us how necessary is the existence of a close bond between these sets of workers, so that each aids the other and to each is given the credit which is his due. Now I believe that not only will the founding of a physical and astronomical section bring about good results of this kind to the Franklin Institute; but I consider that it is only a beginning in the direction in which such an institution should be expanded. It should have its staff of professors, whose only duty it should be to pursue original investigation, and the results of whose work should be made known to the world through the society. Of course such things cost money, and being a practical people we hesitate to give our money to what we please to call unpractical purposes. I hope, however, that we have come to the conclusion that a full return for the money so spent is bound to come back to us in overflowing measure, though in indirect and unseen ways. It seems that our benefactors who give of their wealth to advance education are unwilling to pay for pure science; they willingly give their money to found and endow libraries, they give freely to art collections and to museums; but what cases can we recall of the founding of a laboratory for research only, a place where a Rowland could be put and told to go ahead regardless of expense and enrich the world's treasure-house of thought? The German Government has such an institution, and yet I would be sorry to see ours try to imitate it; for it would be difficult every four years to find a man of the right political complexion to take a well-earned turn at the "job." At the Reichsanstalt, to which I refer, and with which Helmholtz was connected in his later years, is a vast equipment, with its experts, to be counted not by units, but by hundreds, who devote their time not only to standardising apparatus, but also to the devising of the best and simplest forms of instruments and to the production of new ones; and in addition to all this is Prof. Kohlrausch, with a staff of fifteen or twenty assistants, whose only aim is original research in the field of physics. All the products of these men's brains and the results of their labours are given freely to the world. I know of nothing similar in this country in the domain of physics; Harvard College has one of its departments, the astronomical observatory, devoted entirely to research. Prof. Pickering and his associates give no lectures and no instruction in the observatory; they are expected simply to use their best efforts to promote our knowledge of astronomical science, and to this end are provided with a staff of forty assistants and a fully-equipped observatory and library. What better thing could be done by one of our moneyed men, eager to utilise his great wealth for the good of mankind, than to found, in connection with this and similar institutions, a professorship in physics, assuring to one qualified to fill it a liberal stipend (for even a Newton must eat) and all the appliances and assistants his genius can employ? Perhaps this has carried us too far into the future, and whether we shall ever come to this I do not know; but at any rate, I believe that the Franklin Institute has made a move to-night which will redound to its credit and usefulness, and I have taken great pleasure in being present at its inception. [Abstract of remarks of Dr. T. C. Mendenhall, President Worcester Polytechnic Institute, Worcester, Mass.] Dr. Mendenhall spoke substantially as follows:—"The excellent and carefully prepared address of Prof. Abbe leaves little to be said by those who follow him. It is a real pleasure, however, to be able to congratulate the Franklin Institute on the realisation of a plan which is a recognition, tardy though it may be, of the intimate relations between the mechanic arts and physical science, or, as some of us would be inclined to say, the dependence of the former upon the latter. When I read the subject for discussion I wondered how it could be a subject of discussion at all, for I am sure everybody knows and admits that progress in the mechanic arts rests upon and is measured by progress in the physical sciences. But it is no ordinary event in the history of either that the Franklin Institute, which may be justly considered the foremost organisation in the country, whose primary object is and always has been the higher development of the mechanic arts and the encouragement of American invention, has organised a special section for the better development of its interest in the physical sciences. When one reflects upon the splendid work of the Institute in its chosen field, the outlook for the future of this new section of physics and astronomy is most promising, and we are all confident that much important work will here be done. It is impossible to speak in this hall without constantly-recurring thoughts of the pioneers of American science. It is entirely natural that the present should appear to be the golden age, and among the historians of science in this country it is too common to pass over the seventeenth and eighteenth centuries as relatively unimportant. As a matter of fact, some of the most brilliant of America's contributions to science were made before the beginning of the nineteenth century, and, counted in proportion to the population, the number of eminent scientific men in those days was fully as great as now, and along some important lines their share of the world's work was greater. Perhaps the first contribution from America to the proceedings of a scientific society was the first communication of Gov. John Winthrop, of Connecticut, to the Royal Society of London, of which he was one of the earliest members. Another Winthrop, of the same stock, Prof. John Winthrop, of Harvard College, was also a frequent contributor, and doubtless did more to kindle and keep alive the fires of colonial enthusiasm for physical science during the eighteenth century than anyone else. But the one great figure of that period was one whose name and deeds are inseparably related to this city, and in whose memory this institution was founded. The world has produced few, if any, more brilliant men than Benjamin Franklin. It is with only one phase of his intellectual activity that we are interested to-night, and in that alone, as a physicist or natural philosopher, no one will deny that he must be reckoned among the very foremost. There is one quality of his scientific work to which I want to invite especial attention; it is the almost ever-present practical end towards which nearly every investigation was directed. On account of the great lustre of his researches in electricity, it is often forgotten that he enriched nearly every department of physical science, and although he evidently did not lack capacity for that keen enjoyment of discovery which depends upon discovery alone, and is indifferent to practical results, it is everywhere evident that with him the possibility of turning a scientific experiment or principle to good account as a means of bettering the condition of his fellows was paramount. There is a certain class of scientific men, not large and not increasing, we are glad to note, among whom it is the fashion to speak with what they believe to be a "fine contempt" of applied science, and who, having never succeeded in discovering anything of any particular value or use, pride themselves on pursuing science for the sake of science. And we have all heard of the mathematician who thanked God that he had at last discovered a formula of which it would be utterly impossible ever to make any practical use. But this doctrine has not been held by those most entitled to distinction in the annals of Science, and Franklin was a notable example of those who believe that the noblest ambition by which a man of science may be stirred is the ambition to discover laws which may be utilised in the amelioration of the almost necessarily harsh conditions by which mankind is surrounded. It is difficult to address a body of scientific men in this place without thinking of another great name —that of one who stood almost at the beginning of that long and unbroken line of astronomers for which our country is justly famous. And in thinking of Rittenhouse in Philadelphia one is likely to turn from the contemplation of his splendid career as an astronomer to that incident, so characteristic of the men of his time, in which the man of science became, at the behest of the Committee of Safety, the clockmaker again, designing and casting clock-weights in iron which were to be exchanged with the inhabitants of the City of Brotherly Love for leaden weights, to be moulded into bullets, which contributed to the founding of a new nation. During the life of that nation the most marvellous changes have been wrought in the material condition of man and his relations to the planet which he inhabits. We have ourselves witnessed so many of these changes that detailed reference to them is unnecessary, but we may profitably inquire concerning the underlying cause of such a prodigious revolution. To my mind it is found and found only in the discoveries in physical science, and in their application to the control and direction of the forces of nature. Man lives in this world only by the continued transformations of energy, and his comfort and happiness depend largely on the amount of energy he is able to transform. It is not long since his only supply was that furnished by the muscles of his own body, but during the 19th century he has been able, thanks to physical science, to draw upon almost inexhaustible sources from without, and this is why he has progressed by leaps and bounds that have exceeded the most extravagant imaginings of our ancestors. This progress cannot be attributed to war, for war has existed since the dawn of history, and it has failed to lift man above the slavery of unintelligent toil. Nor is it due to religion, nor literature, philosophy, or art, for all have flourished for ages without materially altering the relation of man to his environment. Science, with its unerring processes of observation, experiment, and precise measurement, has inaugurated the peaceful revolution in social relations and material conditions which the nineteenth century now passes on, still incomplete, to the twentieth. The pen has conquered the sword, but the yard-stick is potentially the master of both.

AMID THE ICE PACKS IN SOUTHERN SEAS.

NEWS was received some time ago that Mr. C. E. Borchgrevink and his brave companions had effected a landing at Cape Adair, in Victoria Land, within 200 miles of the South Magnetic Pole. As this is the first time in the world's history that a fully-equipped expedition has accomplished this feat, considerable interest attaches to it, and an article by Sir George Newnes in the September *Strand*, giving details, is sure to attract a good deal of attention. It has been prepared from the log of the *Southern Cross*, and is illustrated with many photographs taken during the expedition.

The Great Ice Pack.

Mr. Borchgrevink, it may be stated, has as his chief officers on board the *Southern Cross*, Captain Jensen, Sub-Lieutenant Colbeck, R.N.R., Mr. Hugh Evans, and Mr. Bernacchi, and they command a fine, stalwart crew. The voyage from London to Hobart Town was uneventful, but the reception that the crew met on arrival there was of the most enthusiastic description. The Governor presided at a banquet in their honour, and they were entertained at parties, conversaziones, and fêtes innumerable. The vessel left Hobart Town for Cape Adair on December 19 last, and before the old year had died out—on Friday, the 30th—she sighted the great ice-pack. "The greatest enthusiasm," Sir G. Newnes writes, "prevailed on board, for the sight to those who looked upon it for the first time was one to fill the spectator with wonder and admiration. Some of the floes were several miles in diameter and from 4ft. to 8ft. thick. The channels between them were very narrow, and at times closed up completely. The danger to the ship was great; but the *Southern Cross* proved equal to her task, and came triumphantly out of ice pressures which would have crushed a less solid vessel like an eggshell."

But there were some very anxious days. On January 22 and 23, for instance, "the ship was fairly buried in the ice; the great blocks rose to the level of the bowsprit, and the pressure of the floes was so

stupendous as to lift the vessel bodily 4ft. out of the water!"

Off the Balleny Islands.

At this time the expedition was off the coast of Balleny Islands. "No more appalling scene of desolation can be imagined than those sinister and ice-bound shores. At evening, however, gorgeous sunsets, which surpass description, glowing on iridescent floe and ice-peak, lend them a wild magnificence of beauty which compensates for all. Nor were the adventurers without resources. Very valuable scientific work was done, especially in the zoological department. No fewer than a hundred and seventy-five birds' skins were prepared. Many seals, including one of an entirely new species, were procured, as well as penguins and beautiful white petrels. More than a hundred species of various fauna were collected. Meteorological and magnetical observations were made, deep-sea temperatures were taken, and a number of most interesting photographs secured."

For forty-three days the vessel remained in the ice pack; but finally open water was reached, and an eastward course steered. The pack was then re-entered at another point, likely to afford an easier transit, and after a few hours the gallant explorers safely emerged in clear water to the south.

At Cape Adair.

Cape Adair was sighted on February 16. A terrific gale was blowing, and the vessel had to lay-to. Next day, however, the gale subsided, the *Southern Cross* steamed into Robertson Bay, and there an anchor was let fall for the first time in history:—"In half an hour the staff were all on shore. On the beach were penguins, gulls, stone-petrels, giant-petrels, and many huge seals of an unknown species. Two of the adventurers, Mr. Evans and Mr. Bernacchi, started off to climb to the summit of the cape. The ascent, over 1,000ft., proved terrible, and they did not reach the top till midnight. But they must have felt full compensation in the thought that they were first to set foot upon the summit of Victoria Land." The next few days were employed in landing stores and erecting huts. This was a task of no ordinary difficulty, but was eventually successfully accomplished.

A Terrible Experience on Shore.

But now a new disaster was before the intrepid explorers. On February 23 a great blizzard came on, and the experience of the men seem to have been a terrible one:—"The wind rose suddenly, and blew thousands of tons of snow upon the little camp. The gale blew with cyclonic force, and it was piercing cold—18° below zero! Four members of the staff—the doctor, Fougner, Colbeck, and Bernacchi—were on shore and could not reach the ship. The only shelter was the tent, which they were obliged to bury with stones and to lash with ropes, to prevent it blowing away. All that terrible night they were toiling in the blizzard to save the cargo from being washed away. Mr. Bernacchi got frostbitten in the ears, which turned quite black, and were only saved with difficulty. The hair of the party froze into solid lumps, and the ice upon their beards took hours to melt, while the clothes clashed with ice like coats of mail. The waves froze solid as they dashed upon the shore. Fortunately, the next afternoon the vessel was reached in safety.

But those on board, it was then discovered, had suffered hardly less severely:—"Stones from the mountain had been blown on board. The cable had parted during the night, and the ship was driving ashore. They endeavoured to cut the mainmast, but could not do so. They were forced to steam out of the bay, and even then nothing could have saved the ship had she not proved herself remarkably seaworthy. On the 23rd it blew another storm, but not quite so strong. But the vessel again lost an anchor, and, driving ashore, bumped on the rocks four times with terrific force. By steaming full speed ahead they contrived to get her off, but a boat was smashed to atoms, and they had to steam for shelter to the other side of the bay, and to moor the ship with ropes to the edge of the glacier."

There good shelter was found, and three members of the staff were permitted to go ashore for the purpose of climbing the great glacier. They were not able to reach the top, although they attained some 2,300ft., and made several valuable discoveries. Near the bottom of the mountain they lighted on a quartz outcrop, which looked as if it contained gold! This was on Sept. 27. What has happened to the brave little band since then will not be known till January next. They are shut up in the ice, and are, it is to be hoped, all well, and carrying on successful explorations. The *Southern Cross*, meantime, has returned to warmer latitudes; but when the ice breaks up will steam again to Cape Adair for intelligence of those she left behind amid the silence of the snows.—*Westminster Gazette.*

There are over 2,550 locomotives on the Midland Railway, from 80 to 90 per cent. of which are worked every day.

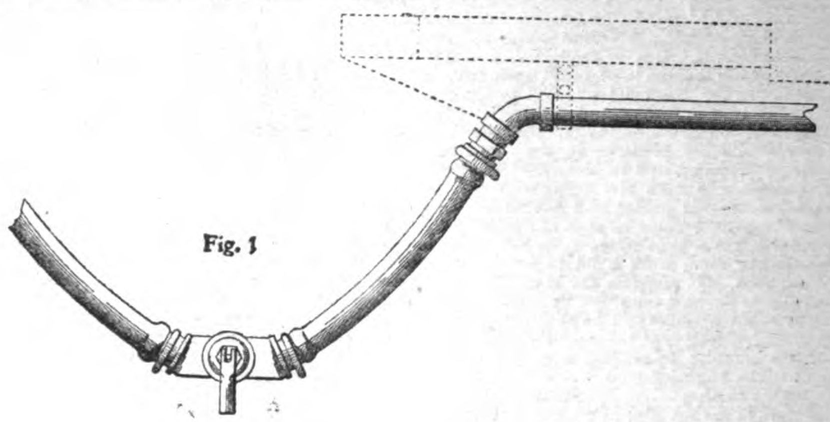


Fig. 1

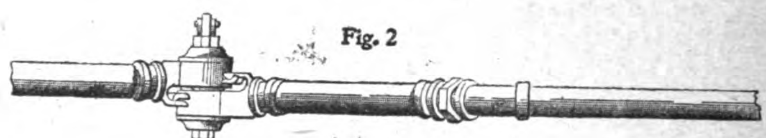


Fig. 2

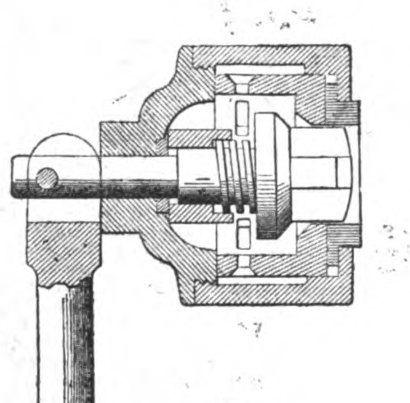


Fig. 3

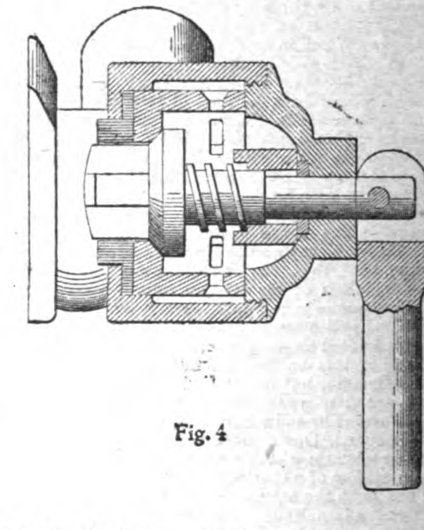


Fig. 4

BROWN'S PATENTED HOSE COUPLING.

THE train-pipe hose coupling has been tried on passenger coaches and freight cars; it works nicely. No more angle cocks cut off by tramps or other persons, as this does away with angle-cocks entirely. The device consists in the combination, with an air-brake coupling-valve having its stem extended beyond the coupling-head of a valve-setting lever, having an eccentrically-arranged fulcrum, through which it is directly connected with the projecting portion of the valve-stem, to operate in bearing contact with an outer portion of the coupling-head, so that in one position of said lever the valve will be unseated and locked against a closing or seating movement, and in the other position of the lever the valve will be free to seat automatically when the two coupling-heads are separated.

Fig. 1 is a side elevation showing the hose coupling and a portion of a train-pipe, to which the hose is directly connected without the interposition of the usual angle-cock. Fig. 2 is a plan of the same. Fig. 3 is a vertical transverse section through the valved portions of two disconnected coupling-heads, showing the lever of the coupling-valve so set as to prevent the valve from seating, and Fig. 4 shows the lever of the valve in the other head, set to permit automatic seating and unseating of that valve.—*Locomotive Engineering*, N.Y.

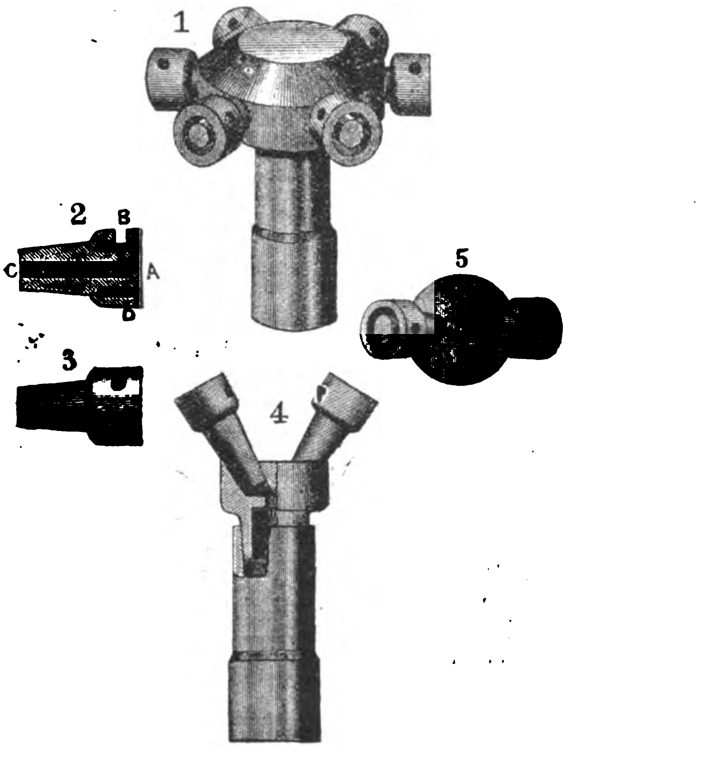
A STUDY OF THE GAS-ENGINE.

AMONG the scientific studies of gas-engines one is contained in three papers by Prof. E. Meyer, contained in recent issues of the *Zeitschrift des Vereines Deutscher Ingenieure*, and based upon experiments made with a Deutz Otto engine in the mechanical laboratory of the Technical High School at Hanover. In these tests the engine was so arranged that different degrees of compression could be employed, and the mixture of air and gas were varied and the motor operated at different speeds in order that comparative determinations of the influence of these elements might be obtained. After discussing the calorific value of various fuels, and describing the methods of calorimetry used in testing the fuels employed, Prof. Meyer goes on to examine the method of computing the heat balance of the gas-engine, deducing the equations by which the distribution of heat may be computed, and showing the method of their application. Broadly speaking, the total heat may be divided into three portions, one of which appears as effective work, one as an increase in temperature of the water in the cylinder jacket, and the third goes out with the exhaust gases.

It is not always easy to determine the exact division of the heat losses; but by careful measurement of the volume and rise in temperature of the jacket water and by brake measurement of the effective power exerted by the engine, the remainder may safely be assumed to represent that portion which is rejected with the exhaust. When, however, it is attempted to so modify the action that a greater portion of the rejected heat may be converted into work, it is necessary to understand the principles which control the heat distribution if improvement is to be expected.

Thus, if an attempt is made to diminish the rapidity of circulation of the water in the jacket, or in similar manner to reduce the proportion of heat carried off through the cylinder walls, it will be found that in general, the only effect will be to increase the proportion rejected with the exhaust gases, the thermal efficiency remaining about the same. An examination of the diagram of the cycle of operations which takes place in the cylinder, however, in connection with the thermodynamic analysis, shows that an increased compression of the explosive mixture should result in an increased efficiency, and it was to demonstrate the truth of this point that many of the experiments were made.

The engine used in the experiments was one of the ordinary Otto type, with the exception that the piston-rod was made in two parts, one portion sliding within the other. By use of a clamp and set of split bushings it was possible to alter the length of the rod without altering any other conditions, and thus the degree of compression could be varied and corresponding trials made. A carefully calibrated Prony brake enabled the effective power developed upon the shaft to be measured, and both the gas and the air entering the cylinder were carefully metered. Thermometers reading to $\frac{1}{10}$° C. were placed in the admission and discharge pipes



for the jacket water, the volume of cooling water being determined in calibrated tanks. The indicator by which the diagrams were taken from the cylinder was provided with a water-cooled stopcock, so that diagrams could be taken continuously without excessive heating of the instrument, and the temperature of the exhaust gases was measured by means of a specially constructed pyrometer of the Le Chatellier type.

The results of these very complete trials are fully tabulated in the paper of Prof. Meyer, and to the original memoir the interested reader must be referred. The general advantage of compression, however, will be seen from the following condensed statement of the average results of trials with four different degrees of compression; all being made with a gas of a calorific power of about 4,700 calories.

The consumption of gas per indicated horse-power when the mixture was compressed to 24 per cent. of its original volume, was 533 litres; when compressed to 25·8 per cent., 559 litres; when compressed to 31 per cent., 624 litres, and when the compression was to only 37 5 per cent. of the original volume the gas consumption per horse-power was 738 litres. There was thus an increase in gas consumption of 38 per cent. in the last case as compared with the first.

STEWARD'S ACETYLENE GAS-BURNER.

ACETYLENE gas possesses so many advantages for isolated lighting that it is little wonder the industry is constantly progressing, and is now on a sure foundation. One source of trouble which consumers have had with the new illuminant has been that owing to the great richness of the gas it was not possible to provide burners which would consume more than one cubic foot of acetylene gas per hour without smoking and consequent loss of luminosity. This difficulty has been obviated in a new acetylene burner, invented by D. M. Steward, of Chattanooga, Tenn., by the grouping of any number of flames on one-burner and by a new air-mixing device. Our engraving, says the *Scientific American*, shows the constructions of the burner. The pillar does not differ from those in general use. At the upper end of this pillar is fitted the head of the burner proper, which is made of lava or other similar substance. The burner stems extend from this head and diverge from each other. They are arranged in pairs, and the jet openings in each stem are adapted to direct the jet towards that at the adjacent stem. Each stem is of cylindrical form, and is made slightly tapering, with the smaller end fitting into the openings in the head and its larger end surmounted by a burner tip former by an annular cup-shaped flange, D, and extension, A, in which the discharge-opening is drilled. An opening, B, is drilled through the flange opposite the opening from the tube proper, C, which conveys the gas to the tip (see Fig. 2). Opening, B, in the flange is of larger diameter than that in the centre wall of the burner. This plan provides an air-space between the extension A, which terminates the end of the gas-tube C, and the interior of the flange, so that as the gas is discharged from the opening it will suck the air into the air space, and so provide for uniform admixture of the air with the gas discharged through the aperture in the flange. The air-mixing device is a unique feature of the burner, and is an improvement on all previous burners, the old method being to surround the jet of gas with a number of small inlets or holes for air. In the new burner the cup-shaped cavity provides a sufficient amount of air, and keeps the burner cooler than with any other known construction.

The tips are so arranged that the two jets are directed towards the jet from the adjacent tip, and inwardly in oblique position. The jets so discharged from each tip commingle with the jets discharged from the adjacent tip on each side so as to form flat flames. The head being located between the pillar and the burner stems, the pillar is kept from becoming heated.

ACETYLENE FOR LANTERN AND ENLARGING.*

THE various kinds of lighting hitherto employed enlarging and projections are in a decreasing order: electricity, oxygen mixed with gas, ether, or petroleum, gas alone, petroleum. In permanent installations a light is employed in the absence of electricity, with oxygen as base. Oxygen is somewhat expensive, and, besides, requires a rather complicated apparatus, in consequence of which it is rarely employed by the amateur photographer, who, not having to illuminate big screens, usually adopts petroleum or gas. Certainly this light does not give him perfect satisfaction, but as there is nothing better he does not complain.

Like most amateurs, I had utilised coal-gas, but owing to several accidents I determined to change my system of lighting, and made some experiments with acetylene. For such experiments it is well, firstly, to investigate the degree of safety of the luminous sources placed in competition, and we have all the elements of comparison.

We know that petroleum, both in the state of lamp oil and of spirit, has caused and causes daily accidents which are often fatal, due, it is true, as much to the carelessness of consumers as to the dangerous character of this mineral oil. The misdeeds of coal-gas are so common that we need not mention them. The oxy-hydrogen, oxy-calcium, and

Oxy-Ether Lights

all require great precautions. Everything considered, acetylene presents fewer chances of explosion than some of the enumerated systems of lighting, and it is not more dangerous than the remainder.

For example, the admixture of oxygen and hydrogen, which gives the brilliant and hot Drummond light, demands great care. Explosions of oil-cans caused by carrying a light in their vicinity occur daily, as with coal-gas, so that comment is needless. Certainly acetylene is not free from these dangerous characteristics, but it reveals its untimely presence by a peculiar odour which warns of danger. Thus the new gas gives a sufficient number of guarantees to justify its admission into the photographer's studio.

If from the point of view of safety, acetylene does not leave the other styles of lighting far behind, such is not so as regards quality and intensity of flame. With coal-gas all the rays of light are not utilised; the flame almost reaches the top of the glass protecting it, and we know that in a magic lantern the only useful light is that near the axis of the lenses. It is for this reason that one seeks before all else a powerful source of light with the smallest possible area. Acetylene beneficially fulfils this important condition.

For projection a row of five burners can be employed, giving 150 litres of acetylene per hour, which is equivalent to a minimum of 20 carcels. The burners are situated one behind the other, like the multiple burners of the petroleum lamp. Owing to this arrangement, the flame is not high, all the light being concentrated at a slight distance around the optical axis. For requirements of an amateur lanternist a row of three burners, 30 litres each, amply suffices. With the 12 carcels thus obtained, a sufficient light can be projected over a circle of 1 metre in diameter. The pictures are brilliantly illuminated. Their dimensions could be enlarged, but it is sufficient if we consider that the amateur will have a limited number of spectators, and that the ordinary dimensions of our rooms hardly admit of having the necessary retreat to cover a

Larger Surface.

On the other hand, the three-burner row gives a luminous power which, when enlarging, allows of considerable shortening of the time of exposure. Even failures are to be feared unless somewhat dense negatives are employed. With a five-burner row exposure would be too much curtailed, and results would not be good on account of the very rapid printing of the sensitised surface.

It being granted that we seek before all else a great luminous power during a relatively short time, no other apparatus seems so fitted for this style of work; besides, management is most simple, and when full there is no fear of a dangerous amount of gas, provided, of course, the operator is prudent. A point not to be neglected is the cheapness of this valuable apparatus, which will contain 750 grammes of carbide, producing 225 litres of acetylene, which represents more than two hours' burning for three burners. In fact, with the lantern, and particularly in enlarging, the time of work is little more than an hour, and it is not necessary to completely fill the metal basket with carbide.

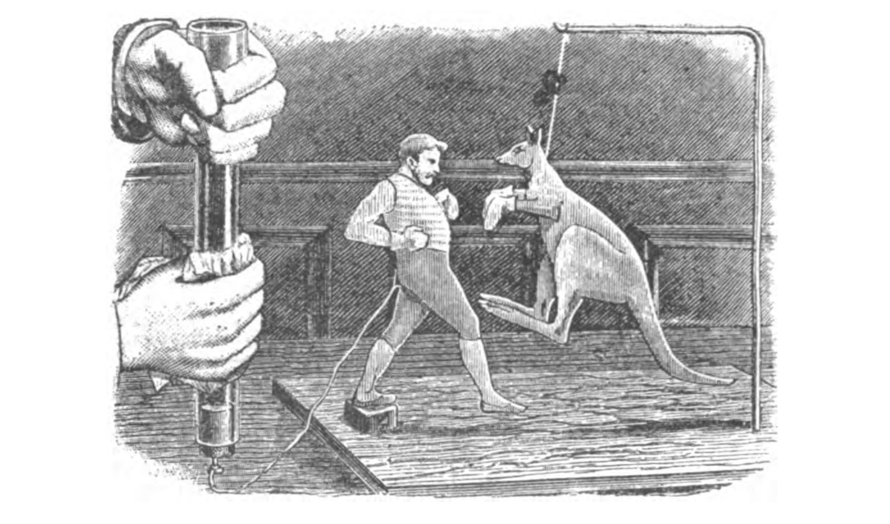
In addition to better light, expenses are less with acetylene. Certainly oxy-calcium, oxy-hydrogen, oxy-ether, and electric lights are more powerful than acetylene, but they are very expensive. On the other hand, it is useless to make a comparison with petroleum, which gives a relatively feeble light of dubious quality. Comparison is only practical and interesting between acetylene and coal-gas. To obtain the 20 carcels mentioned above—obtained by the horary combustion of 150 litres of acetylene—a minimum of 2,000 litres of coal-gas have to be consumed. The 150 litres of acetylene gas are obtained with 500 grammes of calcium carbide at a cost of 65 centimes per kilogramme—i.e., 32½ centimes. The average value of 2 mètres of coal-gas is 60 centimes; whence an economy of 27½ centimes per lighting hour.

To demonstrate the superiority of acetylene, we (*Le Journal de l'Acetylene*) must mention the enormous heat which the 2 mètres of gas would give required for the carcels in the narrow limits of a magic lantern. We could find other arguments, make other comparisons, to the advantage of acetylene. Amateur photographers, without doubt, will wish to ascertain by experiments that the new easily-made gas is more economic and just as safe as its predecessors. Once convinced of this, lanternists will have no other light than this, the discovery of which should be regarded as a god-send for the art of photography.

* From the *Optical Magic Lantern Journal and Photographic Enlarger.*

HIGH EXPLOSIVE SHELL AGAINST ARMOUR.

THE "Isham shell," charged with a high explosive, is said to have produced good effect against armour last month in America. A steel shell unfused, weighing 1,900lb., containing over 129lb. of dynamite, was projected by a charge of brown prismatic powder against a "Harveyed armour-plate, striking it at an angle" more unfavourable than would generally occur on service. The armour, which was better supported than that on a ship's side, was broken to pieces and scattered, the shell itself being blown into fragments, of



which the largest found weighed 4lb. It is difficult to say what conclusions are to be drawn from this trial. Clearly this shell is one of special length and magnitude. The largest gun in the United States navy is 13in. in calibre, and its projectile weighs only 1,100lb., and 1,900lb. fired from such a piece would be what has been termed a double shell or torpedo shell, and the question arises as to what are its shooting powers. Such a projectile might have great value for short ranges, but we do not know the thickness of the armour-plate attacked. We should suppose that the idea is the destruction of the lighter parts of a ship by special double projectiles carrying enormous charges of high explosives. Armour has hitherto entirely defeated shells which explode before obtaining a considerable measure of penetration; but it has always been possible to destroy their plating with explosive shells of disproportionate power. This appears to be a trial of the feasibility of realising the same effect on a larger scale. We should expect the plate to be at least 5in. thick, because it is stated to be a Harveyed plate, and the Harvey process is rarely of practical value applied to thinner plates, which are apt to be contorted in hardening the face. The conditions of this trial are novel, the charge and projectile being enormous. There is nothing surprising in a 5in. or 6in., or even heavier plate, being destroyed by it. Unless the plate was a very heavy one, it means that the heaviest gun was employed against armour which was very greatly outmatched, and the shell is a formidable one to carry. It would be interesting to test the result of such a projectile being struck by a shot when lying in a gun position in the course of supply on board ship. We imagine that care would be taken not to have several brought near together. In short, while the experiment is novel and interesting, we need to know the thickness of the plate, the shooting powers of the projectile, the firing charge which can be used with it, and the arrangements as to supply and handling on service. Happily very little is kept dark in America, so we may hope to obtain the information we seek before long.—*The Engineer.*

THE BOXING KANGAROO.

THE electric pendulum consists of a very light ball of pith, which is suspended by means of a silk thread from an iron wire that is bent at right angles, the longer leg of the angle being placed in a glass foot for the sake of insulation. If the little ball is approached by any object charged with electricity, it is at first attracted, and then, upon being touched, is repulsed. The accompanying illustration, from *Illustrirte Welt*, shows an original way of presenting this old principle. The figure of a boxer is cut out of a card and covered on the back with tinfoil, a little larger than the figure, so that it can be turned over the edges of the card. One foot of the figure is stuck into sealing-wax on a small block, and to the back of this leg is secured a piece of iron wire. As the other foot does not touch the support it is insulated from it. The figure of a boxing kangaroo in position for making an attack is cut of tracing-paper. This figure is also covered on one side with tinfoil and then is suspended by a linen thread from one end of a piece of iron wire that has a rectangular bend, the other end being set in the supporting plate so that the kangaroo shall face the boxer. To obtain the necessary electricity, we take a glass lamp-chimney, stop one end of it by means of a cork, and in the centre of the cork drive a nail, to which is secured one end of a piece of small iron wire, the other end of the wire being connected with the wire on the back of the boxer's leg. After the lamp chimney has been carefully dried, it is rubbed with a piece of silk or fur, thus generating electricity, which is transmitted to the boxer. The kangaroo is strongly attracted by the figure thus charged with electricity, which it attacks, but a discharge of electricity takes place at once, and the animal is repulsed. This is followed by a series of attacks and repulses, the struggle between the man and beast being constantly renewed as long as the rubbing of the chimney is continued.

CYCLE CONSTRUCTION.

A VERY interesting question is raised by the long crank bicycles now coming into favour. The matter cannot be considered as one of pure mechanics, since from this point of view it is obvious that a 6½ crank with a 65in. gear is identical with an 8½ crank and an 85in. gear. In practice, however, riders find that a given distance is ridden much more easily with the second arrangement than the first, a circumstance which points to the conclusion that the principal cause of the fatigue felt is the wear and tear of nerve rather than of muscle. This view is that held by Mr. R. E. Crompton and his son, to whom cyclists are principally indebted for the commercial introduction of the innovation, though, as the Messrs. Crompton quite properly admit, they have themselves been largely indebted to Mr. Otto Blanthy, of Buda-Pesth. Messrs. Crompton suggest that the nerve waste involved in riding is proportional to the number of times the muscles are energised—i.e., to the number of pedal strokes made, and this view seems certainly borne out by the experience of riders who have given the long-crank machines a fair trial. Riders who have done much hard riding with short cranks, it should be observed, find considerable difficulty at first in accommodating themselves to the longer pedal. This arises from the fact that they have become more or less muscle-bound. The great development of the muscles used in pushing down the pedal, and the shortness of the stroke made, leads to a shortening of these muscles, which then find a difficulty in making the longer stroke needed with the long cranks. Messrs. Crompton have also recognised what they call a muscular elastic limit. If the muscle is called upon to exert a force greater than a certain limit, which differs with the individual, it very rapidly becomes tired, and is only restored after a prolonged rest. This limit, according to the experiments of Messrs. Crompton, corresponds to an average pressure on the pedal of 100lb. for weak individuals, and to one of 140lb. for exceptionally strong men. The principal resistance experience by a cyclist on the level is that due to the air. This is strikingly shown by the recent experiment in America, in which a cyclist succeeded in covering a distance of a mile in little over 57 seconds, by following close behind a locomotive fitted with wind screens, which permitted the rider to run in practically still air.—*Engineering.*

THE copper production of the United States in 1898 was the largest on record, and reached 535,900,232lb., of fine copper, an increase of 6·8 per cent. over 1897.

SCIENTIFIC NEWS.

THERE does not appear to be much probability that Holmes's comet will be observed at this return, except through powerful telescopes; but it may be useful to publish an ephemeris by Herr H. J. Zwiers, which gives a position for Sept. 13 G.M.T. (12h.), R.A. 3h. 8m. 52s., N. Dec. 43° 3′ 34″, and for Sept. 30, R.A. 3h. 7m. 29s., N. Dec. 46° 26′ 25″. The comet is well situated, but is very faint.

The new observatory with the great refractor erected at the Astrophysical Observatory, Potsdam, has been formally opened in the presence of the German Emperor.

A fourth edition of Mr. W. Thynne Lynn's "Remarkable Eclipses" has been issued by Mr. E. Stanford, and will be found useful, as it contains information as to forthcoming eclipses, notably the solar eclipse of next year.

An article on Clouds, with reproductions of photographs, by MM. Antoniadi and G. Mathias appears in *Knowledge* for this month, and will be found of especial interest by meteorologists and those who have studied the Rev. W. Clement Ley's work on "Cloudland." Mr. W. S. Bruce has an article on "Ben Nevis and its Observatory," illustrated by the author, who was formerly in charge; and the Rt. Hon. Sir Edward Fry and Miss Fry continue their interesting account of the Mycetozoa.

Sir Howard Grubb, F.R.S., has issued a catalogue of astronomical instruments, observatories, &c., which will be appreciated by observers all the world over, because it is a great deal more than a mere catalogue, as it contains photographs of nebulæ, eclipses, &c., to show what can be done by modern optical apparatus.

It is announced that an Austrian party will visit India (Delhi) to observe the Leonid meteors during October and November. Two stations, about five miles apart, will be connected by telephone.

The arrangements for the meeting of the British Association at Dover are practically complete, and it is satisfactory to note that the railway companies are offering return tickets at reduced fares from Sept. 12 to Sept. 27.

Although Lord Kelvin has resigned the chair of natural philosophy in Glasgow University, which he has held for half a century, he will not sever his connection with his scientific pursuits, and in all probability will be present at Dover to take an active part in the meeting of the British Association.

Capt. Wellby, who has returned from his expedition into the unknown portions of Abyssinia, has given an interview to Reuter's representative, and the following notes may be interesting concerning the "giant tribes":—"They were very friendly. They were quite naked, and both men and women were most powerfully made; they were not of a negro type, and some were good-looking. Their colour was something between copper and black. All the men have long hair down to their waists, and this is arranged in the form of bags, in which they stow their various trinkets, &c., they carry about with them. Round their necks they wore a large number of iron rings of enormous weight. These were placed one upon another until the unfortunate native was scarcely able to move, and had to walk with his chin elevated in the air. It resembled nothing so much as what has been called the 'masher collar.' They are very fond also of wearing rings of various kinds round the arm. For this purpose they wanted to cut off my mules' tails, but to this I naturally demurred. The women are not bad-looking; some are even pretty, and they are always laughing and full of fun. Curiously enough, they have not long hair, their coiffure consisting merely of a collection of ringlets. Each family has its own little village, surrounded by a zariba. The people always carry spears and a sleeping pillow, though when they approached me they covered their spear-tips with bits of leather, as evidence, I suppose, that they did not want to fight." Round Lakes Hora and Lamini the explorer found an incrustation looking like salt; this he found the natives collected and sold for grain. He has brought samples of it with him to London.

The death is announced of Grace Anne, Lady Prestwich, who was married to the late Sir Joseph Prestwich in 1870, and was left a widow

in 1896. She was a daughter of Mr. J. Milne, of Findhorn, was the author of several novels, contributed articles to various magazines, and was much interested in geology, having assisted her uncle, the late Dr. Hugh Falconer, F.R.S., in his investigations of some of the ossiferous caverns of Sicily. She was of material aid to her husband in the preparation of his standard work on geology, published by the Clarendon Press.

In a memoir presented to the Paris Academy of Sciences M. G. Burgess describes a method of determining the Newtonian constant, in which the Cavendish method is modified by supporting the weight carried by the thread in a pan of mercury. The principal difficulty in this method is found in the necessity of keeping the temperature of the mercury constant. The method is worth the attention of those whose business it is to aim at absolute accuracy, and attain it if possible.

Dr. Hamilton Wright, formerly of Montreal, is to take up the study of beri-beri in the Straits Settlements. Dr. R. Fielding Ould, of the Liverpool School of Pathology, has been sent out to join Major Ross at Sierra Leone in the study of Tropical diseases, especially the cause of malaria. Major Ross, in a second letter on the subject, says:—"In my last I told you that I had found a malaria parasite in an *Anopheles* from the asylum at Kissy, where there had been an outbreak of fever. We now turned our attention to the 3rd West India Regiment stationed at the suburb of Wilberforce, where they are suffering severely from fever. On going there we found all kinds of parasites in the patients in hospital. At the same time, we discovered that the only form of mosquito which is plentiful there is a large species of *Anopheles*. We caught a number of these in the hospital and barracks. Out of 13 examined we have found the malaria germs in no less than four, which amply accounts for the fever at Wilberforce. It was, however, necessary to make a definite experiment by actually feeding an *Anopheles* on a case of malaria, and examining afterwards. This was done on the 17th. The insect was dissected yesterday and found to contain malaria germs growing in its tissues. Hence there is no longer any doubt that that kind of *Anopheles* carries malaria . . . . The parasite which I have cultivated is the quartan one, which has never been cultivated before. We are all perfectly well up to date. I am looking round as to sanitary details, &c., as Mr. Jones suggested. Austen has discovered the tsetse-fly here. This is a matter of very considerable importance."

The following rather curious paragraph appeared in a penny London morning paper: "A strange complaint which has lately been prostrating large numbers of Parisians has been attributed by medical men to a rather peculiar cause. This is the presence in their patients' morning rolls of salts of lead, deposited on the floors and walls of the ovens in which they have been baked. According to the medical theory, the extensive use of old timber in place of other fuel that so largely obtains in France is directly responsible for this condition of affairs. As a result, the Paris Council of Hygiene has issued an edict forbidding the employment by bakers of wood from old houses, disused railway sleepers, or wooden paving-blocks for their furnaces. Such timber is usually impregnated with sulphate of copper or creasote, and poisonous volatile salts are liable to rise from it when heated." It is not explained whence the salts of lead come from in the case of wood treated with blue copperas or creasote.

A "cloud burst" is reported from Cwm Avon, at Pontrhydyfen, that washed many thousands of tons of earth down the mountain side into the canal, which burst its banks.

The alarmist statements about the London water supply during the long drought will be studied in connection with a statement by Mr. Benjamin Taylor in the *Engineering Magazine* for September regarding the Glasgow water supply. In Glasgow, it is stated that a £16 householder obtains for 71d. per annum a continuous, never-failing, unrestricted stream of the purest water in the world. It is calculated that 380 gallons of pure water are delivered to the citizen of Glasgow for every penny paid. And it is water of such peculiar softness that the householders of Glasgow can pay their water rate out of what they save on soap. Loch Katrine water is not only soft—it is remarkably bright, clear, and free from vegetable matter. It is uniform in colour, temperature, and quality, and is absolutely free from pollution, and must remain so, because the corporation have now bought up the building rights of the whole drainage area; it needs no filtration, and is practically unaffected by the change of seasons.

It is stated that kingfish (Opah, *Lampris luna*) is on exhibition in the Midlands (rather a wide address). It was caught recently in the North Sea, and is somewhat like the sunfish, being without teeth and living by suction. It has bright red fins, and no fewer than 22 colours can be traced on its back. It is a native of Eastern seas, and is held sacred by the Japanese.

The Royal Mound of the Hill of Tara, County Meath, on which for a thousand years the kings of Ireland were crowned with great pomp and ceremony, has, in the words of the Rev. Dr. Healy, rector of Kells, been "destroyed beyond the possibility of restoration." A gentleman hoped to find the Ark of the Covenant buried beneath the mound, and the landlord permitted the excavations. The Board of Works had no legal power to prevent the work of destruction.

The new explosive invented by an American scientist is exciting a good deal of interest in the United States. It is said to be more destructive than dynamite, and less dangerous to handle than any high explosive now in use. It is also claimed for it that it does not give off the slightest particle of smoke, nor does it contain either nitro-glycerin or nitro-cellulose. The United States Government is carrying out some elaborate experiments to test its merits practically.

USEFUL AND SCIENTIFIC NOTES.

"CASSIER'S MAGAZINE" is an "electric railway number," and will be found very interesting by all who are studying the coming means of locomotion. It is illustrated with numerous representations of electric railways and plant in practically all parts of the world—certainly in all parts where electric railways have gained any position.

IT is said that the application of heat accumulators on the locomotives of the Moscow-Koursk line of the Russian State railroads has given excellent results, allowing of the increase in weight of trains from 15 to 25 per cent. The apparatus consists of a cylindrical reservoir of cast iron, with a capacity of about 300 gallons, placed horizontally on the top of the boiler, and communicating with it by pipes and valves. During stops, or in runing down gradients, when little or no steam is consumed, it is used to heat the water in this reservoir, which is then used for the feed.

ACCORDING to a Simla correspondent of the *Pall Mall Gazette*, a scheme is now maturing for the provision of an electric railway in the Himalayas, the power for which is to be provided by the mountain streams. The line would start from Pathankot, proceed up the Kangra Valley to tap the tea industry, thence cross to Mundi on the Beas River, whence it goes to Bilaspur, on the Sutlej, where the chief installation of water-power will be situated. From there it will be taken on to join the Simla-Kalka Railway, the place of junction being most probably somewhere about Kalka, a total of some 250 miles.

SOME interesting experiments on the corrosion of metals by sea water have been carried out at Kiel during the past two years. The plan followed was to cut off twelve specimens of the metal to be tested, of which three were kept as "witnesses" whilst the other nine were placed in salt water. At the end of eight months three of the latter were withdrawn and compared with the "witnesses." Eight months later a second set were withdrawn and a fresh comparison made, those then left being taken out after the lapse of a third period of eight months. The metals tested included alloys of copper rich in zinc, bronzes containing little zinc, bronzes containing no zinc, pure aluminium bronzes, and finally bronzes containing aluminium and zinc, or zinc and iron. The latter in particular showed remarkable resistance to the corrosive powers of sea water, being practically untouched at the end of a two years' immersion. The alloys containing zinc, however, gave much less favourable results. The copper-tin alloys and copper-aluminium alloys and the iron bronzes resisted perfectly when immersed in sea-water in contact with iron. The bronzes containing iron, when placed in contact with those of tin, showed a loss by corrosion. It is thus important, if corrosion is to be prevented, to avoid placing these alloys in contact with metals electro-positive to them.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

A POWERFUL MAGNET—SHIFTING (?) OF THE TERRESTRIAL POLES—DARWIN AND THE DELUGE—THE STEREOSCOPE — FIGURE OF THE EARTH — VELOCITY OF LIGHT—GRAVITY—FIXING GNOMON OF SUN-DIAL—SATURN—ENCKE'S COMET—A MAN OF MANY MEDALS—PROF. PICKERING'S NEW PHOTOGRAPHIC TELESCOPE—THE BRITISH ASTRONOMICAL ASSOCIATION AND THE ROYAL ASTRONOMICAL SOCIETY—RIGEL—INCLINATION OF PLANETARY POLES—THE ASTRONOMICAL TRIANGLE.

[42776.]—I REMEMBER that the Earl of Crawford, when he was yet Lord Lindsay, had in his laboratory somewhere in Soho, an electro-magnet of enormous power, which would bring a metal candlestick flying across the room; but this remarkable instrument must have paled before that of Dr. Haab (to which you refer in your "Scientific News" on p. 36) which "is strong enough to draw a nail from a board!" The *Morning Leader* apparently has omitted to mention the length of the nail and the thickness of the board.

"Little Bookham" (letter 42721, p. 40) is quite obviously muddling up the Southern Magnetic Pole with the southern pole of the earth's axis of rotation. The shifting of the earth's poles has been adduced over and over again in attempts to account for changes of terrestrial climate, floods, and goodness knows what and all; but the most elementary dynamics will show its impossibility. Did "Little Bookham" ever hear of an instrument called the gyroscope?

Mr. Dormer calls attention (in letter 42723) on p. 40 to what, if not an absolute piece of controversial dishonesty, is certainly the merest effort to argue for victory, when he speaks of Darwin's total change of views as to the extinction of species by cataclysms. It would be just as defensible to quote the late Dean Buckland's "Reliquæ Diluvianæ," published in 1823, as the outcome of that well-known geologist's mature views as it is to appeal to Darwin's earliest utterances as decisive of the conclusions to which he was led by more extended research.

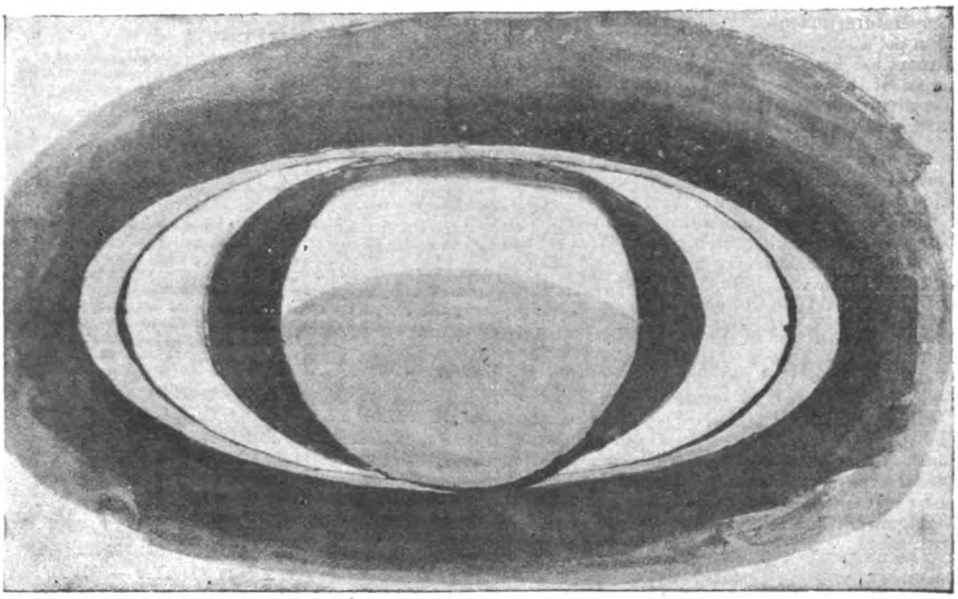
While fully appreciating the spirit which has prompted Mr. Kelly to write letter 42762 (on p. 66), I would invite his attention to what is said by an eminent church dignitary and theologian (I mean Dean Farrar) in "The People's Bible History":—"The faintest semblance of harmony between Genesis and physical science can only be obtained by a licentious artificiality and casuistry of exegetic invention."

Letter 42742, p. 43, suggests to me to express my regret that the reflecting form of stereoscope has been so entirely superseded by the lenticular one. I always thought that it exhibited objects in stronger relief than that with eye-lenses, and it had the manifest advantage of admitting the use of very large pictures when necessary.

"J. D." (query 96506, p. 46) is so far right that when the earth was in a gaseous form it did not present, or may not have presented, its existing oblate spheroidal form; but as soon as ever it became viscous, its existing rate of rotation would produce exactly the amount of equatorial protuberance which it now exhibits. The proof is a purely mathematical one.

In reply to query 96520, p. 46, light of every wave-length travels *in vacuo* with identically the same velocity. Otherwise we should have all the stars and planets exhibiting prismatic colours. It may be taken that such velocity differs very little from 186,326 miles per second. Pitch is not supposed to make any difference in the velocity with which sound is propagated through the air.

Mr. Alexander asks (in query 96538 on p. 47) what is meant by the instantaneous propagation of gravity? and whether this signifies that it acts so



quickly through great distances that its velocity is incalculable? Well, substantially this last form of expression is correct, for if the action of gravity were not practically instantaneous, the earth's path round the sun would become a spiral instead of being as it is, a re-entering curve, and the year would increase in length. I have said in the preceding paragraph that the velocity of light in vacuo is 186,326 miles per second, so that it takes light over eight minutes to come from the sun to the earth. Now, suppose that gravity were only propagated at this rate, then the earth would feel the sun's pull rather more than eight minutes after she had been in the place where the sun began to exert it. In other words, the pull would not be in the direction of the straight line joining the sun and earth when the pull was felt, but in that of the line connecting these two bodies between eight and nine minutes before. This would increase her velocity and what is popularly known as her "centrifugal force," and so she (*very* slowly) would move outwards, and the diameter of her orbit and her year would lengthen.

"Nauticus" (query 96543, p. 47) can cement his brass gnomon on to his slate dial by stirring freshly-burned plaster of Paris into melted resin, and adding enough boiled oil to bring the whole composition to the consistence of honey; but I should rather recommend him to retap the screw holes and get new screws or pins. I have cemented a gnomon on to slate with plaster of Paris to which alum has been added. It should be dry and hot before water is added to it.

After reading query 96547, p. 47, I turned the telescope upon Saturn, and have represented everything that was visible with a power of 260 in the subjoined very rough sketch. Definition was, of course, unsatisfactory. Had I not known of the existence of the crape ring, I should not have detected it.

I do not understand why "W. S." puts query 96549 (on p. 47), inasmuch as the last perihelion passage of Encke's comet did occur on May 24, 1898.

Many of those who will read these lines will remember how the late Mr. A. Cowper Ranyard was instant, in season and out of season, in his protest against the award of medals as a form of recognition of the value of scientific work, and how earnestly he tried to deprecate such awards in the case of the Royal Astronomical Society. I wonder what he would have said to the reception of a *ninth* medal by that astronomical veteran Dr. Lewis Swift, who has just been the recipient of the Donohue Comet one from San Francisco for his latest discovery. Of these tangible testimonies to the value of his unwearying work, Dr. Swift himself says: "The medal arrived safely last night, increasing my number to nine. . . . Three are of gold, one of silver, and five of bronze. Those of gold were awarded by the Academy of Sciences at Vienna, Austria. The silver was included in the Lalande prize of 540 francs, awarded by the Academy of Sciences of France, and 500 francs in cash and the medal. The large bronze medal and 125dol. from the Royal Astronomical Society of England, being the first award from the 'Mrs. Jackson Gwilt gift,' which causes me to prize it more highly than even the gold ones. The four others of bronze are all alike as to size and design, and were bestowed by the Astronomical Society of the Pacific, from funds founded by Joseph A. Donahue in 1890." Verily Dr. Swift is a much decorated man.

The surmise in the third paragraph of your "Scientific News" on p. 59 is a correct one. Prof. Pickering's new telescope is nothing but a photo-heliograph of very long focus fed by a siderostat or cœlostat.

The query put by "An Old Printer" (in letter 42746) on p. 60 may conveniently be divided into two parts. Imprimis, then, as to the question of "means." The entrance fee to the Royal Astronomical Society is two guineas, and the annual subscription the same; or an elected Fellow may, after paying the entrance fee, compound for his annual subscription by a single payment of twenty guineas. In the case of the British Astronomical Association the entrance fee is only five shillings, and the annual subscription half-a-guinea, or composition may be effected for six guineas. Thus your correspondent will see that the Association offers facilities to the young astronomer of narrow means, which the older society is perforce unable to afford him. When we come to "qualifications," we get upon more ticklish ground, because there can be no doubt that there are men who write "F.R.A.S." after their names (more or less for advertising purposes) whose claim to be considered astronomers is of the very scantiest, even if it be not nil. A heavy responsibility rests upon every Fellow who signs a candidate's paper "from personal knowledge." I have not seen the morning paper from which "An Old Printer" quotes; but if the writer in it alleges "that no important addition to our knowledge of solar physics has accrued from the observations" made during the Indian eclipse of 1898, he is talking nonsense, pure and simple; and shows a curious incompetence to comprehend the volume which he professes to criticise.

In reply to one question which Mr. Ellison puts in letter 42752, on p. 64, Rigel always has seemed bluish to me. It may perhaps be described as white, but I certainly cannot detect any yellow in it.

When (in reply 96467, p. 70) "J. R. J." asks "*Why* are the poles not all at right angles to the various orbits?" he puts a question which it would require omniscience to answer.

If (of which I am somewhat doubtful) I understand query 96553, on p. 74, "Jancis," if living in a Southern latitude, would work his triangle from the *South* Pole, and hence his co-latitude would = 90° − latitude, and the Sun's polar distance = 90° + his North Declination.

A Fellow of the Royal Astronomical Society.

VARIABLE STAR OBSERVATIONS, AUGUST, 1899.

[42777.]—S PERSEI has been unusually faint, and has varied but little from 9·7 magnitude the whole month.

R Lyncis passed a very bright and well-marked maximum 6·5 magnitude Aug. 9. The interval from the previous maximum, Aug. 11, 1898, was 363 days. The star was then 9·2 magnitude.

R Ursæ Majoris. The light-curve has been very irregular during the last two months, and several rapid fluctuations between 8·7 and 7·6 magnitudes have occurred. The maximum 7·6 magnitude was Aug. 12. The interval since the previous maximum, Sept. 14, 1898, being 332 days.

S Ursæ Majoris. The light-curve during the last three months has been very irregular. The maximum 7·5 magnitude, July 20, was followed by a sudden decline. The interval since the previous maximum, Nov. 6, 1898, is 256 days.

R Camelopardi was 12·7 magnitude Aug. 18, and has varied but little during the month. It is nearing minimum, and very faint, being near the limit of vision with this telescope.

T Draconis has not varied much from 8·0 magnitude during the last six weeks. This is probably about maximum brightness; but the light-curve is so flat that the precise date is difficult to determine.

S Herculis has increased exactly three magnitudes from April 19 to Aug. 23; at the latter date it was 8·6 magnitude. The maximum will probably occur some time in September.

The instrument in use 6·4in. equatorial refractor. Weather has been very favourable, and observations were made on 21 nights. C. E. Peek.

Rousdon Observatory, Lyme Regis.

SOME RED AND RUDDY STARS.

[42778.]—THE following list is a continuation of that published in the "E M." Sept. 16, 1898, page 113, letter 41489, Vol. LXVIII. No. 1747. The stars were observed with Mr. Espin's 17¼in. reflector. The magnitude has been underrated, on account of the moon; but a correction is added for each of the three nights:—

No.	B.D.	α 1900	δ 1900	B.D.	Obs.	Col.	Date.
	°	h. m.	° ′				1899.
14	+30 3995	20 17·4	+30 33	7·6	8·7	or[1]	Aug. 23
15	+31 4046	17·6	+31 0	7·9	8·5	or	,, 23
16	+30·4005	18·6	+30 56	6·5	8·0	or[1]	,, 23
17	+31·4056	18·8	+31 13	7·0	8·4	or	,, 23
18	+28·3706	28·6	+28 43	8·0	8·5	or	,, 23
19	+31·4152	31·7	+32 6	8·6	9·0	or	,, 22
20	Anonymous	32·7	+32 3	—	9·1	r	,, 22
21	+31·4213	41·9	+31 55	8·2	8·5	or	,, 22
22	+30·4185	44·5	+30 25	7·5	7·8	or	,, 28
23	+30·4191	45·5	+30 16	8·1	8·5	or	,, 28
24	+32·3980	49 8	+33 3	6·0	6·0	or	,, 22
25	+32·3989	51·3	+32 18	7·2	8·0	or[1]	,, 22
26	+31·4268	51·7	+31 43	7 6	8·5	or[2]	,, 22
27	+29·4253	54·1	+30 6	6·7	8·7	or	,, 23
28	+31·4304	55·9	+32 7	7·0	8·3	or	,, 22
29	+31·4320	58·9	+31 57	7·2	8 4	or[1]	,, 22
30	+30·4352	21 8·1	+30 30	8·2	8·5	or	,, 28
31	+31·4416	14 9	+31 46	7·3	8·2	or	,, 22
32	+30 4410	17·5	+30 22	8·4	8·7	or	,, 28
33	+30·4411	17·8	+30 30	9·2	9·1	or	,, 28
34	+29·4397	18·4	+29 53	6·5	7·7	or[1]	,, 28
35	+30·4421	19·2	+30 41	7·8	7·8	or	,, 28
36	+29·4419	24·1	+29 47	7·5	8·8	or	,, 28
37	+29·4440	28·2	+30 8	8·2	8·2	or	,, 28
38	+30·4479	31·4	+30 33	8·0	8·5	or	,, 28
39	+31·4505	32·3	+32 0	7·7	8·3	or	,, 22
40	+29·4481	36 6	+29 51	7·7	8·0	or	,, 28
41	+29·4496	40 0	+29 52	8·2	7·8	or	,, 23
42	+28·4643	23 43 2	+28 17	8 8	9·0	or	,, 28

Magnitude correction:—Aug. 22. −0 7; 23, −0 9; 28, −0 4. C. E. R. Brocklebank.

BRILLIANT FIREBALLS.

[42779.]—HOPING to obtain notes of duplicate observations, I give particulars of some of these objects recently seen by me.

1899.	G.M.T.	From	To
	h. m.	° °	° °
August 27	9 15	216 + 38½	201½ + 32½
,, 28	9 30	302½ + 13½	315½ − 5
,, 28	12 35	292½ + 17	301 + 3

The first was as bright as Venus, and moved slowly. The second was trained and traversed its course in about one second; it was equal to Jupiter in brilliancy. The third was also trained; its colour was a brilliant white and its motion slow (duration about 0·5sec.). In brightness it slightly exceeded the full moon, and cast a dark shadow. The shape was somewhat like that of a kite, and the greatest breadth was very nearly 1°. The brightness was the greater in the second half of its course. The three meteors appear to have belonged to the same radiant—270° + 45°.

A letter appeared in the *Daily Mail* of the 26th ult. stating that the writer had seen at 8h. 8m. on the 24th "a falling meteor of unusual size, and of a metallic pale green colour, which fell to the south-east of the Great Bear constellation." The place of observation was not specified.

Further letters on the 28th record that at Blythe, Surrey, "it appeared a little to the south or south-west of Cassiopeia, and fell almost vertically for a short distance"; also that at Frinton-on-Sea the meteor was noticed as "pear-shaped, and with a long tail behind it." A note mentions that the object was also seen at Guildford, Bath, Leicester, Acton, Blackheath, Hatfield, and a score of places in London.

About 8h. 30m. on the same date (24th), a brilliant meteor was seen near the zenith by a friend of mine at Scarborough. Perhaps some readers of

the English Mechanic have recorded more definite observations of these two meteors.

Walter E. Besley.

The Chase, Clapham Common, Sept. 2.

METEOR.

[42780.] — Whilst crossing Blackheath at 9h. 10m. on the evening of Sunday the 3rd inst., I noticed a brilliant meteor, which passed from near α Capricorni to near δ Aquarii in a space of three or four seconds, and then suddenly disappeared; no sparks were seen, and there seemed to be a little haze at the point of disappearance.

Blackheath, Sept. 4. W. T. Lynn.

THE COLOUR OF RIGEL.

[42781]—With reference to the third paragraph of Mr. Ellison's letter in your last issue (42752, p. 63), I append a few notes on the colour of this star.

Webb in "Celestial Objects" (last edition) gives the colour of Rigel as "yellowish white" (from Smyth). He adds, "I always see a blue tinge" in the star. In the 1881 edition of the same work these words are found:—"Struve, however, gives yellowish white; Fletcher, yellow; Sadler, yellowish with reflector, bluish with achromatic, side by side."

Twenty-eight observations by eight members of the British Astronomical Association made Jan. 9 to April 6, 1892, in connection with the star colour section, give the mean colour white. Flammarion also calls the star white; Espin bluish-white. Foulkes says: "white with a tinge of blue." Gregory remarks that "Capella and Rigel have a bluish tint, but do not differ considerably from Sirius, Vega, and Regulus, which are generally referred to as white stars."

For my part I regard Rigel as bluish-white; but Capella as yellow. Walter E. Besley.

The Chase, Clapham Common.

THE MEDIAL TELESCOPE.

[42782.]—Being particularly interested in telescopic matters, I read letter 42758 through two or three times before I could grasp any idea of what the writer is alluding to. I am still much in the dark about the new telescope, and shall look forward to the promised explanation by Mr. A. Caplatzi. I can understand that a lens has to be divided into two; but I cannot think Mr. Caplatzi really means what he says when he states such a *half* lens "does not bring the rays to a focus as the *whole*." I should say the two halves will have the same focus as when they were whole.

With such meagre data it is almost unwise to criticise the idea; but I would ask if the same result could not be got by only boring a suitable hole through the centre of the object-glass, and letting the instrument be a kind of refractor Gregorian; the concave mirror placed in a position to lengthen the focus is Gregory's idea.

I suppose the image, if formed on the focal plane, would require a flat in front of the o.g. to turn the cone of rays at right angles? But perhaps my imagination is leading me astray from the rough data given!

It is plain a reflector is used to lengthen the focus (cribbed from Gregory's telescope), and half an o.g. as the light gatherer, the result being "perfect achromatism." Now, after all these letters of your painstaking correspondent "H." on the Gregorian telescope, it does seem strange anyone should go such a roundabout way to gain "perfect achromatism" in *a kind of* Gregorian telescope, when it is much more simple to follow Gregory, and with the same result—namely, "perfect achromatism."

323, Kirkstall-road, Leeds. David Booth.

GREGORIANS AND "H."

[42783.]—I hope you will allow me a short explanation of some of the points raised by "H." in letter 42757. I have so far expressed nothing but admiration for his abilities, and given no cause for the abundance of sneers with which his letter is interlarded. As to testing small speculum, I do not pretend to ability to do so; but I have had the assistance of an expert workman, and I have asked him to describe his method of testing for the benefit of the English Mechanic; but he declined, on the ground that he would not lay himself open to be sneered at and his methods claimed as already, or to be, included in the intellectual property of another; but he promises to describe it at a future time, when "H." has completed his masterly expositions.

As to his following paragraphs, I have nowhere acknowledged want of either theoretical training or practical experience in telescope making.

That the large speculum has been injured is conclusively negatived by the performance as a Newtonian being uninjured. The conclusion that more injury has been done to it as a Newtonian than as a Gregorian is, therefore, gratuitous, and does credit only to his imagination. I note here that he has just discovered that any defect in figure of large mirror is ten times more injurious in the G. than the N. To ask for the opinion of others about an eyepiece is not to profess ignorance. My measures to minute fractions of an inch stand on the same ground as those of "H." The assertion that *I know* he cannot avail himself of invitation to inspect my telescope is simply untrue. I have no notion of his residence or name. He may be my next-door neighbour. Anyhow, I am willing to show it to him.

I have neither begrudged nor bragged of the expense of alteration; but cost has, nevertheless, in most people's minds, much to do with telescopes. Even a scientist wants something as a result of his labours. As to the opinions he quotes, Parkinson, Coddington, Dr. Robinson, Airy, and Gregory were all, like "H." himself, theorists only; and Lord Rosse took care to make his own telescope a Newtonian. And we may set against these opinions the common judgment of astronomers in favour of the Newtonian form.

I am advised to obtain a diagonal. This is all right for low powers, but it spoils definition with high ones. I am also advised by "H." that an evening in some public observatory would "put me in the way of observing easily at all altitudes." I happen to have observed with a giant, but the comfort was conspicuous by absence. I do not think the explanation *re* the sea-green discs is either ingenious or ingenuous. The stars are not sea-green, yet he used sea-green to calculate upon. I quoted his exact words, and leave the matter; but if he has anything further to write *re* my doings, will he kindly eschew personalities and save space?

I thought everyone knew the meaning of the sentence "Old Printer" (42746) quotes. There are many amateurs who cannot afford the five guineas entrance fee and two guineas per annum of the R.A.S. For them the B.A.A. supplies a tolerable substitute. There are others whose education or local status is insufficient, as the R.A.S. was not intended for shopkeepers, but for gentlemen. There are notorious members of the B.A.A. who would not get a vote for Fellowship of the R.A.S.

Allow me to conclude by expressing my great indebtedness to "H.," and admiration of his abilities and tactics. Ell Hay.

TELESCOPES.

[42784.]—Will readers kindly give me some information on the following subjects? I have in my possession three lenses as follows: one double-convex of crown glass, 6⅛in. diameter by 47in. focus, mounted in a very fine cell as an object-glass, and having a clear aperture of 5⅞in.; one plano-convex of crown glass, 3in. diameter by 3¾in. radius; one plano-concave of flint glass, 3in. diameter by 3¾in. radius. The above lenses are beautiful specimens of workmanship, and by all the tests I have been able to apply they are simply perfect.

A short time ago I mounted them temporarily on a wooden bar, using the 6in. lens as an object-glass and the two 3in. lenses combined as a corrector, and applied an eyepiece of 1in. equivalent focus taken from an old telescope which I had at hand. After much experimenting, I finally placed the lenses of the corrector with their flat sides together—convex side towards object-glass, concave side towards eyepiece. Distance from o.g. to corrector, 26in.; o.g. to first lens of eyepiece was then 62in. With this arrangement the combination seemed to be perfectly achromatic, and the definition on terrestrial objects exceedingly good. I had no opportunity of trying it on celestial objects.

I intend to construct a telescope with these lenses, if it is likely to prove worth while. Will some reader inform me just what results I can expect from it when finished? How will it compare with a regular achromatic of like dimensions? How great a power should I be able to use with it on double stars, &c.?

The only description I have ever seen of such an instrument is in Dick's "Practical Astronomy," published in 1846, in which it is described as the invention of Mr. A. Rogers. Of course, I have no doubt many such instruments are in use, but I have not been able to find any account of them.

According to Mr. Rogers, after the condition of achromaticity is satisfied by shifting the corrector along the tube of the telescope, the spherical aberration may be corrected by slightly separating the lenses of the corrector. Is this a fact in practice? And if so, about how much separation would I be likely to need? I ask this that I may make the mounting of the corrector to admit of the necessary separation.

I have also an old Gregorian by Geo. Sterrop, of London, of the following dimensions. Diameter of large mirror 2¼in., focus 9in.; diameter of small mirror ¾in., focus 1¼in.; field lens ¾in. diameter, 2¾in. focus; eye-lens 1in. focus. The two lenses are 2in. apart. This instrument has not been used for over ten years, but is said to have once been a very good one. The metals are badly tarnished, and the small one is out of adjustment—that is to say, it is not properly centred, although being adjustably mounted. I suppose I could adjust it if other particulars were right? Any information as to cleaning or polishing the mirrors without danger of injury to their figuring, and also regarding re-adjusting the instrument in general, will be thankfully received, as I have not been able to find an optician who knows anything at all about the Gregorian or about metallic specula.

E. P. Clark.

245, West Eighteenth-street, New York.

OBSERVATORY LIGHTS—POWER FROM FALLING WEIGHTS—A FLY PROBLEM AND ANOTHER.

[42785.]—If Mr. Baly, and also "Carliol" (query 96575) will think the matters out seriatim, they will at once see that the idea of deriving power in any considerable quantity from the energy of a falling weight is quite impracticable. One horse-power is developed by a weight of 33,000lb. falling 1ft. per minute. Assume that the 8-volt lamp will require 10 watts to light it, and that to drive the dynamo we use a 56lb. weight. 1H.P. = 746 watts, hence 10 watts is, in round numbers, $\frac{1}{75}$H.P., and to develop this power we would require $\frac{33,000}{75} = 440$lb. falling 1ft. per minute—i.e., 56lb. falling nearly 8ft. per minute, or an hour's light represents a drop of 440ft., not allowing for any loss of power in the dynamo. Here are three methods by which Mr. Baly could light his lamp in a perfectly satisfactory manner: (1) Dispense with the accumulators altogether, and light direct from a small dynamo driven by an oil-motor. Cost of plant, about £6; working cost, ½d. per hour. (2) If a good head of water is available, use a Pelton wheel instead of the oil-motor. Cost of plant, about £4; working cost depends on the price of the water. (3) Use a small windmill to drive the dynamo, and charge the accumulators during the day, as the power will not be sufficiently steady in this case to light direct off the dynamo.

In reply to Mr. Ellison (42752), I may be wrong, and am quite open to conviction; but I fail as yet to see that it makes any difference whether the carriage is roofless or not, or what distance the fly is above it. Without the fly you have the weight of a column of air of a given height. With the fly the same weight plus the weight of the fly, but minus the weight of the equal bulk of air displaced by it. With regard to the cylinder and bullet problem, my own idea was that, as the bullet is travelling at a much higher rate of speed than the cylinder, the greater part of its energy would be converted on impact into heat, and the cylinder would swing past the point of impact, thus giving the converse of a heat engine where motion results from the absorption of heat; here motion resulting from the disengagement of heat. W. J. G. F.

A RACE WITH THE SUN.

[42786.]—In "E.M." of Sept. 1, 1899, an imaginary aërial machine is supposed to travel at 1,000 miles an hour. This is scarcely likely to be realised. But, suppose we have a locomotive capable of running 100 miles an hour, and that we lay down a railway along a parallel in north latitude about 84° 30′, or some 400 miles from the North Pole. A traveller, drawn along at 100 miles an hour on this circular line, which would be 2,400 miles long, would just keep pace with the Sun, if the train runs from E. to W., and the season is an Equinox. Going W. to E., the days and nights would be shortened to six hours each.

In a higher latitude, at the same speed, and going from E. to W., the traveller would gain on the Sun, which would slowly move from W. to E., set in the E., and rise later on in the W. In a latitude lower than 84° 30′ the days and nights would be lengthened; but the Sun would rise and set in the usual direction.

In a paper on the moon, published some time ago, I wrote as follows:—So slowly does the moon rotate that a brisk walker starting at noon, in lunar latitude 66° N., and walking along that parallel from E. to W., could keep the sun always in the south, and thus enjoy perpetual noon.

If, by cycling, he increased his pace, the sun would appear to back in the heavens from W. to E. A train, starting at noon, and going W., at 21 miles an hour, along the same parallel, would so gain upon the sun that, forty hours later, it would appear to set in the E.

C. T. Whitmell, F.R.A.S.
President Leeds Astronomical Society.

Leeds, Sept. 1.

MICRATOMIC ETHER.

[42787.]—The remarks of "Lucretian" (letter 42770) are certainly worthy of consideration, giving rise as they do to instructive thoughts; but he will, I am sure, pardon me if I say that in places he seems to have become involved in a multitude of words, and thus fallen into error. As far as one

can see, the purpose of his letter is to show—(1) That the ether is composed of discrete particles (which he terms "micratoms") animated with great velocities. (2) That the atoms of elements are themselves composed of these micratoms grouped or arranged (I presume) in different ways in the different elements. (3) That radiant energy causes these micratoms to vibrate, and that these vibrations are communicated from one micratom to another by means of collisions. While leaving this third consideration to others more competent than myself to answer, and confining myself to the statement that I do not think such an hypothesis capable of satisfactorily accounting for the phenomena observed in the propagation of light, I should like to offer a few remarks on the first two considerations.

The medium which we call ether, which is supposed to permeate all bodies and to fill space, whatever its real nature may be, is certainly not *matter*.

In the past, different kinds of ether were postulated and endowed with various properties pertaining to material substances to meet the requirements of different hypotheses, and to explain various phenomena. This unscientific method has since given place to the more rational one of seeking to learn the true nature and properties of the ether from a study of the various phenomena in which it may be involved; and, at the present time, we are just beginning to be able to form faint but definite ideas as to its existence and true properties.

Let me reiterate that the ether is certainly not matter, and possesses none of the properties which we find associated with matter. This being the case, it is evident how very unscientific it is to credit the ether with any particular structure, and then to try and deduce from this assumption the courses which certain natural phenomena should take.

The very fact that radiant energy travels with such immense velocity, though undoubtedly propagated by means of transverse vibrations; the very fact that when we attempt to deduce the course of certain phenomena from preconceived and hypothetical notions as to the nature of ether, we are at once confronted with insurmountable difficulties;—these, and many more like them, all tend to confirm the above conclusion.

I do not mean that in investigating the properties of the ether, we ought to confine ourselves rigorously to the inductive method. The scientific use of the imagination is always fruitful; but if we allow our imagination to run away with us, we always fall into error. With regard to the second consideration, though in the past chemical compounds have been mistaken for elements, such a mistake would seem impossible now. If the elements are really non-elementary they must all be compounds of the same order, *totally* distinct from ordinary chemical compounds. There can not be the least doubt that there is a broad line of demarcation between ordinary chemical compounds and the elements. Nevertheless, there is a great deal to be said for the view that each element is *not* composed of a certain kind of matter totally distinct from the matter of which every other element is composed.

But whether, even if this view is correct, we shall ever be able to decompose the elements into this primordial form of matter is quite another question. For many reasons I am inclined to think not. There are several other points I should have liked to touch on, but I have already occupied too much space. I may do so (with the Editor's permission) in the future. In conclusion, I should like to say that if I, in my turn, have fallen into error, I shall be only too glad to have it pointed out. The real object of these discussions is not to support one's own opinion, but to arrive at the truth.

Trin. Coll. Oxon. J. M. W.

MICRATOMIC ETHER.

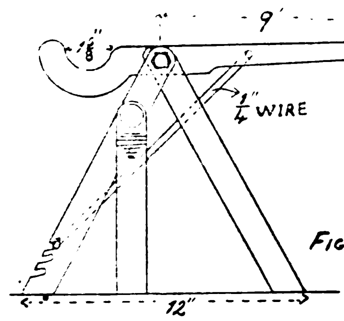
[42788.]—IN connection with "Lucretian's" letter in last week's "E. M.," would some reader kindly inform me whether any, and what, attempts have been made to "polarise" sound? If this can be done, then "Lucretian's" hypothesis will be much strengthened. I like his theory, because by it "gravitation" can be explained so simply, as also that other force known as "chemical union."

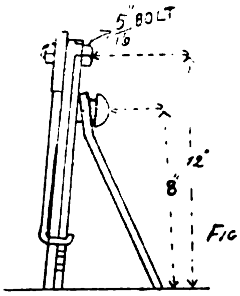
I might add that the polarisation of sound should, it seems to me, be expected just as much as that of light and heat. I will further explain, if so desired.

R. A. Kennedy.

LIFTING JACK.

[42789.]—IN view of the interest being taken by numerous readers of "Ours" in the motor tricycle, I venture to send a sketch of one of a pair of lifting jacks which I made a few weeks ago to lift the driving wheels of a tricycle, so that it could be run in the shop for testing, &c. These jacks are light, and can be folded up nearly flat, while the fact that a pair of them carried the motor and its 10-stone rider speaks for their efficiency. The legs and handle are made from 1¼in. iron, the handle being bent hot, and the edges rounded at the tapered end. Note on one of the legs the little lip





turned up to prevent the legs spreading too far. The rivet which holds the short leg is ⅜in., the hole in the leg being made a very sloppy fit to allow the leg to fold down flat. The piece of ¼in. wire shown clearly in Fig. 1 should be mild steel, as it has a good deal of strain on it. Where it enters the handle it should fit loosely and have the end burred over, so that it can move easily but not fall out. In Fig. 2 is seen the method of turning up the other end to engage in the slots in the leg. I have given sizes as near as I can recollect them, but a little variation will not matter. When the handles are horizontal, the cycle wheels should be about 2in. off the ground. The jacks should be placed as near the wheels as possible, and the handles should point away from the steering wheel of the tricycle. Notice that the jacks are not exactly vertical; if they were, they would fall over to one side too easily.

"Regent's Park" (reply 96403) gives a few supposed cures for burnt steel. Has that gentleman ever tried any of those mixtures? If so, with what success? I am not asking out of idle curiosity, for successful treatment will be worth many shillings to me, and also, I presume, to many other readers who use and work steel. Right here would I warn fellow-readers who burn the ends of their lathe-tools or other steel goods, to cut them off and remake or throw them on the scrap, and not to waste time, money, and patience in making such "mucks" as given by "Regent's Park."

Ernest W. Fraser.

MOTOR CYCLES.

[42790.]—ALTHOUGH I had not intended to enter this correspondence, I cannot but think that my experience with motor bicycles would interest "F. R. D." and others who have that burning desire to fit a motor to an ordinary bicycle. I was once so afflicted, and a cycle-making friend and I set to work to make a frame, to which we fitted a 60mm. De Dion motor. We fixed the motor behind the bottom bracket, leaving room between the bracket and the tire of the back wheel to take it in. The motor drove the back wheel by means of a chain gearing into a sprocket-wheel fixed on the back-wheel axle, on the opposite side to the ordinary hub, which contained a free-wheel clutch. The pedals were geared to 60; the motor ten revs. to one of the back wheel.

But all the flaws of the machine became apparent at the trial trip. To begin with, mounting was difficult; then there was awful work for a minute or two until the motor started, which it did with a jerk which nearly sent you over the handle-bar. On a level road the machine would run better, but the slightest unevenness sent the machine bouncing up and down in a most erratic manner. Sideslip was most evident, and after two falls I always led the machine through moisture or thick dust. To turn the spark off when going fast was like putting on a powerful rim brake. To stop without opening the compression cock was a most exciting experiment, generally resulting in a roll in the road. Needless to say, I soon gave it up and took to a De Dion trike, with which I have no fault to find. I believe when you ride an ordinary bicycle you instinctively apply the power when it is wanted; but the motor goes pounding on all the time.

H. Bevan Swift.

[42791.]—I WAS amused at the description of cross-gudgeon pin in piston of Dion motor getting tuneful. I think fault must lie with user, as surely makers would have found a remedy if trouble was serious, seeing they have orders for about 40,000 on hand at present. The trouble is not with the engine being vertical, this being far and away the best position to adopt, but in ignorance of user not trying to find cause of trouble. The chief difficulty to guard against, I can assure the writer, is to avoid getting too much oil, to prevent which a plate is cast right across crank chamber, with a slot only just large enough for rod to work through. The flywheels running in oil at 2,000 revs. per min. drive the oil up with incredible force right to top of piston. The connecting-rod at top end is, or should be, provided with an oil-hole ⅛in. diam., largely countersunk; in addition, the top bush has a groove from end to end 1/16in. diam.—this is on top side, pressure being on under side of pin. If oil fails to get here, probability is user of tricycle perhaps oils his cylinder with a locomotive squirt-can before starting on a long ride, and this with an oil quite *unsuited* for the purpose. The oil, which must be finest gas-engine oil obtainable (which, up to present, I have found none better than Price's), requires to be put in every 15 to 20 miles, and care must be taken to see aluminium case does not leak, sometimes caused by repairer throwing case on workbench studded with nails. In no case put more than two tablespoonfuls of oil at one *time!* Otherwise, extra oil is simply wasted in exhaust, and it tends to carbonise up on top of piston and round valves; then, as writer puts it, it smells to those on foot worse than to rider, causing a general impression it is usual thing with motors to fly along groaning and belching forth suffocating fumes.

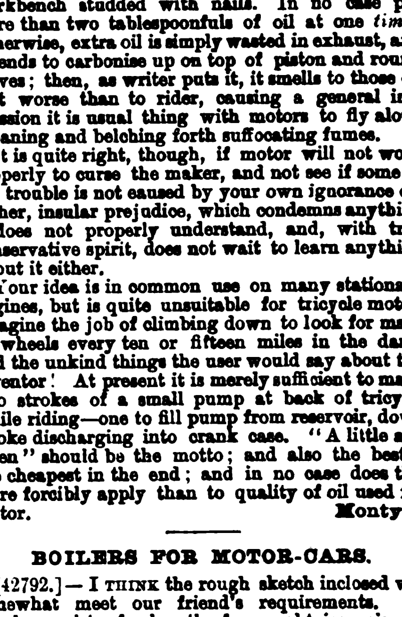
It is quite right, though, if motor will not work properly to curse the maker, and not see if some of the trouble is not caused by your own ignorance or, rather, insular prejudice, which condemns anything it does not properly understand, and, with true conservative spirit, does not wait to learn anything about it either.

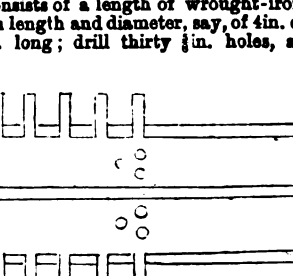
Your idea is in common use on many stationary engines, but is quite unsuitable for tricycle motor. Imagine the job of climbing down to look for mark on wheels every ten or fifteen miles in the dark, and the unkind things the user would say about the inventor! At present it is merely sufficient to make two strokes of a small pump at back of tricycle while riding—one to fill pump from reservoir, down stroke discharging into crank case. "A little and often" should be the motto; and also the best is the cheapest in the end; and in no case does this more forcibly apply than to quality of oil used for motor.

Monty.

BOILERS FOR MOTOR-CARS.

[42792.]—I THINK the rough sketch inclosed will somewhat meet our friend's requirements. It simply consists of a length of wrought-iron pipe of any given length and diameter, say, of 4in. diameter, and 18in. long; drill thirty ⅜in. holes, as shown





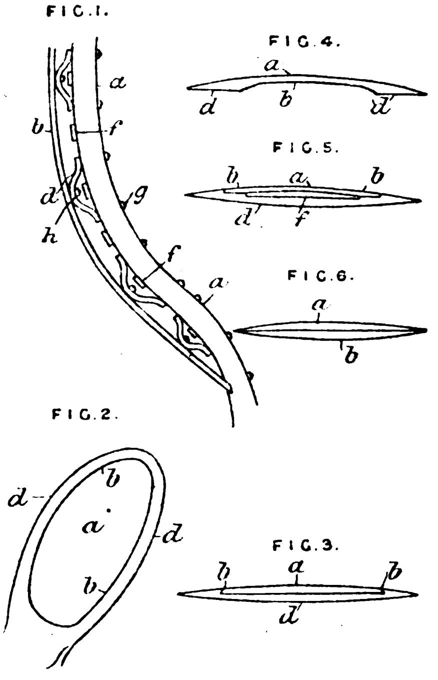
in sketch, and tap with fine gas thread. Then cut off thirty pieces of ⅜in. brass tube; one end of each must be stopped up by brazing a disc of brass, which will be best done "after cutting out the discs with a punch," with silver solder, made by melting two parts of silver with one part brass, then screw the other end to correspond with the holes in the iron pipe before mentioned. Then make two plates to act as covers, then the ¼in. bolt to complete the job. Make joints with asbestos paper, take the steam from the upper plate. Now the fire is of the oil type. By using this you can most easily control the make of steam when stopping, this being most essential, according to the Act. I should mention that the boiler should be placed in a fireclay

cylinder, such as are found in any ironmonger's shop, in the form of slow-combustion stoves, so that by increasing the number of tubes and length of main body, any amount of steam may be obtained, and steam may be got up to 50lb. in eight minutes. All steam must be condensed, which I have successfully done by carrying the exhaust pipe several times round the frame of the carriage, ending in the water-tank under the seat, so that very little water is necessary. R. Allison.

IMPROVEMENTS IN SHIPS' PROPELLERS.

[42793.]—On a former occasion I had the privilege of submitting in the columns of your paper, for the critical examination and approval of your scientific readers, certain improvements in chain-gearing, and I am glad to believe that my doing so was largely instrumental in securing the appreciation of the novel principles involved, and adding to the gratifying measure of success my Resilient chains have already attained. I again seek your hospitality in order to lay before your readers details of certain radical improvements in the construction of ships' propellers recently invented and patented by me, the importance of which becomes sufficiently manifest by the statement (the truth of which I shall demonstrate) that they are calculated to materially increase the speed attainable by ships, to lessen the requisite consumption of fuel for any given speed, and to reduce the tendency of the machinery to break down. To those who attribute the abnormal increase of driving-force now requisite for the attaining of a comparatively insignificant addition to the existing high speed of vessels to the increased frictional and other resistance of the displaced water, my first proposition will appear to be an untenable one; but experience and a careful examination into the various dynamical circumstances involved have convinced me that such a theory is not the true one, and that it is inconsistent with the rules governing the development of force and resistance;—hence it follows that the explanation must be sought elsewhere, and I am glad to believe that I have succeeded in finding it and in providing an effective remedy. My view is that such apparent resistance is, to a very large extent, due to the leakage of energy and destruction of the density of the water caused by the "shock" of the impact of the propeller blades on the water, which, by concentrating an abnormal application of force into an atom of time, causes the faults above referred to without increasing the momentum transferred to the water, or the vessel's speed.

The following facts all go to demonstrate the truth of my contention, and as they have hitherto been practically ignored in calculating the efficiency of propellers, I give them in some detail. When even a moderate rate of speed is being attained, the pressure of the "faces" of the propeller blades on the water is greatly in excess of that of the height of the superimposed column of water plus atmospheric pressure; hence the displacement caused by each blade must, under such circumstances, inevitably leave a vacuum at its reverse side, which vacuum must, to a large extent, in consequence of the "slipping" of the blades, be passed through by the succeeding blade before it finally strikes the more solid mass of water beyond. Again, the inherent imperfections of all crank-driven machinery cause perpetual variations in the velocity of the shaft, and consequently of the propeller, and *pro tanto* relative momentary increases in the resistance of the water, which also have the injurious dynamical faults of "impact." Further, the resistance offered by the water acted upon constantly varies, not alone with the perpetual variations in the condition, height, movement, and mass of such water, but even that offered under most favourable circumstances to an ascending blade is materially less than that against which a descending blade works. Every one of those circumstances goes to cause an intermittent action of the driving pressure, and either a relative or an actual succession of "impacts." They thus set up an increased friction and recurrent concentrations of the driving force, which thus wastes itself in lessening the density and consequent effectiveness of the water as a propelling medium, in vibrating the hull of the vessel, and in causing that "shock" and consequent reaction which is the direct offspring of a misapplied propelling force, and a fruitful source of the snapping of the blades and of breaking down of the machinery—in a word, it means a gigantic leakage of power. Those faults become intensified with any increase to a high velocity, and, to my mind, demonstrate the truth of my contention, that the difficulties then encountered arise mainly from shock, and that they may better be met by a conservation of the existing driving energy than by abnormally increase of horse-power. Apropos of this, it is worthy of notice that better results are obtained when their flexible propeller blades are used than with those devoid of such flexibility; but such flexible blades have serious faults which I shall later on refer to. One other consideration I should like to lay before your readers before proceeding to explain my improvements. The laws governing the waste of energy incidental to the impact of bodies are epitomised by "Newton's experimental law," which demonstrates that such loss is in proportion to the absence of elasticity in the masses colliding, and he has shown that where perfect elasticity exists, all loss by impact ceases—that is, where such elasticity is accompanied by the proper "coefficient of restitution." Hence it follows that *elasticity on propellers must prove of advantage.* In such conditions it is the radical and only cure for "shock," and when it is recollected what an enormous waste of force is now occasioned by such "shock," in the propulsion of vessels by propellers, some estimate of the advantages to be obtained may be arrived at. In the case in question, the measurement of the proper coefficient of restitution may be taken to mean a resilient force approximating to that of the normal *resistance* offered by the vessel when being propelled at average speed, apart from that occasioned by "shock," as then any lesser force would be unable to give back in propelling the vessel the full pressure-force absorbed in causing elastic compression, and consequently a waste of energy would ensue. This is one of the faults inherent in the thin, weak, and flexible propeller blades, and in endeavouring to overcome the inordinate yielding of such blades, that arose when they were shaped in accordance with the normal "pitch," another serious fault became inevitable, because by increasing the twist of the blades in order to increase their resisting force, their true driving pitch had to be abandoned, and their working displacement largely increased, causing thereby increased vacuum at reversed sides, increased friction, and a decrease in the momentum



communicated to the water. This shaping is much in evidence in the propellers used in torpedo craft and the like, and the vacuum thereby occasioned by causing increased "churning," largely explains the absence of vibration, which is principally due to the reduction in the density of the water acted upon, in addition to which the "rebound" of such blades increases the subsequent velocity of impact and "shock." I would also direct attention to the important difference between such elasticity of flexure of thin blades and that of direct compression provided by my improvement—viz., the elastic resistance in the former case varies from zero at the base of the blades to a wholly excessive amount of yielding at their extremities, and thus the greatest force is met by least resistance. Whereas, by the latter, an even resiliency may be provided throughout, or its force may be increased at the extremities. My invention shortly consists in so constructing the propeller blades as to combine requisite strength with sufficient elasticity on their faces, and a *full and lasting resilient* force. Fig. 2, of drawings annexed to my patent specification, shows the faces of a blade hollowed at the centre at *a*, *d d* being the surrounding flanges. Fig. 3 shows a sectional view of same, *d* being the hollowed blade, and *a* being any suitable elastic substance fixed in such hollow. Fig. 4 shows another form in section, *a* being the face and *b* the reverse side. In this case the edges at *d d* have increased substance, so that they may offer the necessary resistance whilst the central thin portion, *a*, yields under the force of undue pressure. If desired, the hollow at rear may be covered so as to provide for reversing. Fig. 5 shows another form, in which *a* is a steel plate fixed over the propeller blade *d*. This may be securely attached, as shown, by riveting or otherwise, and the space between plate and blade may be filled in with any suitable elastic substance. By those means the required elasticity may be combined with a resisting force in the blades which will enable them to be constructed with the most advantageous "pitch" for driving purposes, and such elasticity may have a perfect coefficient of restitution at *all parts*, unlike that of flexible blades, in which the greatest pressure which takes place at their outer extremities is met by the weakest resisting force or by a distortion of the "pitch," which alike destroys their driving efficiency and increases friction. The increased sectional thickness occasioned by the use of my invention will add little, if anything, to the friction of such blades, as such thicknesses being substantially at the centre of the reverse sides, it will be well within the lines of the deplacement caused by the oblique action of the blades on the water. The increased weight, affording as it will an increased momentum force, will prove advantageous, as it will reduce tendency of the blades to "react" after impact with the water, and thus enable them to impart a greater momentum to the water. Such decreased reaction will also much lessen the jarring on the machinery, and consequent tendency to break down. As to the regulation of the elasticity and resilient force, Hooke's law shows that, under such conditions of elastic compression, the amount of the elastic yielding is in direct ratio to the force of the pressure applied. To this dictum, which ignored the element of time, may be added the factor that such yielding under any given applied force is considerably greater than is generally imagined, inasmuch as it increases in the case of impact pressure with the square of the velocity of such impact. This latter fact I have ascertained from experiment, and as it is, so far as I am aware, contrary to the hitherto accepted theory of viscosity, I would commend its consideration to scientific readers. It would also go to explain the remarkable virtues of even an apparently insignificant elasticity in many dynamical problems, as for instance, that of the increased penetration and improved wearing powers obtained by its introduction into the construction of heavy guns. As to the amount of yielding requisite, some misapprehension appears to exist. The function of elastic yielding in such cases being to spread the application of a sudden and abnormal force over an increased space of time and doing of work, it follows that in the case of any powerful and rapid dynamical action, a slight amount of yielding supplemented by a powerful resilient force is sufficient and even preferable to any greater yielding, especially when time and distance are of moment. As regards the maintenance of the face elasticity, it must be remembered that, so long as the "limit of elasticity" is not exceeded, the resiliency lasts indefinitely, and that such "limit" will not even be approached except when the greatest pressure requisite for attaining the highest speed is being applied; whereas in flexible blades such "limit" is constantly and inevitably exceeded, the result being "tiring" of metal and snapping of blade. In conclusion, my conviction is that by the use of my invention a large proportion of the force now wasted in vibrating the vessel and in "churning" the water may be diverted into procuring an acceleration of the speed, that a more constant application of the driving pressures may be obtained, and my calculations all go to show that an increased speed of from 15 to 20 per cent., and possibly even more in the case of shallow craft may be attained.

Fig. 1 is a sectional view of part of a yacht's frame to which the invention is applied, *a* being one of the timbers having my outer frame or timber *b* attached to it by means of the intervening "steel springs" *d*, each being secured as shown at *g h*, or otherwise suitably fastened. *f f* show sectional views of suitable "stringers," preferably of steel, which I fasten longitudinally outside the inner frame so as to securely brace it up. The outer frame *b* may be made of steel, elm, or other suitable material, and of the required substance, the vessel's planking or sheathing being fastened to it by bolting, riveting, or otherwise. In place of the springs as shown, any other suitable contrivance or yielding substance may be used. I would place a sufficient number of suitable light ribs between such spring timbers so as to secure the planking so attached from leaking. I would graduate the elasticity so procured so as to assimilate its extremities to that of the planking with which it ultimately comes in contact, and when applying my invention to small craft I may support such outer sheathing with suitable pads of inflatable rubber, and thereby enable its elasticity to be readily regulated to suit all weathers, in which case I would have a suitable inner ceiling. The shape and position of "timbers" so treated must be altered so as to enable the outer frame to receive and support the planking in the required lines. This invention may also, with suitable modifications, be applied to the outside of the ordinary sheathing of the bows of vessels, and it should be found beneficial when thus applied to armoured ships; it may

also be applied for the purpose of reducing the "impact" of shell of such armour, in which case I would use an inner plating of suitable soft and elastic metal. Fig. 2 shows the face of a propeller blade made in accordance with my invention; *a* being the hollow face, *b b* the edges of same (slightly hollowed as shown at *b b*) Fig. 3, and *d*, *d* solid edges of the blade.

Fig. 3 shows a sectional view of a propeller blade made in accordance with my invention, *d* being the blade or casting as shown in Fig. 2 and, *a* a facing of soft spring steel or other suitable material the same being securely fastened by welding, brazing, riveting, pressing or otherwise. Fig. 4 is a sectional view of another propeller blade made in accordance with this invention; in this case the required elasticity is procured by hollowing the reverse side *b*, the substance of the surrounding edges being increased as shown at *d d*, for the purpose of maintaining the required strength in such blades, the central portion being sufficiently thin to allow of its "springing" sufficiently when the driving pressure is applied at the face *a*. This form I would preferably forge, or roll from suitable steel or bronze. Fig. 5 shows a sectional view of another form of my improved propeller blade, *a* being the solid blade with hollowed face, such hollow being covered by the plate *e*, made of elastic metal and securely fastened to the surrounding flange *b b*, as already described, leaving a hollow space at *f*, which may if desired be filled in with any suitable elastic substance. Fig. 6 is a sectional view of another propeller blade, the face *a* being composed of softer metal than the reverse side, *b*; this may be effected by joining two different sections of metal, or in a less advantageous form it may be got by having the face *a* tempered more softly than what is required for the reverse side *b*—or I may "shroud" the blades with soft steel. **P. M. Staunton.**

Dalmeny, Howth, Dublin.

THE DELUGE—THE MOSAICAL DAY.

[42794.]—A BELATED letter such as that of Mr. Kelly (42761) provokes questions similar to those which have appeared in a certain daily of late. Is it worth while? Is it good enough?

Certain facts have been reproduced in these columns within the last few weeks which do not support the universality of the Deluge, and the arguments thereon have not been invalidated. Until Mr. Kelly is in a position to controvert them, it would surely be best to refrain from displaying such utter ignorance of geology and zoology as his letter evinces. There is no need to proclaim oneself blissfully unaware that the moose, even at the beginning of the Christian era, lived south of the Baltic, and still inhabits Northern Asia and Europe, that elephants roamed over Europe in former days, and so on. I daresay he would object to my advancing the extermination of the wolves in the British Isles about A.D. 1710, reindeers in the twelfth, bear about the tenth, beavers in the thirteenth, and wild boars in the seventeenth centuries as proofs of universal deluge at these periods. But *cui bono?* Facts don't trouble the Diluvialist. He manufactures them if necessary. Although it was as chronologically impossible for either Newton or Halley to be acquainted with the bulk of facts now available to the disproof of the Flood as it was for them to be conversant with spectroscopic astronomy, yet the Diluvialist esteems their opinions on the subject convincing, I can assure Mr. Kelly that to maintain the literal veracity of the Biblical Flood narrative serves far more to promote scepticism and disbelief than the frank avowal that it is a poetical myth based on a disastrous local inundation. If he likes a definite up-to-date conclusion of "modern research," here is one from Bonney's admirable "Story of Our Planet" (ed. 1893), p. 530: "Certainly there is not, even from the earliest epoch, the slightest evidence of any general catastrophic destruction of life and repeopling of the globe."

If Mr. Monck (letter 42724) cares to refer to "Haydn" (ed. 1895) he will find sixteen of the dates which have been assigned to the Flood tabulated therein.

One doubts whether it would serve any useful purpose to discuss letter 42762. Mr. Hardy ought certainly to tell us which Assyriologist has proved the Chaldeans called their years seconds, and anticipated Hipparchus in discovering the precession of the equinoxes. It does not help matters to say all primitive people count by fives and tens, for some Australian aborigines do not get beyond ones and twos. It is not necessary to remark that any lengthening of the day in Chapter I. of Genesis raises questions about the age of the patriarchs in Chapter V., or that for Adam and Eve to live throughout the seventh day and attain at least a respectable age of 86,400 years does not seem to rationalise the undertaking. For neither competent geologists nor physicists will dream of accepting even seven periods of such duration as sufficient time for the evolution of the whole universe. One vastly prefers to regard the account of the Creation as poetical as Homer's Trojan epic, for instance, and not a *verbatim et literatim* report of actual proceedings. **J. Dormer.**

THE COMET AND THE DELUGE.

[42795.]—I NEED not discuss the views of Newton, Halley, or Whiston about comets. If Cometary Astronomy has made no progress during the last two centuries it differs widely from all other branches of the science.

I fail to see any more reason for believing that there was a great comet (to say nothing of the water comet) in the year B.C. 3102 than in the year B.C. 2356, or any other very early date that Mr. Garbett chooses to fix on. I have more than once indulged in speculations in astronomy, and have been pitched into for so doing. But speculators ought to have some foundation in observed or recorded facts, and for the theory of a universal deluge in B.C. 3102 caused by a comet composed of water, I think it would be desirable to give something like evidence that there was a deluge in that year, that there was a comet in that year, and that comets are sometimes composed of water—though, granting all three, it would be difficult enough to reconcile the theory in question with the narrative in the Book of Genesis. **W. H. S. Monck.**

THE DELUGE.

[42796.]—MR. LEONARD KELLY writes that "the very simplicity of the narrative of the Deluge is the most conclusive proof that Moses wrote just as he was inspired to write." I should advise Mr. Kelly to study a little more his Bible, possibly in the Hebraic original, and then say why the narrative in this case runs sometimes under the name of Elohim and sometimes under the name of Jehovah, and just so that if all the paragraphs of the one and the other name are put together, there are *two complete* stories of the Deluge, both the same as to the substance, but differing in the details (the two and the seven pairs, &c.) I expect he will find out easily that "simplicity" has to be applied to something or somebody else.

How can Mr. Kelly say that the flood was caused by the water suspended in the atmosphere being suddenly condensed, when he says just at the beginning of his demonstration that this water would make a stratum of only 20ft. depth? Twenty feet of water that reaches up the "high mountains"? Would it not be better in any case to stick to the theory of the "watery" comet, no matter how watery? Mr. Kelly says that shells of oysters have been found on the tops of all the high mountains. Does he think the time the Deluge is said to have lasted was sufficiently long for depositing sometimes strata of mètres and mètres of shells?

Mr. Kelly marvels at the Ark having landed on Mount Ararat, and takes it as a proof of the finger of God. I should, however, like him first to prove that there was actually the Biblical deluge, as described, and Noah's Ark—as I do not see that the "elementary facts of experience" he mentions prove that; and also let him kindly explain, if it is an "elementary fact of experience," that of the aqueous vapour all over the world condensing suddenly, and the 20ft. of water that submerge 8,000ft. mountains.

Poor religion! At first it made Galileo hold his tongue by force, then it mocked Darwin, and declared his theory ridiculous and absurd, and now it comes humbly to the very same science it did all in its power to crush down, and feigns to exalt her, whereas it only steals her crumblings for support.

Milano, via Zeccavecchia. **Libero Gorio.**

[42797.]—WITHOUT replying to the main point in "Little Bookham's" letter (42721), it seems very clear that the return of the shadow on Ahaz's dial was *not* caused by any magnetic influence, nor yet was it an atmospheric effect, as implied in Mr. Garbett's letter (42774). The return can be explained by the occurrence of a partial solar eclipse, which would hide the upper portion of the sun's disc.

Hezekiah's illness is fixed by Demetrius as having occurred about the time of such an eclipse which happened on Jan. 11, 689 B.C., at 11.30 a.m. The only difficulty in the explanation is that the form of the dial in question is unknown; but if it took the form of the Greek heliotropian (an arrangement of steps rising towards the sun when on the meridian, so that the shadow of the gnomon fixed on the top would just fall on the bottom step when the sun was at its lowest altitude), the partial total eclipse would explain the return of the shadow, in that the eclipse of the upper portion of the sun's disc would have the same effect as lowering of the sun's altitude, and would cause a lengthening of the shadow, throwing it back a certain number of steps—as to how many it would return depends upon the total number of steps in the heliotropian. The effect of the actual eclipse would be to throw the shadow back one-twelfth of the total length. If the total were 120 steps, then the steps or degrees which the shadow returned would, of course, be ten.

That Ahaz's dial did take the form of the heliotropian is suggested by the profane writer Glycas: —"They say that Ahaz, by some contrivance, had erected in his palace certain steps, which showed the hours of the day, and also measured the course of the sun."

I would recommend "Little Bookham" and others to obtain G. F. Chambers's, F.R.A.S., little book, "The Story of Eclipses" (from which I have borrowed), recently published by Geo. Newnes, Ltd., as one of the "Library of Useful Stories," in which they will find this subject dealt with in detail with diagrams in illustration.

To those interested in the Solar Eclipse of May next, I would also recommend that book. There is a very interesting diagram of the planets and principal stars which will be visible during the eclipse which will no doubt prove useful.

It is possible that the record of the sun standing still in Gibeon, recorded in the 10th chapter of Joshua can receive as satisfactory an explanation as Mr. Chambers gives of the returning shadow.

Huddersfield, Sept. 4. **Wilmay.**

[42798.]—LEONARD KELLY seems to repeat (in p. 66) what Bible notes used to say early in this century. But nobody can "examine the highest eminences on earth," because nobody can climb to them, and it is even doubtful whether anybody transported thither could live ten minutes. The cold would be too extreme, and the air not a third as dense as what we commonly breathe. The mountains known to contain "shells and skeletons of sea fish" are far from the highest; and, moreover, indicate no flood of a few days, but immersion in the sea for ages. Some mountains of only moderate height seem never to have been under sea, as those of Scotland and of Auvergne in France.

The account in Genesis (not by Moses, but probably much older) says, "the waters prevailed 15 cubits when the mountains were covered." That must have been Noah's belief, meaning that he knew the draught of his Ark to be 15 cubits when it grounded. As he and his family never saw a higher hill than Ararat, it means that this was 15 cubits under water when he grounded. It then rose till becoming now some 10,000 cubits over sea-level. The account nowise implies that other mountains, unknown to him, were under the sea. They were simply deluged with rain that swept everything off.

It is a gross error to say the atmosphere contains enough "to cover the whole globe to the depth of 20ft." It never contains enough to cover it with half a foot. The sea contains enough to yield more than a mile, if the globe were all level. But it has an old cliff line, 600ft. below its present level. That is what I fancy to have been the pre-Noachian coast. The quantity of rain to raise the sea to its present level may have been between 400ft. and 450. Halley's and Newton's theory affords abundant water for that, but I never heard of any other theory affording a tenth enough.

What is now wanted, in geology above all things, is clear particulars of the timbers Nouri (or Honri or whatever his name is) saw on Mount Masis;—those that, according to Missionary Wilson, "*deceived* him." **E. L. Garbett.**

THE MOSAICAL DAY.

[42799.]—TAKING the day as a period of 43,200 years, or, rather, 86,400 years—I don't see why Mr. Hardy (p. 66) could not have doubled it again, it would have brought him a bit nearer—and multiply by six—six days being the period given in the only (rather doubtful) authentic record in existence; this gives us a period of 518,400 years as the time taken by the Creation. Now it is manifest, or should be, to any intelligent person, that 518,400 years is but as a minute is to a day in the time required for the evolution scheme. I do not think the Chaldeans made their days half long enough. **Silverplume.**

AHAZ'S DIAL.

[42800.]—MANY thanks to Mr. Garbett (letter 42774) for his kind reply; but I do not think that atmospheric effects caused the return of the shadow on Ahaz's dial. I think that would not explain the standing still of the sun and moon. See Joshua x. 13, "So the sun stood still in the midst of heaven, and hasted not to go down about a whole day." I think this points to other causes than atmospheric effect. I should much like to see my question answered: What would happen if the South magnetic Pole was moved a thousand miles nearer the North Pole? as I think it has a great bearing on the subject. Now, would the earth revolve in a different manner than it does now, and what would be the probable effect on springs of fresh water? **Little Bookham.**

THE FUTURE OF AERIAL LOCOMOTION.

[42801.]—WILL you kindly permit me to point out, in reply to letter 42756, that I have not claimed in these columns the originality of Jules Verne's creation, but have aimed at demonstrating how the system of the screw for both elevation and pro-

pulsion with suitable concave surfaces is the most practical to imitate the principle of nature? What I certainly should have said is, "that the design, although taking it as an illustration, is far more practical in technicalities and concentration of scientific facts than Jules Verne's imaginary one." For this I have shown how absolutely indispensable concave surfaces are to retard a sudden fall when, for instance, the machinery might break down; how the ram in front, if movable, would act as a rudder for steering right or left; how the fan-shaped horizontal tail in the rear would assist an inclination upward or downward after impetus; how the twin-propellers are more effective to throw the air behind the blades than a front one, how the eight blades on a vertical shaft, being of larger diameter, would be proportionately of higher efficiency, how modern light oil-engines are more suitable than the imaginary ideal accumulators mentioned, &c.

Thanks to Mr. Challis for his warm remarks respecting same. My own original ideas, it may interest him to know, are on precisely the same principle (the screw); but the hull of the flying craft is cylindrical, with a sharp bow to minimise air resistance, with concave surfaces, horizontal rudder, elevating and propelling screws, &c. In short, I assure him my design contains *practical* lines over other systems, that I can claim still his cordial verdict, in that "I have broken all records in publishing far and away the best flying-machine as yet devised." I sincerely wish him, therefore, every success with his own ideas.

E. Wilson.

[42802.]—MR. L. SENECAL's letter (42702, p. 16), in commenting on Mr. Challis's limited ways, &c., gives us an important suggestion, "from a few yards to several miles long," giving greater range of safety for balancing. There cannot be any doubt that the failures of all flying-machines, past and present, are due mostly to the want of stability. This is simply because the machines were too small, and consequently the fractions of time too short for any efficient control of the motions of these machines. But the results would be very different with aërial machines of very large dimensions, as the times of the oscillations would increase and follow directly with the linear dimensions, as is the case with the large sea-vessels which give ample time for controlling (when necessary) their motions, which become almost impossible in the case of the model placed in similar conditions. These large machines, when once launched, should never touch ground again, but be perpetually sailing the atmosphere like the albatross, frigate bird, &c.; they probably could be constructed on aërial docks and launched on the gale, and then proceeded with by analogous methods and processes to sea-going vessels, which service is carried on by smaller craft; similar means could be adopted for aërial machines. Aëronauts tell us that the greatest danger of ballooning lies in leaving the ground, but specially in landing: the same will apply without exception to all flying and aërial machines. Keeping this in mind, it follows that small machines (aërial) doing the land service must be structurally and materially stronger, more powerful as regards motive power for controlling the weight of the whole machine, and consequently much heavier proportionately than the large sailing machines, while the steering and stability may remain the source of great trouble and danger. But with machines that would never come near land this state of things would be reversed, on account of the conditions surrounding the floating structures comparatively speaking. The first machines could be launched either from a high cliff or mountain, or better *still*, from an Eiffel Tower fitted with counter-lever beam crane with rotary motion. These structures would also solve many unsolved problems, such as etheric telegraphy, telephony, light- and sound-waves propagation, &c. F. Willey.

[42803.]—IN my former letter (42652, p. 558, Aug. 4) it was intended to describe the flight of "certain small birds in rapid flight." I have seen a small bird beat its wings for a second or two and then fold the wings tight to its body while it moved on with the rapidity of a stone thrown from a sling. Not having seen anything like it described, nor an accurate account of it, I should like to know what birds fly in this manner. My friends say owls fly so in daylight. The speed of flying was very great, much over that of an express train, and the line of flight horizontal, a little above the tree-tops. The turkey and the vulture are both heavy birds, and I would be glad to know whether the large birds of prey fly as before described.

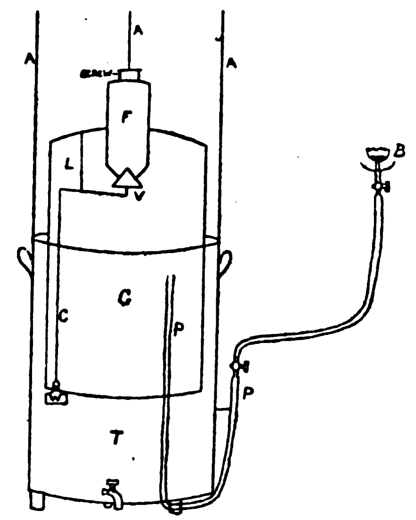
In regard to the limit of size in the figure-of-eight wing it depends on the nature of the materials. Mr. Senecal will no doubt be aware that the construction of a large flying model with indiarubber motors is a matter of difficulty, and this is because of the nature of the elastic material used. I have made a great many of these models in geometric sizes, and find that it is no use trying with too large a size. In consequence, it is supposed that the figure-of-eight wing, being elastic, will have a limit of size also, like the indiarubber motors. Kaufman's flying-machine described in Vol. VIII. p. 73 of the "E.M." broke its wings off short on trials, and, later, Welner's experimental rotary wing could not stand the strain on the materials when driven at full speed. J. Sutcliffe.

[42804.]—ANENT the discussion on flying-machines, I see that no notice is taken of what might be called the valve-action of the pinion feathers of the wings of birds during flight. A pinion feather has a broad and a narrow side. If this feather is waved up and down, the broader side offers more resistance to the air than the narrower one, and it tends to rotate on its axis or shaft. Again, if a wing is waved so as to imitate flight, the resistance to the up-stroke is very much less than to the down-stroke, as spaces open between the feathers by their broad sides screwing round, and allowing the air to pass freely through. In the down-stroke, the feathers act like valves, the broader sides closing up against their neighbours, the wings thus becoming airtight.

Now, could this principle not be applied to those machines in which the wings of birds are imitated by using materials such as thin wood and steel shafts, to imitate the broad and narrow sides of pinion feathers? G. Dickson.

ACETYLENE GAS GENERATOR.

[42805.]—I INCLOSE my idea of a reliable acetylene gas-generator, which I have worked for three months, and have had no trouble with it. I know that some of our readers would take interest in it by following the instructions. In the figure T is bottom tank that holds water; G is gasholder; F is



carbide-holder; V is valve; L, lever; C, chain; W, weight; P, outlet pipe to supply gas-burner B; iron rods A for guides for gasholder. The instructions are very simple, as it works automatically, as when the carbide-holder is full a portion of it falls into the water and gas is made intently; the gasholder rises, and the valve closes by the weight. Any one of our readers may call and see the same at work. H. Matthews.

122, Third-avenue, Queen's Park, W.

LEGAL REMEDY.

[42806.]—"A FELLOW of the Royal Astronomical Society" (letter 42712, p. 37) is no doubt right as to there being theoretically a legal remedy in the cases mentioned; but, practically, the remedy is worse than the disease. In each case some time elapsed before the purchaser became aware of the fraud practised upon him, and no doubt the dealer would have fought tooth and nail. In my own case, after only two days' purchase of an article which it was impossible the seller could have forgotten, I was met by a flat denial that the man who served me had ever seen me in his life, or had any memory of the sale. Fortunately, I had not any complaint to make, but he was consistent in his denial, even when he found that out. How would it have been in other cases? But I want to point out that although we have the most upright judges in the world, still law is a very costly thing *to a complainant*. The defendant often suffers, but *the complainant always is punished*. It was cheaper to put up with the first loss than to incur law expenses of greater amount, even if successful. I was advised by a solicitor in a case where a man obtained goods on credit when his books were already in the accountant's hands, that he was certainly in the grasp of the law, and I might get him three months, but it would cost me £50 in any case. I could fill the "E. M." with instances such as this, and worse. Suppose the purchaser of the £50 6in. had sued for damages, and recovered his money with costs, even then "costs" recovered are not costs as between solicitor and client, and £50 is a moderate estimate of their amount, which would leave him without either instrument or money, while there is the possibility he might have failed to get redress, and had to pay the dealer's costs in addition. This is a case again in which, before moving a step, it is best to consider and Hear Both Sides.

EFFECTS OF CHANGE OF TEMPERATURE.

[42807.]—ARE the textbooks wrong? I find in one the following regarding the effect of a change of temperature—viz.: "If the pressure remain constant an increase of temperature of 1° Centigrade produces in a given mass of air an expansion ·003665 of its volume." Consider the foregoing in the following manner—

Let V be the number of cubic feet in the original volume.

a be the increase ·003665 of 1c.ft. due to a rise of 1° Centigrade in temperature.

M be the new volume in cubic feet.

r denote the volume of 1c.ft. after the temperature has been raised 1°.

Then $r = 1 + a$, and Vr = the volume in cubic feet after a rise of one degree in temperature. Now raise the temperature another degree, and the volume will be Vrr or Vr^2. Raise it another degree and the volume will be $Vrrr$ or Vr^3, and so on. Thus $M = Vr^n$, where n is the number of degrees increase in temperature.

Should this solution of gas expansion be the correct one, a volume of gas will more than double itself if the temperature is increased 273° Centigrade, whilst lowering its temperature would never cause it entirely to cease to exist. Then what becomes of the imaginary absolute zero? William E. Tanton.

PRINCIPAL AND INTEREST.

[42808.]—MR. MONCK makes nonsense of my teaching at p. 67, by taking me to advise gratuitous lending, which is, like all charity, hateful and damnable to every capitalist.

"I hate him, for he is a Christian;
But more, for that, in low simplicity,
He lends out money gratis, and brings down
The rate of usance here with us in Venice."

Mr. Ruskin is easily attacked on this ground, because, in condemning the crime of borrowing or lending on interest, he begged people "to observe respecting ancient or modern denunciations of interest, that they are much beside the mark unless they are accompanied with some explanation of the manner in which borrowing and lending, when necessary, can be carried on without it." But he never observed that the Bible, the chief of the ancient denouncers of interest, did not begin denouncing it (in Exodus xxii.) till *after* describing, in Genesis xlvii., the hugest possible case of borrowing and lending without it. We cannot find any case of greater contrast between rich and poor than between Pharaoh and his people, when the famine had enabled Joseph to buy up all the seed, live-stock, and tools of Egypt, and finally to buy the people and their land. Pharaoh was then sole capitalist and landlord, and the people mere wagelings.

Never was such an occasion for capitalism on the hugest scale, and national debt *consols* at ever-so-much per cent. But Joseph taught them to lend and borrow by *partnership*. He took the labourers, one translation says, into cities, or, another says, "made them slaves." But the supreme point was that, if he made them Pharaoh's slaves, he made them Pharaoh's *partners*.

That was understood also throughout the middle ages—that if one contributed capital and another labour, they should agree on the rate of division of the earnings; the *whole* earnings, not the excess over certain wages or certain interest, but the whole earnings to be divided—in the Pharaoh's case, *four-fifths* to labour and *one-fifth* to him, the sole landlord and capitalist. The "uncertainty of rate of interest" has to be divided always between them. No such thing as a fixed "rate of interest" was ever allowed, because, as Lord Bacon predicted, where usury is allowed, it bringeth all the wealth of the state into too few hands, for as usurers trade on a certainty, but all other men on uncertainties, at the end *all* the money will be in the box."

In the New Testament, Mr. Monck quotes the parable of the Talents, but not that of the Pounds. Both contain the case of the idle and wicked servant, though the two parables give very different views of Divine justice. In neither of them is any interest taken, by the master or anyone else. Far from taking "what he has not sown, or gathering where he has not strawed," he does not resume his own principal. But the servants (who are not agents at all) are praised and rewarded proportionally to their industry in the Pounds case, where they

deserve unequally; but in the Talents, where all are equally deserving, they all fare alike. The pound of the idle servant is given to him who had ten pounds; but the bystanders expostulate, "Lord, he hath ten pounds." In the other parable, the talent of the idle servant is also given to him who hath ten talents; but there is no expostulation, and I fancy this particular has been copied from one parable into both. I deny that there is a "capitalist" or an "agent" in either. The profitless servant is called not only idle but *wicked*, because he falsely taxes the master with meaning to take other men's earnings, or, in short, to play capitalist. "Out of thine own mouth will I judge thee." Thou tookest thy master for a vile usurer—taking what he has not sown. Well, then, to avoid being fleeced by him, why not have put his money in a bank, or as the other parable says, to the "*table-holders*," or bankers; that so, on the rascally capitalist's coming, he might require not only "his own," but "usury" that was not his own, besides?

The notion that he approves of banking, or would have had the money banked, is absurd; for he could have banked it himself, instead of letting "an agent" do so. Bankers are merely regarded as an organised gang of thieves; but the difference between burying the money or banking it is that in one case the investor will share in their plunder, in the other case not. Whether there be more or less in the banks really makes no difference to them. They obtain all the usury that the nation's poverty can yield. This is then divided between investors proportionally to their investments.

For just two centuries, since they sanctioned national debt, we have only an idolatry for Anglicanism. Capital, or Ευπορία, teaches us what god to worship, and whoever dies a capitalist dies with the mark of Ευπορία in his right hand or forehead. E. L. Garbett.

LIQUID AIR.

[42809.]—Is liquid air the valuable article it was said to be? It was said that if you, with a steam-engine, produced 10c.ft. of air, you would never require a steam-engine again, because 3ft. of air used as power were enough to produce another 10ft. of liquid air. So that you could go on for ever without any other motive-power than the three-tenths of the air you liquefied applied to producing a further supply of 10ft. successively. Thus giving a constant supply of 7ft. to utilise for propelling machinery either on land or on a ship at sea? Will any of your readers who have actually produced liquid air give an honest reply to this question? G. A. H.

USEFUL AND SCIENTIFIC NOTES.

In 1898 there were 159 schools of science in existence, with 21,193 students. This is a considerable increase on the preceding year, when the number of the schools was 143, with 18,142 students. Schools of science in Scotland are not included in these figures.

The Imperial authorities have recently definitely resolved to extend the Central-Asian Railway to the town of Werny, and thence in a northerly direction. It now remains for the direction of this new line to be decided upon. A detachment of engineers has already left Tashkend for the purpose of making a preliminary survey. Two routes have been suggested: one would be across the Steppes to Orenburg, to the southwards of the Ural Mountains, and the other, viâ Semipalatinsk, to Barnaul and Krivoschtschekovo. The former route has very influential supporters in the persons of the cotton-growers of Tashkend and the manufacturers of Moscow, all of whom naturally desire to have the shortest possible means of transit for conveying this raw material to Moscow. A recent conference at Semipalatinsk clearly proved the route viâ that place and Barnaul will be the more advantageous. The authorities will allow the new line of railway to be built by private enterprise.

The *Bulletin* de la Société d'Encouragement pour l'Industrie Nationale contains an account of an interesting application of electric-power transmission to cottage industries. The district of St. Etienne is largely engaged in the manufacture of ribbons; the looms, being situated in the houses of the weavers, were until lately driven by human agency. Many of these are now driven by electro-motors, the generating station being situated at St. Victor-sur-Loire, nine miles away, where three turbines, each of 300H.P., have been fixed. The power company now serve 24 communes, the distribution being on the three-phase system. The cables have a total length of over 68 miles, the electromotive force on the transmission line is 5,200 volts, which is reduced by transformers to 190 volts for the house circuits. About 2,500 looms are now driven in this way, and the company has also a large lighting load. Each loom takes about a ¼H.P., on which 10fr. a month is paid.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96218.]—**Charging Accumulators.**—You can best charge these from your plating dynamo by putting the cells in parallel groups of two in series. The proper charging current must be ascertained from the maker's catalogue. Supposing a charge of 10 ampères be permissible, then you will be able to put as many as five groups in parallel of two cells each without exceeding the capacity of the dynamo. The conditions of the cells can be ascertained by (*a*) testing their individual voltage, which should rise to 2·3 or 2·4 at the end of the charge; (*b*) by taking the specific gravity of the electrolyte, which is generally about 1·195 to 1·200 when fully charged; and (*c*) by observing the appearance of the electrolyte, whether "milky," and if gas is evolved freely. The positive plates should turn a chocolate, or even a plum, colour; but experience is the only safe guide. See the many hints given in back numbers. A. H. Avery, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96304.]—**American Organ.**—In reply to "Organon" (p. 43), absence from the vicinity of the Patent Office prevents me sending exact details of the organ. I will look them up on my return to town. The name of the patentee was R. Willard Paine, and the date was somewhere in 1896. The organ was adapted for automatic playing, and was divided into two parts, one containing the two reservoirs and feeders driven by an electro-motor, and the other containing the reeds, pneumatic action, and a piano with pneumatic hammers. In such an instrument as the Æolian automatic organ, I have found the action quite as quick when there is there is the least possible suction that will make the reeds speak as when the reservoir is fully drawn up. H. Bevan Swift.

[96364.]—**Steam Barge.**—Query imperfect. Is the barge to go with stream or against an ebb?—because that makes a great difference. This kind of query has been frequently answered in back volumes; but it seems useless to point out that "conditions alter cases." Metors.

[96367.]—**Perforating and Cutting Paper.**—Punches for cutting paper, or even leather, can be obtained from any of the makers. Nowadays iron and steel are cut by that method when power is available; but as an example, such leather work as gentlemen's "braces" is often punched by the hand hammer and tool. Any of the ordinary toolshops keep such punches. A block of lead (soft) is about the best material to punch on. T. L.

[96426.]—**Magnetism.**—There is no known substance, either liquid or metallic, which will "insulate" magnetism. The only way to isolate a magnetic field is to intercept the lines of force, and offer them a path of less resistance than their air-circuit, such as a closed circuit of iron. This has an effect similar to shunting a current, and the analogy holds good insomuch as it is impossible to deflect *all* the lines of force unless the shunt or iron circuit possesses absolutely no resistance or reluctance.
A. H. Avery, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96452.]—**Meal Powder.**—Forty years ago I used to make my own thus:—Saltpetre 15 parts, flowers of sulphur 2 parts, ground charcoal 3 parts. It answered admirably for rockets. The saltpetre was crude, pulverised by the simple boiling down and vigorous stirring, and suddenly cooling, when it resembled moist salt, then hung up to dry in paper. This mixture is, in fact, gunpowder, but not granulated. Hammer.

[96439.]—**Quadratic.**—To "Ontario" and "Scorpio."—Will the friend who informed "Ontario" that his equation could be solved by quadratics kindly show your readers how it can be done? Unless he can resolve it into two quadratic factors equateable to zero, his statement must be inaccurate, especially as the values obtained by myself (and still more accurate ones by "Scorpio") point to the non-existence of rational factors, or, at least, to a fundamental difficulty in finding them. The equation is certainly not a quadratic, but one of four forms which the biquadratic,

$$81x^4 - 1368x^3 - 3332x^2 + 35772x + 95832 = 0,$$

may assume, whether expressed integrally or as—

$$\pm\sqrt{x+3} \pm \sqrt{\frac{x-2}{x+3}} = 3\tfrac{2}{3}.$$

If we put $\sqrt{x+3} = y$, we may change the form to—

$$[y(3y - 11)]^2 = 9(y^2 - 5),$$

where $y = 3, 4·5367, -·1017 \pm ·59747\sqrt{-1}$. For some time I have been inviting mathematicians to re-examine the theory of equational roots, and this equation again proves the importance of such re-consideration. Every equation has one proper solution only, when strict regard is paid to form. Every additional value of x means either a change of value or of form in the original equation; in other words, fresh equations. The normal and inverse processes of multiplication lead to normal and inverse powers and roots. Equational principles demand that the same process shall be applied to each branch. Thus, if $x^2 = a^2$, we may deduce (i) $x = a$, (ii) $-x = -a$, but not (iii) $x = \pm a$, which involves two distinct primaries, for if—

$$x^2 = a^2,\ x = a, \text{ or } -x = -a.$$

Again, if we take normal or positive roots.

If— $(x - a)^2 = a^2,\ x - a = a,\ x = 2a;$
If— $(a - x)^2 = a^2,\ a - x = a,\ x = 0.$

If we take inverse roots, then—

$$-(x - a) = -a, \text{ or } x = 2a;$$
$$-(a - x) = -a, \text{ or } x = 0.$$

Lastly, since $(x - a) = a$ is a different equation from $(a - x) = a$, so $(x - a)^2 = a^2$ is a different quadratic from $(a - x)^2 = a^2$, and the dual solutions strictly arise from a change in the primary, which is formally inadmissible.
West Norwood, Sept. 2. Henry T. Burgess.

[96461.]—**The Mineral Waters of Germany.**—Much obliged to those correspondents who have replied to my query; but may I ask them whether it is true that patients are warned not to eat fresh fruit at the time they are taking the waters? If so, what can be the reason? Does the acid of the fruits act injuriously when taken with the waters, and if so, what is the cause? Lithia.

[96471.]—**Loan Amortisation.**—In this reply on p. 71, the word "extraction" should, of course, be extinction. B. D.

[96471.]—**Loan Amortisation.**—I did not notice "X.'s" original query, and, being away from home, cannot refer; but his table in this week's number (Sept. 1) is useless for comparison purposes, because he is treating one loan at 3½ per cent., and the other at 4½. To be of any use the same rate should be used. R. H.

[96480.]—**Preserving Flying Fish.**—In this reply on p. 71, why should alcohol of 95 per cent. be diluted with two parts of water? Seems that a weaker alcohol would do, without diluting the more expensive spirit. Perhaps "Regent's Park" will kindly explain. It seems to be a waste of money to purchase strong alcohol and then dilute it with water. Perhaps there is something which does not appear in the reply. M. S. T.

[96482.]—**Insects in Floor.**—A wooden floor over soil is pretty sure to be destroyed by dry-rot, unless the boards are ill-fitting—ventilation is the only preventive. A cottage ground floor should be solid concrete all round the walls for 9in. or so; surbase also concrete; ventilation through walls and concrete below the joists by a common drain tile, protected outside by a perforated vermin-proof brick. This is perfect until the tenant plugs up the ventilation, which he generally does. Hammer.

[96488.]—**Pitch of Worm.**—As this simple query seems strangely enough to have been as yet passed over by your numerous mechanical correspondents, and as the reply of "Regent's Park" is totally inapplicable to the case, I now venture to trespass on the extensive field covered by your encyclopædic correspondent. The reply at p. 71 refers to wheels, not to "worms" or screws. Besides, even as applied to wheels, the method there quoted is now almost obsolete, since the general introduction in this country of the "Manchester Diametrical Pitch," which, as we all know, refers to the number of teeth in the space of the diameter of the pitch circle, without any reference to the number of teeth per inch. For "worms," which are simply coarse screws of single or multiple pitch (generally the latter), a totally different method applies. Indeed, the querist himself, by mentioning the change rigging up of change-wheels to find the pitch, knew better than to suppose his problem had any relation to the subject raked up by his informant (?) at p. 71. It it be possible for a man to have worked a week among screws without finding out for himself the means of measuring pitches accurately in threads per inch or per cm., I beg to be excused wasting space in trying to inform him. Lay alongside the "worm" or screw, and perfectly parallel to its axis, a rule or scale divided in any grade of divisions, moderately fine divisions being preferable. (Of course, only by the merest chance will a scale be at hand whose divisions correspond with the screw-threads, or are even aliquot parts of them.) Cause one perfect thread at the end of the screw to coincide with a division of the rule or scale, then pass the eye along (best if assisted by a watchmaker's glass stuck on it), till it is noticed where the screw-threads and the scale divisions again coincide. If, on the length of screw available, no second coincidence takes place, try a scale of some other division. In all cases take as great a distance between the two coincidences as the length of screw permits of, if great accuracy be required. If of V-pattern, make the exact centre, as near as can be

estimated, of the first *thread* measured from, coincide with one of the scale divisions, and seeing to the equally perfect alignment at the next coincidence, count the number of *spaces* included between these limits, counting both the *spaces* of the screw-threads and the *spaces* of the scale applied to it. If of square-thread pattern, make the coincidences with, say, the right-hand margin of a thread (i.e., the beginning of a space), and count, as above, the included *spaces*. Then, if the screw or "worm" be of single thread (known by having but one beginning, work out the simple proportion which the screw-threads bear to the divisions of the scale employed to measure them. Take a case:—Let the screw or "worm" be single-threaded, and the scale employed one divided in $\frac{1}{16}$ths of inches. With a coincidence of thread centre and scale division, say, at the left hand, the next coincidence happens towards the right, including a space which takes in three *spaces* of the screw, and 20 *spaces* of the scale. As in the ordinary use of the foot-rule the initial line is zero, and it is only the spaces we count.) Here, therefore, we have the proportion 20 : 16 : : 3 : 2·4, or, more simply $\frac{16 \times 3}{20} = 2{\cdot}4$, so that our screw has $2\frac{4}{10}$ threads to the inch. If the screw as above be "coarser" than the scale used to measure it, we multiply the scale grade by the smaller number (three here) and divide by the larger (20 here). The reverse when the screw is "finer" than the scale dimensions. Again, other scales may be used (say for testing results) thus:— $\frac{12 \times 2}{10} = 2{\cdot}4$, which gives the same measurement of our screw, made in this instance by a scale divided in $\frac{1}{12}$th of inches. Lastly, the "worm" or screw may be multiple-threaded, in which case, simply count the number of beginnings it has, and divide the "pitch" as found above by that number. For example, if double-threaded, we should have $\frac{2{\cdot}4}{2} = 1{\cdot}2$ threads per inch. If triple-threaded, $\frac{2{\cdot}4}{3}$ = ·8 threads per inch—i.e., 4 threads in 5in., and it is to these pitches as finally found that we set our change-wheels. H.

[96491.]—**Electrical.**—If "S. B. G." refers to Wright's maximum demand indicator, I gave a sketch and description of that in the "E. M." not very long ago. I cannot put my hand on the exact number, but it certainly was not more than two years ago. A. H. Avery, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96504.]—**Macadam.**—Why not refer to the author's own works: "A Practical Essay" (1819), "Remarks" (1820), and "Observations" (1822)? J. Dormer.

[96512.]—**Electric Lighting.**—Provided no public supply of current is available, about the most economical way of going to work is to install a ½B.H.P. gas or oil-engine and a 30-volt 4 ampère Lahmeyer dynamo. A couple of switches and a few yards of cables and lamps will complete the outfit, which need not exceed £10 in cost for first-rate articles. For temporary work the wires need not be cased in, but simply suspended by insulated eyes and hooks. I can help "A. R. P." further on receipt of his address.
A. H. Avery, A.Inst.E E.
Fulmen Works, Tunbridge Wells.

[96513.]—**Hereditary Insanity.**—No answer of any value can be given to such questions. The probabilities are all in favour of sanity, if the children lead healthy lives. J. D.

[96519.]—**Water Power.**—A pipe 100ft. long with 10ft. head, and one 1,000ft. long with 100ft. head, have the same maximum carrying power. They would each discharge, under the conditions named, about 344 gallons a minute "freely into space"; but a much greater horse-power may be got out of the long pipe than out of the short one. The maximum power in either case would be obtained by arranging the quantity of water used so that about a third of the head is utilised in overcoming the friction in the pipes, leaving the remaining two-thirds to generate power. With a loss of head of 40ft., leaving 60ft. useful pressure, the 1,000ft. pipe will pass about 210 gallons a minute—i.e., 2,100lb. falling 60ft. = 126,000ft.-lb. per minute, or, roughly, 3¾H.P. The querist will see, on working out the short pipe by the same figures, that only a tenth or so of that power could be got from it. W. Wyatt.

[96521.]—**Speed of Falling Chain.**—Mr. Carnegie is, I take it, wrong in his answer to the above. The chain will acquire a uniform velocity equal to that of a body falling freely through the distance between the pulley and the bottom of the pit, and the tension at any point of the chain will be represented by the weight of that portion of the chain between the said point and the ground. The uniform velocity acquired will thus, in this case, be given by $v = \sqrt{(2 \times g \times 580)}$. It is obvious that this must be so from the principles of the conservation of energy; every pound weight of chain at the level of the pulley has 580ft.-lb. of potential energy in it, due to its height above the bottom of the pit, and this must be converted after it has fallen 580ft. into 580ft.-lb. of kinetic energy. And how can this be the case unless the uniform velocity acquired be $\sqrt{2gh}$, where h = 580ft.? It is true that the first 580ft. of the chain that descends will not have this velocity, since its energy will be partly employed in accelerating the portion descending above it; but the kinetic energy that thus disappears is restored when the last 580ft. of the chain descends, the kinetic energy of which will be just as much in excess of $\sqrt{2gh}$ as that of the first 580ft. fell short of it. P. B.

[96522.]—**Electric Motor.**—Carcase of the Lahmeyer type: Armature bore, 7in. diameter by 7in. long; pole-pieces, 7in. deep by 5¼in. high by 3in.; winding space, yokes, 7in. deep by 2¾in. wide; distance between yokes and pole-pieces 3in.; armature, drum wound, 32 (or more) sections, 10lb. No. 20 S.W.G. in four layers; core discs, 6¾in. diameter; field winding for shunt machine, 30lb. No. 23 S.W.G.; speed, about 1,800 revs. (This corresponds to my "No. 7 Lahmeyer.") (1) About ⅛ B.H.P. (2) The drum, if properly insulated. A Lahmeyer motor of this size, with a 2½in. by 3½in. armature, takes 12oz. No. 30 on the armature, and 3½lb. No. 32 on the fields in shunt. (3) See preceding. (4) Yes, with a resistance in series with the main circuit: the normal speed for this size machine is 2,600 revs. A 10-ohm resistance would have hardly any perceptible effect, unless placed in series with the armature only. (5) "Doctors differ"; in larger machines probably yes, but in small ones decidely no.
A. H. Avery, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96523.]—**Water Lifting.**—Thanks very much to "M." for his reply to my question. I think this seems the best plan I can adopt. At the same time I shall be very pleased to hear a suggestion by "Trytoaid," and to his question I reply that the tank is to be emptied twice weekly perpetually. Redbun.

[96524.]—**Automatic Flushing Tanks.**—Siphon having widened overflow and discharged latter sealed in water trap below, so that the air may be compressed in the siphon before the water falls over lip and starts it, is a general arrangement. Another one is a water-tight valve in tank, balanced at opposite end of lever by small tank. Overflow of large tank fills small tank and overbalances lever, raising large valve and flushing. A siphon pipe from small cistern into large one is started by rush of water, empties small cistern back into large one; valve closes, and tank collects water once more. See W. R. Maguire's "Domestic, Sanitary," &c., and many others. Regent's Park.

[96528.]—**Chemical Action.**—An unfortunate misprint has occurred in my reply. The last term of the equations should read $5O_2$ instead of SO_2.
Trin. Coll. Oxon. J. M. W.

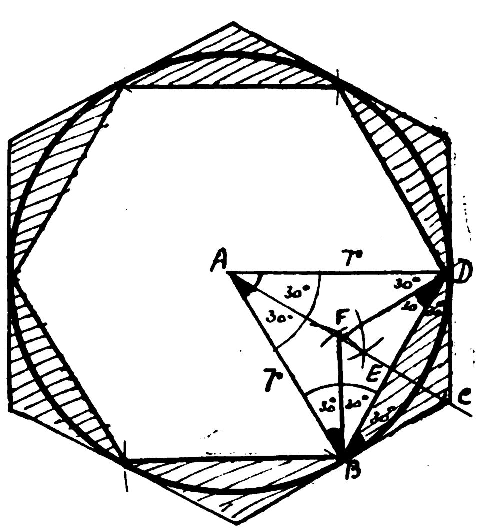
[96530.]—**Alternator.**—The use of the synchroniser is, of course, to get the various currents "into step"; without it, although the alternators might be running at precisely the same speeds, it would be possible to have them differing in phase, so the impulses of their respective E.M.F.'s were opposing, and consequently the available current at the bus-bars little or nothing. It is certainly inadvisable to parallel alternators by different makers, as the wave form seldom coincides, and would thus give rise to various trouble internally.
A. H. Avery, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96531.]—**Heating Power of Coal.**—A search through such publications as the *Minutes* of the Institutes of Civil, Mechanical, and Electrical Engineers would yield the information required. The accompanying table, taken from "Hutton's Works Manager's Handbook," may be of service. It may safely be assumed that on the average not more than 47 per cent. of the theoretical heating power of fuel is utilised, the remainder being lost through imperfect combustion, radiation, and other causes. In the "E. M." Vol. XLIX. p. 356, there is a notice of a paper on "The Heat-Producing Powers of Twelve Samples of Coal," contribubed by W. Thompson to the Manchester Section of the Society of Chemical Industry at a "recent" (1889) meeting. The figures given in the extract are: Anthracite 8,340 Centigrade units, Pendleton 7,736 units, Wigan 7,552 units, Atherton (lowest of the twelve) 6,448 units. In two cases the experimental results were higher than the theoretical, in two cases equal, and in the remainder lower. In calculating the theoretical heating power from the analysis of a given sample, 1lb. of carbon may be taken as yielding by its combustion 14,500 Fahrenheit units, 1lb. of hydrogen 62,032 units, and 1lb. of sulphur 4,032 units. It is usual to deduct from the total percentage of hydrogen present a quantity equal to one-eighth part of the oxygen with which it exists in combination as water. The writer of the above-mentioned paper, however, appears, as far as I can gather, to have considered it necessary to deduct hydrogen corresponding to the whole of the oxygen present, which would, of course, lower his theoretical results considerably. W. J. G. F.

Description.	Sp. gr.	Weight and bulk. 1c.ft. solid.	Weight and bulk. Bulk of 1 ton heaped.	Percentage composition. C.	H.	O.	N.	S.	Ash.	Heat in degrees F. to which 1lb. of water will be raised by 1lb. of fuel in conjunction with oxygen.	Pounds of water heated from 32° to 212° F. by 1lb. of fuel.	Pounds of water converted into steam at 212° F. by 1lb. of fuel.	Percentage of coke produced from the coals.
		lb.	c.ft.										
Welsh	1·31	82·0	43	84	4·6	4·0	1·0	1·5	4·9	14833	82·4	15·0	74
Newcastle	1·25	78·1	46	83	5·3	5·31	1·35	1·24	3·8	14796	82·2	14·9	61
Scotch	1·26	78·6	42	79	5·6	9·3	1·0	1·1	4·0	14150	78·6	14·3	54
Derbyshire	1·29	80·6	48	80	4·9	10·0	1·4	1·0	2·7	13919	77·3	14·1	59
Lancashire	1·27	79 4	46	78	5·3	9·1	1·3	1·4	4·9	13890	77·2	14·0	58
Yorkshire	1·29	80·6	48	80	4·9	10·1	1·4	1·0	2·7	13913	77·3	14·1	59
Coke	0·75	48	80	94	—	—	—	1·0	5.0	13800	77·2	14·0	—

[96539.]—**Ebonite Boxes.**—If indiarubber cement is not possible, following may answer:—Resin 5lb., beeswax 1lb., red ochre 1lb., plaster of Paris 4oz.; continue heat little above 212° Fahr., stir till frothing ceases; or resin 6lb., red ochre (dried) 1lb., calcined plaster of Paris ½lb., linseed oil ¼lb.; or stir into solution of soluble glass finely pulverised chalk (sol. glass of 30° B.) until mixture is fine and plastic; hardens in six to eight hours, &c.
Regent's Park.

[96550.]—**Mensuration.**—In diagram area of shaded portion is 813sq.in. A B D is an equilateral



triangle, six of which make up the interior hexagon. Bisect the angles A B E, A D E by the straight lines B F, D F. Then the four triangles A F B, A F D, B F D, B C D are equal in area, for each has two equal sides and two equal angles. (See diagram.) ∴ area of triangle A B D = three times area of triangle B C D. ∴ area of int. hexagon = three times difference of areas of the two hexagons. ∴ area of interior hexagon = 3 × 813sq.in. = 2,439sq.in.; but area of hexagon having a side, "r"—

$$= \frac{6 \times \sqrt{3}\,r^2}{4} \therefore r^2 = \frac{2{,}439 \times 4}{6 \times \sqrt{3}} = 542\sqrt{3}\text{sq.in.}$$

but area of a circle having radius "r" = 3·14159 × r^2. ∴ area of circle = 542 $\sqrt{3}$ × 3·1459sq.in. = 2,947·44602118sq.in.
Lancaster. John Shaw.

[96544.]—**Lard Refining.**—In my previous reply I omitted to state the commercial uses of lard-oil: edible, lubricating, wool-softening, and

also for adulteration of olive and spermaceti oils, being cheaper. Sp.gr. of 0 9165 to 0 9200 at 15° C., and setting point of −1° to −5° C. By pressing hog's lard at zero C., lard-oil, which does not set at even comparatively low temperatures, is obtained, leaving behind tallow (margarine, palmatitin, and stearine), useful for candles, &c. Pure hog-fat is used as medicine for ointments, pomades, creams, &c., alimental, edible, and cooking foods. "Animal Fats and Oils," by L. E. Andés, of Scott, Greenwood, and Co., London, E.C., 1898.

REGENT'S PARK.

[96553.]—**Astronomical.**—The method mentioned by "Jancis" for solving the astronomical triangle when the latitude and sun's dec. are of opposite names is quite correct. In so doing we would be solving the triangle formed by the zenith, sun, and depressed pole (beneath horizon), and would obtain the value of the angle at the depressed pole, which would be the sun's hour-angle. But it would be more natural to solve the triangle formed by zenith, sun, and elevated pole. We would then use for colat. 90°−lat. and for polar dist. 90°+dec. The results would be identical. ARCTURUS.

[96554.]—**Magnetism.**—You can magnetise even better with the horseshoe, provided, of course, you place the magnet down on the needle with opposite poles facing—i.e., N. to S. and S to N.—and remember to lift off when the needle lies equidistant between the poles of the horseshoe. But you can keep your bar-magnet strong if, when you put it away, it is placed between the jaws of a piece of well-fitting soft iron of this shape |_____|. To be efficient, this piece of soft iron or "armature" should be of the same general thickness and width as the base itself. S. BOTTONE.

[96555.]—**Equations.**—Simultaneous equations of the kind referred to by Mr. Harding require usually some algebraical device in their solution. Some involve equations of a higher degree than that expressed in the given equations, and are often insoluble; others require recourse to the various complicated theories of elimination embodied in "higher" algebra. In the present example, if we observe the symmetry of the coefficients—viz.:

$$\left.\begin{array}{l}\text{(i) } \tfrac{2}{3}x^2 + \tfrac{3}{5}yz = 6\tfrac{3}{4} \\ \text{(ii) } \tfrac{3}{5}y^2 + \tfrac{5}{7}xz = 7\tfrac{1}{2} \\ \text{(iii) } \tfrac{5}{7}z^2 + \tfrac{7}{9}xy = 11\tfrac{2}{3}\end{array}\right\}$$

—we may assume x to be fractional and the reciprocal of the coefficient of x^2—viz., $\frac{3}{2}$—whence:

$$\tfrac{2}{3}x^2 = \tfrac{2}{3} \times \tfrac{3}{2} \times \tfrac{3}{2} = \tfrac{3}{2}.$$

$$\therefore\ \tfrac{3}{5}yz = 6\tfrac{3}{4} - \tfrac{3}{2} = \tfrac{21}{4},$$

and— $$y = \frac{35}{4z}.$$

Substituting these values of x and y in (ii) and (iii), and reducing, we get—

$$\text{(iv) } \tfrac{15}{14}z^3 - \tfrac{15}{2}z^2 + \tfrac{735}{16} = 0$$

$$\text{(v) } \tfrac{5}{7}z^3 - \tfrac{35}{3}z + \tfrac{245}{24} = 0.$$

Multiplying (v) by $\frac{3}{2}$ and subtracting it from (iv), we get—

$$\text{(vi) } -\tfrac{15}{2}z^2 + \tfrac{35}{2}z + \tfrac{490}{16} = 0.$$

Change signs and $\times \frac{2}{15}$:

$$z^2 - \tfrac{7}{3}z - \tfrac{49}{12} = 0.$$

$$\therefore\ z = 3\tfrac{1}{2},\ y = \frac{35}{4z} = \tfrac{35}{14} = 2\tfrac{1}{2},\ x = 1\tfrac{1}{2}.$$

The secondary values $-1\frac{1}{6}$, $-7\frac{1}{2}$, $-1\frac{1}{2}$ do *not* satisfy the given system of equations.

West Norwood. HENRY T. BURGESS.

[96556.]—**Oil and Gas Engines.**—Capacity of motor cylinder to combustion chamber is about 2¾ to 1. Test by filling space swept by piston with water; which measured in suitable vessel compare with quantity combustion chamber holds. This proportion gives about 65lb. compression, for which it is usual to allow six times this pressure, when designing for strength of parts. I cannot go further into matter here. Get last edition of Clerk on gas and oil engines at nearest free library for full information. It is a very good work. MONTY.

[96557.]—**Window Cases.**—You cannot do better than send 1s. to Birkenhead, Sale, Manchester, for his little fern book, which gives exactly the information you require. J. D.

[96558.]—**Injector.**—You do not state if injector is lifting water or taking it from town main, which makes a difference. Steam pipes to supply injectors must be taken direct from boiler top, never connect with a steam-pipe used for any other purpose. I enumerate a few causes likely to prevent injector working. 1. No water, leaks in suction-pipe; strainer blocked, want of a check-valve in end of suction pipe—if a long one; air leak in valve-stem of suction-pipe valve, often unsuspected, which repack to cure; too high pressure for long lift; dirt in pipes, iron scale, &c.; a bad check-valve, not lifting enough, or not at all—all checks for injectors want more lift than for a pump to work well; valve in suction-pipe not regulated below pressure wherein can be thrown wide open; loose disc on water-supply valve, or valve put on wrong way—i.e., pressure on top causes loose disc to close automatically; wet steam, foaming boiler; water-supply too hot; air in pipe between boiler and injector—remedy, put pet-cock in a tee piece between, which open a few seconds on starting; injector jets may be limed up—to clean, soak in water to which hydrochloric acid has been added in proportion of 1 part acid to 12 water. Cut reply out and paste up near kettle, as faults and remedies are not given in standard works on injectors.

MONTY.

[96558.]—**Injector.**—We should suppose you are taking steam for injector from the pipe supplying steam to engine. If so, the remedy is obvious—viz., take it from the boiler.

WEBSTER MICHELSON AND CO.

[96559.]—**Billiard Table.**—First remove the pocket-plates, and then the cushions. To remove the cushions, take out the plugs along the front, and then unscrew the bolts exposed. Remove the old cloth by pulling out the tacks or by cutting it round underneath the table. The old tacks will not hurt being left in. See which is the right side of the new cloth, and in which direction the "nap" runs. Lay the cloth on the table so that the nap runs from the baulk end to the spot end. Place it about centrally, and then put a couple of strong tacks in at the centre of one end. Go to the other end and take a good handful of cloth, and pull hard, putting two tacks in the middle when the cloth is as tight as possible. Then go to one middle pocket, and pull moderately hard, putting a tack in on each side of the pocket. Then go to the other pocket, and pull hard, tacking again on each side. Be careful to keep the centre line of the cloth straight. Now go to each corner pocket, and pull hard, tacking on each side of the pockets. Do not mind about wrinkles over the pockets at present. Now tack the cloth down between the pockets, pulling it tight each time. The cloth will now have to be carefully coaxed over the pockets, and only patience will bring about a satisfactory result. The centre pockets especially will need great care. When the cloth is successfully stretched, the cushions and pocket-plates may be put on again, and the pockets tacked underneath. If the cushions are capable of longitudinal adjustment, care must be taken to get all the pockets of the same size. When putting on the cushions do not screw each bolt up tight as you put it in, but screw all of them up fairly tight, and then fully tighten them. Reclothing the cushions is a job beyond an amateur not practised in it, and should on no account be attempted, being sure to result in failure. H. W. A.

[96560.]—**Perspiring Hands.**—After having washed the hands, allow the tap to run on them for a few minutes. I have found this an effectual cure.

J. WIGHT.

[96561.]—**Perspiring Hands.**—Best to have a free skin, but if you elect to reduce, try washing once a day (not oftener) for about two minutes with liquor atropiæ 2 drachms, water 1 pint. The face and other parts may also be washed as often as desired with alum 1oz., glycerine 1oz., water 10oz. Powder for hands and feet:—Carbolic acid 1, burnt alum 4, starch 200, French chalk 50, oil of lemon 2. REGENT'S PARK.

[96563.]—**Belting.**—Let L = length required, D and d = diameters of pulleys, C = distance of centres, D + d = S. For a crossed belt—

$$L = \left(\frac{\pi}{2} + \theta\right) S + 2C \cdot \cos\theta$$

where— $\sin\theta = S \div 2C$.

For an open belt—

$$L = \frac{\pi}{2}(D + d) + \theta(D - d) + 2C \cdot \cos\theta$$

where— $\sin\theta = (D - d) \div 2C$.

J. WIGHT.

[96564.]—**Organ for the House.**—In my query I gave the size of bellows 48 by 24. It should be 54 by 24.—PIPE ORGAN.

[96564.]—**Organ for the House.**—I am afraid you will find your bellows too small for the instrument you propose. You cannot do better than follow the specification and instructions given a short time since in the ENGLISH MECHANIC on building a small two-manual pipe organ. Pedals (independent) could be added, acting on separate pedal organ. The organ described will give every satisfaction as a practice instrument, and considerable variety can be obtained from it. Surely your specification is wrong: only one 8ft. stop out of six?—this would never do. Or do you mean that the largest stopped wood pipe is only 4ft. on the manuals, thus giving the 8ft. tone. If you only wanted the instrument for practice purposes, one stop on each manual would be sufficient, with full compass pedals and usual couplers. If you like to advertise your address in the Address Column of "Ours," I shall be pleased to communicate with you, and advise you as to the best kind of instrument for your purpose. DIAPASON.

[96565.]—**Dynamo for Nickel-Plating.**—The plan suggested is not feasible, as there is a certain "critical speed," below which the dynamo will not excite itself. The only course open is to put a resistance in series with the shunt-coils, which, by cutting down the magnetising current, will reduce the volts to any desired extent; but, of course, no more than 8 ampères must be taken from the armature. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96565.]—**Dynamo for Nickel-Plating.**—Although it would be possible to reduce the voltage from 50v. to 6v. (that required for nickelling) by running the dynamo at a lower speed, yet it would hardly be worth while so to do, since the current in ampères would fall in like proportion, so that the available current would only be a fraction of an ampère. Your best plan would be to get a spare armature made, wound with coarse wire, so as to give about 6 volts and 40 to 50 ampères. With a properly arranged switch, you could put the F.M. coils in parallel or series at will, so that you could use the two armatures, and either light or plate at your option. S. BOTTONE.

[96565.]—**Dynamo for Nickel-Plating.**—You can do as you mention by running very slow; but you would do better by having a dynamo specially constructed for plating purposes.

WEBSTER MICHELSON AND CO.

[96566.]—**Motor Cycles.**—By all means fit your "trike" with electric ignition, and, as soon as fitted, try to understand working of same, as it is really quite simple; it gives about 25 per cent. more power than lamp, especially on hills. I have given both methods a long trial, and find there is simply no comparison. Sims' magneto-ignition would be as cheap for you to fit as usual batteries; and give far better results. Magnets are permanent, and would run about two years before requiring remagnetising. You can easily get a vacuum valve put on top of 2 to 1 gear-case cover, where you will find a boss for purpose—simply a plug of brass ½in. diameter, fine thread, into which another plug is fitted; holes drilled $\frac{1}{16}$in. diameter right through both plugs. A $\frac{1}{16}$in. cycle ball is placed between the plugs, allowing $\frac{1}{16}$in. lift. Be sure have a ⅛in. hole drilled just below small gear-wheel through crank-case, to allow oil to return; you will find one also at back of foot on valve-rod. Your engine is probably one of old 1¼H.P.; it should be worth alterations. MONTY.

[96567.]—**Dry Pile.**—I do not think you can look for luminous (which means heating) effects from the dry piles, because their resistance is so enormous that their current is infinitesimal. But it seems probable with a modification of the old dry pile in the direction of the secondary battery. This might be done by using peroxide of lead on a paper containing or coated with some of the gelatinous preparations used in the so-called dry cells, and using precipitated lead instead of the usual tin. A series of these might be charged occasionally by means of Wimshurst machine. This suggestion, of course, needs a little experiment and working out; but I think something useful might be made of it. SIGMA.

[96567.]—**Dry Pile.**—To "SIGMA" OR MR. BOTTONE.—I do not think you could get the desired effect from a dry pile; certainly not with any degree of permanence. With a pile of some 50,000 or 60,000 alternations you might get weak ⅛in. sparks, but no permanent result, except, of course, that the opposite poles will show opposite polarity for a very long time—say a year or two—if not short-circuited too frequently. Why not use a small electrophorus? This is easy to make, cheap, and quite efficient in producing the fluorescent effect. You can use red-lead instead of peroxide of manganese. S. BOTTONE.

[96568.]—**Palms.**—Use electricity for illuminating your drawing-room. Your palms will not then suffer. WEBSTER MICHELSON AND CO.

[96568.]—**Palms.**—The reason may be sought in insufficiency of light, air fouled by gas, inattention to watering, or air too dry. J. D.

[96569.]—**Phonograph for Recording Music.**—No difficulty should be experienced in taking a record with the Edison home phonograph, providing you use a large horn about 30in. long, and 15in. diameter at the mouth. This is attached to the diaphragm case by a short length of rubber tubing, and the musicians arranged in a semicircle in front of the horn. A special room is not absolutely necessary. A much louder sound can be produced by using a "Bettini" reproducer, or a "polyphone" attachment, as illustrated in last week's issue. If very loud reproductions are required, a machine having six diaphragms, and recording the music of each instrument separately, and reproducing all simultaneously, would be much better. F. F.

[96569.]—**Phonograph for Recording Music.**—Only to-day (September 1st) by a curious coincidence I saw a cripple on our Thames Embankment (Victoria) who had a small apparatus (whether Edison's or no cannot say), circular disc, wound

up by spring clockwork motion no doubt, with trumpet projection. The sound was sufficiently powerful for me to hear it 50ft. or 60ft. away. It was reproducing music-hall ditties. The same day I was in Cheapside, and saw in window at western end a stock of loud reproducing Edison's from £2 to £50, or even more, for large or small, commercial, and domestic purposes, and no doubt to be heard of at Calcutta, if not at Moulmein or Rangoon. Perhaps (if not already fitted with trumpet attachment) you could have one fitted to your machine. It may be the older pattern with ear-discs and cords attachment. REGENT'S PARK.

[96571.]—**Electro-Motor.**—To MR BOTTONE.—It will be a great advantage to replace the solid H by a laminated one. The H form is rather more efficient (powerful, with a given current) than the tripolar; but, on the other hand, the tripolar is virtually self-starting in any position when the current is turned on, which the H form is not. This refers to its work as a motor, for which it is well adapted. As a dynamo there is little difference; but the Siemens H is good for lighting and general experimental work, but *not* for electrolysis or accumulator charging, while the tripolar works well for these purposes. It will be convenient to have a sliding resistance to regulate speed if used as a motor. S. BOTTONE.

[96572.]—**Spark Coil.**—To MR. BOTTONE.—Your proportions are perfectly correct, and if the coil is well made and the secondary well insulated from the primary by a good stout ebonite tube, it will give a 1in. spark, which can be shortened to $\frac{3}{8}$in. gap, to get a good *hot* fat spark. S. BOTTONE.

[96573.]—**Steamy Windows.**—If S. Watson puts a saucer of sulphuric acid at the bottom of window, it will absorb the moisture. W. T. S.

[96573.]—**Steamy Windows.** — Glycerine is very useful as a preventive of steamy windows. Clean the glass, and polish off with glycerine. F. PRINGLE.

[96573.]—**Steamy Windows.** — Clean your windows with cloths moistened with glycerine. J. H. S.

[96575.] — **Small Dynamo.** — Construct a machine of the Lahmeyer type, after the same general lines as that illustrated in the "E.M." for May 7, 1897, making the armature 2in. in diameter by 1in. long. This should be wound as an 8-part drum, with 2oz. No. 24, and the fields with 8oz. of No. 21in. shunt. At a speed of about 1,000revs. per minute, this should develop 4v. 2A., and take 440ft.lb. per minute to drive. The idea of driving by means of a weight is not very practicable, as either a very heavy weight or a very long fall is necessary to keep the light going for any length of time. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96575.]—**Small Dynamo.**—It would seem hardly worth the trouble and expense to construct a dynamo for so very small an output as 8 watts. Probably a battery of three dry cells would be more satisfactory for such as the querist's purpose. However, in the following is given particulars of the little machine desired. Output, 2 ampères at 4 volts; armature, Siemens "H-girder" or shuttle type, laminated; size, $1\frac{3}{4}$in. long by $1\frac{1}{4}$in. diameter, with with winding spaces $\frac{3}{8}$in. by $\frac{5}{16}$in.; speed, 3,300 revolutions per minute. Wire on armature No. 22 S.W.G. silk-covered copper, 120 complete turns = $18\frac{1}{2}$ yards = 2oz. approximately. Field-magnet, overtype or undertype, wrought iron; size, 4in. high by $2\frac{3}{8}$in. wide; cores and yoke (in one piece), $\frac{3}{8}$in. thick by $1\frac{3}{4}$in. deep—i.e., in direction of armature's length. Pole-pieces bored $1\frac{5}{16}$in. diameter. Wire on fields, No. 22 S.W.G. silk-covered copper, 756 turns = 122 yards = $13\frac{1}{2}$oz. Tinplate bobbins, for field-windings, 2in. long, with sheet-brass cheeks $2\frac{1}{16}$in. by $1\frac{5}{16}$in., winding in each seven layers of 54 turns. Field-windings to be connected in shunt with the armature. Probable efficiency of the machine, about 60 per cent. Driving power required, $\frac{1}{57}$B.H.P. With regard to the proposal of employing gravity as a motor on the clock-movement system, it can be shown arithmetically that such an idea is almost practically impossible. As stated, the dynamo needs $\frac{1}{57}$B.H.P., making the work to be done $33{,}000 \times \frac{1}{57} = 579$ft.lb. per minute approximately. If the drop to be allowed for a weight is 10ft., and the motor is required to run two hours for once "winding," the rate of fall will be $\frac{10}{2 \times 60} = 0{\cdot}0833$ (&c.) ft. per minute, and, therefore, the necessary weight must be $\frac{579}{0{\cdot}0833}$ $= 6{,}950{\cdot}79$lb. But it is probable that the train of wheels required to convert the weight's motion into usable form may not have a higher efficiency than 80 per cent., if so high, so that the actual weight should be, at least, $6{,}950{\cdot}79 \times \frac{100}{80} = 8{,}688{\cdot}5$lb. (nearly). This reply may also interest your correspondent, F. D. C. Baly, letter 42715, p. 38. D. W. GAWN.

[96575.]—**Small Dynamo.**—Armature laminated, H pattern, 2in. long, 1in. diameter, wound with 18yd. No. 24 silk-covered copper wire; field-magnets, undertype, 2in. wide, $\frac{1}{2}$in. thick, 4in. high, including tunnel; winding space about 2in. on each limb, wound with seven layers No. 24 silk-covered wire (about $\frac{1}{4}$lb.) on each limb, connected in shunt with the brushes. To get good results the armature must run within $\frac{1}{32}$in. of the jaws of the F.M.'s; speed 3,000 revs. per minute; power required, $\frac{1}{20}$H.P., or, using a weight, 1,375lb., falling through 1ft. per minute. S. BOTTONE.

[96576.]—**Induction Coil.**—For working across 50ft. or 60ft., an induction coil giving $\frac{1}{4}$in. spark will be ample, if you have a good coherer and relay on the receiving instrument. Of course, you know you will require a three-ball transmitter, a key, and a Leyden jar in circuit with the coil at the transmitting end. For the coil, have a core 6in. long, $\frac{1}{2}$in. diameter, wound with $\frac{1}{4}$lb. No. 20 for the primary, a good $\frac{1}{8}$in. ebonite tube over this, and then about 6oz. No. 36 silk-covered copper wire carefully wound on in even layers, each carefully insulated from the superjacent by paraffined paper, for the secondary. Condenser, 50 sheets tinfoil, 4in. by 6in. Battery power, two pint chromic-acid cells in series. S. BOTTONE.

[96578.]—**Subterranean Topography.**—There is considerable literature dealing with caves from archæological, zoological, and palæontological aspects; but I think no comprehensive work describing their formation physiographically. General geological treatises and books by Dawkins, Buckland, Dupont, Putnam, Mitchell, Lartet, and others, furnish an introduction to the subject, which is large and full of varied interest. "Cavernology" would suffice if a name be wanting, for hybrid terms are quite fashionable. J. DORMER.

[96581.]—**Steam Whistle.**—I asked a similar query twelve months ago, to which I could get no practical answer. One thing I found was, using organ-pipe $3\frac{1}{4}$in. diameter 26in. long, $\cdot$180 boiler pressure—lip opening was not enough, causing overtone or unpleasant sound: it was $2\frac{1}{4}$in. at first, and I increased it to $2\frac{3}{4}$in., with beneficial results. Usual length of pipe is eight times the diameter; yours is proportionate. The edges or lips are improved by thinning down to a knife-edge. Should be glad to hear results of your experiments, being interested in the subject. I am afraid you will get six months if you blow such a whistle as you describe anywhere but on a boat. A great improvement is to divide pipe into three chambers of unequal length, producing first, second, and fifth notes; this gives a soft, harmonious musical chord, very penetrating. MONTY.

[96582.]—**Medical Coil.**—To MR. BOTTONE.—Your coil, from your description, is slightly constructed. But you must keep your primary entirely separate from the secondary, not run them together. The clapper is rather too far from the end of core: $\frac{1}{16}$in. would be ample. One pint bichromate cell should give a most powerful shock with this coil. Two cells in series would give a regular "knock-down." S. BOTTONE.

[96583.]—**Tips.**—Would not $\frac{1}{2}$in. lengths of tightly-fitting indiarubber tubing stopped up at the ends (if necessary) with rubber solution answer F. Newton's purpose? B. HARCOURT.

[96584.]—**Removing Rust.**—Some, or all, of these will answer purpose possibly. Soak with petroleum—roughest dark stuff, if you can get it—for several days; it eats into rust, and can be scrubbed off by a wire brush. Brush over nearly saturated solution of chloride of tin, and rest 12, 14, or more hours; clean off; brush over with strong solution of cyanide of potassium—say $\frac{1}{2}$oz. in wine-glass of water—then, with fibre or hair brush, with paste of cyanide of potassium, Castile soap, whitening, and water, to creamy consistency; proportions to be found. Sulphuric acid diluted 1, water 10; afterwards wash with hot lime, water, and dry off with sawdust if possible. Cover with sweet oil well rubbed in; 48 hours after rub with finely pulverised unslaked lime. Whichever of foregoing processes tried, and when fairly clean surface is got and enamel or paint is required, use a good maker's anti-rust; but if, in getting their list, you find they do not sell small quantities to suit you, ask for a retail customer's address most convenient where you can get supplied. REGENT'S PARK.

[96584.]—**Removing Rust.**—Best way, if ironwork is intricate, is to make portable sand-blast out of cycle brazing hearth; sand must be very dry for this. After cleaning, give two good coats of red-lead paint, after which colour as desired. MONTY.

[96585.]—**Bollee Motor.**—Piston should be at bottom of stroke—that is, right out when exhaust valve is wide open, $\frac{1}{8}$in. lift being ample, diam. of valve being about $1\frac{3}{8}$in. as near as I can remember. If not, open correctly, examine 2 to 1 gear for timing. Possibly your carburator spindle is bent, from a blow on side. This would cause float to stick, perhaps getting too much oil, or jet in same may be choked. It is a great improvement on these cars to fit a thin leather disc inside air-inlet cone, at the back of which put a very light spring. To see positions for valve, strike a circle equal in diameter to stroke of engine, cut right across both ways with angle of 60°; at points where lines cross circle will be position of piston, when engine should fire and open to exhaust—assuming engine runs at usual speed, viz., about 600; if above this speed, then 45°, though the latter angle will make it difficult to start against compression. Why not get a book of directions on this motor, which gives some useful illustrations? Price is 1s. MONTY.

[96587.]—**Speed Indicator.**—The Newark trials in 1875 seem to have been estimated by means of electrical apparatus which recorded the instants at which the experimental trains passed over contact pieces placed on rails 200ft. apart. Arrangements well carried out; and Reynolds says the system as a whole was vastly inferior to that of obtaining a continuous record of speeds by means of a speed-indicator. So I suppose "B." could not give particulars *re* those trials, as he had none to give; but, as you know, he does give much on Westinghouse inventions, same page, 188, and on apparently hydraulic speed-indicators. Whether it is "Railways and Locomotives," by Barry and Bramwell, 1882, I am not quite sure. Planimetre.—Polar P. is an instrument for measuring areas, either by actual measurement or to proportional scale, invented by Jacob Amsler, a Swiss mathematician. These are fixed and proportional. Amsler also invented the integrater, which also computes areas, and also gives static momentum and inertia of a plane surface taken in relation to any axis whatever. There is a good deal on this in "Drawing Instruments," by W. F. Stanley, and in one of Van Nostrand's scientific books (New York: 50 cents). Probably B. T. Batsford, 94, High Holborn, W.C., keeps, or could get it for you. REGENT'S PARK.

[96587.]—**Speed Indicator.** — I do not know what form of indicator was used by the North-Eastern Railway, but a very common form is one driven by a belt from one of the axles of the van, and indicating directly on a dial the speed at which the vehicle is moving. A glance at a planimeter would tell more than pages of description. Take a pair of compasses, and lay them horizontally on a sheet of paper. Hold one end fixed, and cause the other point to move along a straight line and back again. Watch the motion of the joint whilst doing this, and you will see that had there been a wheel attached to it it would have revolved a certain number of times in one direction as you went along the line, and again the same number of times the reverse way as you came back, ending exactly where it started. Now repeat the operation, but follow the outline of a rectangle (or other figure) this time, and you will find that the algebraical sum of the back and forth movements of the wheel will not now be zero. This difference bears a definite relation to the area of the figure traced by the moving point. Given mechanism for registering the sum of the wheel's revolutions and certain constants pertaining to the instrument, and you can at once calculate the area of any figure traced by the moving point. W. J. G. F.

[96590.]—**Motor Bike.**—Take my advice and don't make one; they are utter rotten. Plenty advertised far cheaper than you could buy even parts. Useless in the wet. If you want a few details, however, I may be able to give you some information. 1. Gauge for tube: use one gauge heavier all round than roadster, except where strain is most felt—viz., on front forks; these must be at least three gauges heavier, and head tube stiffened by inserting two D-shaped liners, flat to flat, half-way up, the whole well brazed together; 26in. wheels, tandem tires twice canvas lined; fabric is no good at all for motor work. You can buy sets of $\frac{3}{4}$H.P. motor parts, advertisement in this paper, which are suitable; $2\frac{3}{8}$in. diam. cylinder by $2\frac{3}{4}$in. stroke; fly-wheels must be used. Other theory seems feasible, but does not work well in practice, unless you hang a flywheel about 18in. diam. on hub. Use helical gear (spiral) if you like to transmit power, ratio six to 1. Ball bearings are not satisfactory; have seen them well tried with no apparent compensating advantages; with best make of cups, wear into a series of minute dents, and give trouble with adjustment, being slack when cold and too tight when engine warms up. Roughly speaking, with a $1\frac{1}{4}$H.P. motor, a pint of spirit will carry you nine miles—depends on weather, though; lubricating oil Price's. Two tablespoonfuls will carry you 20 miles with electric ignition, 15 with lamp. You must, however, guard against leaks. Take as a model for bike, machine described by "Derwent." You can place motor either on front or between cranks where it will not go without a wide tread; or make motor take the place of lower main tube, in which case it would be diagonal; or, for variety, place it upright over back mud-guard; right place I think is where back bridge is on machine; back frame being suitably lengthened, motor vertical "Dions" are placed thus. I am too busy to give further particulars. MONTY.

[96592.]—**Phonograph.**—"Amateur Mechanic"

should find no difficulty in constructing the Gillett phonograph, providing he has the necessary tools, and gets the thread on the main shaft cut by some experienced firm, as stated; but I should advise him to have it cut with 100 threads to the inch, instead of 80, so as to be able to reproduce from the Edison standard records. If he will advertise his address I will inform him how to make the phonograph more up-to-date. F. F.

[96594.]—**Ship's Tonnage.**—Gross expresses total cubical interior space of vessel. Net expresses the cubical space available for freight-carrying. There are several kinds:—(1) Displacement. (2) Register, gross and net. (3) Freight. (4) Builder's. (5) Yacht. (1) For war-ships. (2) For commercial purposes. (3) and (4) are different rules for carrying power. (5) is for classification of pleasure craft. Tonnage equals L × B × D × a decimal factor ÷ 100. Decimal factor for ship's sailing, ·7; steam vessels and clippers (two-decked), ·65; ditto three-decked, ·68; yachts above 60 tons, ·5; small vessels, ·45. Gross tonnage under deck equals L × B × D × decimal factor ÷ 100 decimal factor; passenger steamer's high speeds and sailing ships, ·6 to ·65; passenger and cargo steamers, ·7 to ·72; cargo steamers and oil-tank steamers, ·72 to ·8. L = inside length on upper deck from plank at bow to plank at stern; B = inside main breadth from ceiling to ceiling at timber strake. Horse-power: Nominal is commercial term used by makers to denote only size of engine, without regard to the actual power it will exert. Nominal H.P. of non-condensing engines. Rule: Multiply square of diam. of cylinder in inches by 7, and ÷ 80. Nominal H.P. of condensing engines. Rule: Multiply square of diam. of cylinder in inches by 7, and divide by 120. Actual H.P. Rule: Multiply area of cylinder in square inches by the average effective mean pressure of steam in pounds per square inch, minus 3lb. per square inch for friction, and by speed of piston in feet per minute. Product = number of foot-pounds per minute engine will raise. Divide this by 33,000, and the quotient = actual H.P. of engine. Brake H.P. is power of engine measured by friction brake or dynamometer. It equals effective H.P. or indicated H.P. minus power absorbed by its own friction. H.P. equals unit of power for driving machinery, is power required to do work at 33,000 units of work per minute, or to lift 33,000lb. 1ft. high per minute, or 550lb. at 1ft. per minute, or 55lb. at 10ft. per second. REGENT'S PARK.

[96595.]—**Foreign Books.**—Foreign booksellers like Williams and Norgate, Dulau and Co., H. Grevel and Co., O. E. Junson and Son, Putnam and Son, or even B. T. Batsford (all London) may be worth trying. REGENT'S PARK.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96205. Colouring Porcelain, p. 451.
96208. Shadow Photos of Bullets, 451.
96209. Paddle-Wheels, 451.
96210. Velocity of Descending Rope, 451.
96222. Microphone and Phonograph, 451.
96227. Homing Instinct of Pigeons, 451.
96232. Speed Indicator, &c., 452.
96240. Strange Affliction, 452.
96244. Tobacco Smoke, 452.
96245. Jointing for Steel, 452.
96246. Speed for Loco., 452.

96355. Eccentric Wheels, p. 538.
96360. Lightning Flash, 539.
96361. Force Pump, 539.
96363. Silvering, 539.
96368. Refraction of Cut Diamonds, 539.
96369. Pleating Machine, 539.
96370. Decauville Car, 539.
96373. No Dead Centre, 539.
96374. Lamp for Firing Tube of Motor, 539.
96376. Organ, 539.
96380. Blue Enamel, 539
96384. Softening Horn, 539.

GREAT BRITAIN is the largest customer of the United States for mineral oil, taking last year 242,265,563 gallons, as against 155,203,222 sent to Germany, 53,398,115 to Japan, 44,523,552 to China, and 360,431,316 to various European countries.

ACCORDING to an American contemporary, a machine-tool manufacturer in the United States is now making magnetic chucks, which are designed to do away with belting, strapping, or otherwise fastening down work by the usual methods, which require considerable time. The mechanism consists of an electro-magnet made in box form, completely inclosing an electric coil. A switch is provided to manipulate the current, which may be taken from the shop-lighting circuit, and any of the chucks can be connected in place of a lamp.

QUERIES.

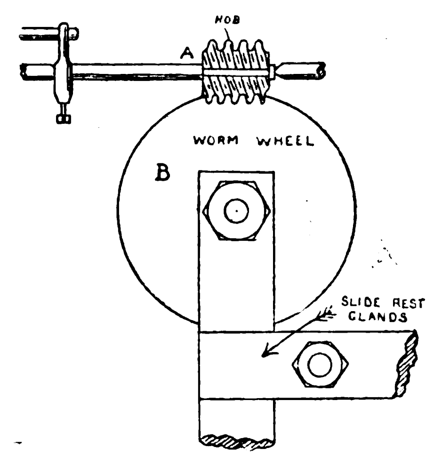
[96598.]—**Self-Sustaining Gear for Hoist.**—Will any reader kindly suggest a simple self-sustaining gear for a 6cwt. hoist? The hoist is belt-driven and lowers by its own weight, but has a tendency to run away down when weight is put on, unless someone is holding on brake at bottom.—C. C.

[96599.]—**Cutting by Circular Saws.**—In the shop in which I am employed we have two circular saws for cutting girders, &c. Both of these run so as to cut upwards on the work. While some of the men say this is the correct way, others say that they should cut downwards on the work. Perhaps some of your correspondents could say which is correct.—APPRENTICE.

[96600.]—**Astronomical Signs.**—Will anyone tell me where the symbols of the signs of the Zodiac and the symbols that are used for the planets first originated?—F. C. LAMBERT.

[96601.]—**Telescope.**—I live near the seashore—indeed, almost at sea-level. Nevertheless, without climbing a hill at all, I can see land across the sea quite distinctly on a clear evening without the aid of a glass of any kind. Those hills I see are, I know, 60 to 70 miles distant, and what I would like to be told is the number and probable cost of lenses required to make a telescope which would show a house or like object on those hills as distinctly as one can see a house a mile distant with the naked eye.—J. SMITH.

[96602.]—**Cutting a Wormwheel.**—May I trouble my fellow-turners for some help on the following? I had a wormwheel to cut 50 teeth ¼in. pitch. I calculated diameter of pitch circle, which came to 3·98. Then I added height of tooth each side of P. circle, which brought outside diameter to 4·14in. The way it was to be done



was with a hob driven between centres of lathe as shown (A). The wheel was to revolve on a bar fastened in slide-rest, as shown (B). While hob revolved the wheel was worked gradually in. After a few revolutions we counted the teeth, which turned out to be 57. Also the teeth were being cut away altogether. Can the wheels be done in this manner? I can't see how, although they have been done, I am told. My difficulty is: Suppose the worm was calculated to give 50 teeth on P. line. The hob was started on outside diameter of wheel, therefore there must be over 50 teeth owing to increased diameter, 2 by ·3 P., which is twice the height of tooth outside P. circle diam. Now, as the hob was worked into the bottom of teeth the diameter got less than P. circle; therefore the number of teeth would be less, which would be impossible. I should like a little help out of the difficulty. Is there any fault with hob if they are done this way?—TURNER.

[96603.]—**Gas Blowpipe.**—Will any reader kindly give sketch with dimensions of a powerful gas blowpipe, suitable for brazing, &c.? Any hints on making will oblige.—GAS.

[96604.]—**Transformer.**—I thank correspondents for information on charging accumulators, and would now like to know whether the current from the dynamo (6v., 50amp.) could be adapted by means of a transformer to light a few 20v. 16c.p. lamps. If so, please give data for constructing transformer.—E. A. W.

[96605.]—**Gas Pressure.**—Will some reader kindly explain simple rule for working out the following? Suppose a cylinder having a capacity of 5c.ft. with a pressure of 100lb. to square inch should burst, say, inside another having 20c.ft. capacity, what pressure should I have in the larger cylinder?—GAS PRESSURE.

[96606.]—**Defective Battery.**—I have bought a wet battery with porous and zinc in it. I have also a bell, but have not connected it as yet. I have connected wire on to hook on zinc, and one on to terminal on top of porous, and also connected a separate wire to both of them, and held them, and touched one and both with tip of tongue, but can't get a least bit of current. There are two small holes on top of porous one, with a little plug on, and the other nothing but the small hole in it. I should be extremely glad if any readers of ENGLISH MECHANIC would give me some information about it, and whether it is the fault of battery. Perhaps I have connected the wires wrong?—W. H. M.

[96607.]—**Mummy Wheat.**—As the story concerning the germination of wheat from ancient Egyptian sepulchres has again turned up (see p. 59), one would like to know whether any proof of this has recently been obtained. De Candolle observes: "No grain taken from an ancient Egyptian sarcophagus and sown by horticulturists has ever been known to germinate," and mentions that even American maize is palmed off on suspecting tourists as grain from the tombs.—J. DORMER.

[96608.]—**Electric Clock.**—I have, as an amateur, constructed an electric clock, and although the clock itself goes and keeps time admirably, I have been unable up to the present to find a suitable battery that will supply current for a sufficient period of time. The best results up to now have been from a Fuller battery, which succeeded for a month only, and then gave out. It is a pendulum clock, and has only three contacts per minute, each only a fraction of a second in duration. Do you think a battery of Leclanché cells (say six) would be sufficiently lasting? Or what would you advise? It takes about six volts to drive it.—E. A. LESLIE.

[96609.]—**Ether.**—Can any reader give me references to articles or publications dealing with the most recent experiments in ether waves, and the apparatus used?—CURIOUS.

[96610.]—**Motor Roller.**—Would any of "ours" kindly say what would be the probable cost of a set of accumulators, giving dimensions, &c., to work a 3H.P. electric motor, intended to propel a 30cwt. roller for a cricket green? Any information with regard to any special type of motor, and cost of same, also of battery, would last for an eight-hours' run at a time, will oblige. I prefer an electric motor, as we have every facility for charging cells.—IDEAL.

[96611.]—**To Mr. Bottone.**—Would Mr. Bottone greatly oblige by informing me what quantity and size of wire I would require to wind a voltmeter to register ten volts?—VOLTMETER.

[96612.]—**Silver Wash.**—Can some readers instruct me in the making of silver washes?—J. M. W.

[96613.]—**Motor Waggon.**—Can someone kindly say the power of oil-motor required to propel nearly one ton at walking pace? And what make might be recommended for cheapness and durability?—C.

[96614.]—**Charging Pocket Accumulator with Small Dynamo.**—I have a small pocket accumulator, and also a 15c.p. dynamo, with H armature. I don't know the ampèrage or voltage; but it is wound with B.W.G. 24 wire. Can I charge the accumulator with this? And if so, how?—CARLIOL.

[96615.]—**Brown Boot Polish.**—In the reply by "Regent's Park" on p. 44 to question 96427 on p. 584 he mentions a chemical called phosphin, which I have not been able to get at some of the largest chemists in Manchester, as they do not know it. I should be much obliged if someone could give me a recipe for a good brown boot polish.—STELLA.

[96616.]—**To Mr. Bottone.**—I have a small motor (or dynamo), with an armature (plain drum), 1¾in. outside when wound by 1¾in. long, laminated, commutator four segments. The iron of field-magnets is ⅜in. thick, cast, and winding space 1¾in. by 1¼in. by ¾in. deep. I have wound fields with five layers of No. 18 B.W.G. I intend making a series motor of it; but want to know what wire to use for armature, which is 1in. before winding. (2) Could you oblige me with a table of copper wires from 10 to 30 B.W.G., giving resistances per 100 yards, and weights of ditto also if possible, areas of wires and turns per inch? (3) What is a three-phase current?—H. Æ. S.

[96617.]—**Telephone.**—I shall be greatly obliged if anyone can tell me the best arrangement for following purpose. I wish to fit up a table telephone for use of a partially deaf person, and have a Hunning's cone transmitter (with carbon grain) and a double-pole watch receiver. The line will only be four yards of wire; but I want to get the maximum sound from the receiver under these conditions. If a secondary circuit is necessary for the purpose, please say gauge and lengths of wire suitable.—C. ROBERTS.

[96618.]—**Reducing Temperature.**—What ought I to do for the above? Size of room 12ft. by 9ft. by 8ft. high? Average heat this summer 65° Fahr. Wish to keep it to 50° Fahr. Window is blocked up; moisture no object.—F. S.

[96619.]—**Electric Organ.**—I have a two-manual American organ, and also a small pipe organ, and I wish to connect them by electricity, so that by depressing the keys of the American organ, the corresponding ones of the pipe organ will also be depressed. How can this be done? If this is not practical, could I, by an electric arrangement, add a few pipe stops to the American organ? If so, how could I obtain instructions? Is there any work published dealing with electric-organ building?—J. S. Z.

[96620.]—**Acids for Etching and Engraving.**—Will any reader kindly tell me the acid and chemicals, &c., for eating into by etching or engraving deeply into the following metals: steel (knives, scissors, &c.), brass (articles and letter-plates), nickel goods, as money-boxes, &c.? I have used nitric acid, but with very variable and uncertain success. While it acts on brass deeply, it only faintly touches steel and nickel, and not deeply, as I require, and gets underneath the beeswax and effervesces it, causing a black blotch, thus spoiling the article. I suppose the heat of the acid melts the wax? I should like acid to eat into the above metals without discolouring the lettering; also in each metal to burn the lettering a chemical black or other colouring that shows up well and neatly. What tools do I require for ordinary writing and for small block lettering?—ETCHING ACID.

[96621.]—**Warts.**—Would some reader please tell me of a way to cure warts? I have unsuccessfully tried nitric acid, acetic acid, lunar caustic, &c. What is the cause of them? I have got a lot, and some more are coming.—CICERO.

[96622.]—**Motor-Cycle.**—Will the writer of the articles now appearing kindly give sizes and quantities of wire for the induction-coil?—W. A. J.

[96623.]—**Steamer.**—*Empress Queen*, paddle, plying between Liverpool and Douglas. Please give horse-power, tonnage, speed, and passenger capacity of above?—A. G.

[96624.]—**Etching or Engraving Ground.**—Will any correspondent kindly tell me the best, most reliable, and durable etching or engraving ground to use for etching or engraving names, monograms, mottoes, quotations, &c., on metal articles, such as knife blades, scissors and on brass and cheap nickel goods, such

nickel money-boxes, &c.? Some ground superior to beeswax, and that does not tear, chip, or flake when using the etching needle, &c., and that will withstand the acid. As an amateur I have tried beeswax by heating the metal and rubbing on the wax, but find it unreliable; the plate of wax after etching is easily damaged by touch or contact, and when applying the acid (nitric) the acid somehow causes the wax to effervesce and gets underneath it, and burns only a black blotch, spoiling the article. Have only got a burnt blotch on no end of articles after hours and hours of most tedious scratching with a needle much words and lettering.—ETCHING GROUND.

[96625.]—**Brass Coating for Iron Wire.**—I would like to know how to put a brass coating on to iron wire the same way as they coat copper wire. I do not want a lacquer, nor to be run through melted brass. It will have to be run through a liquid, but I should like something to take the place of copperas to throw a brass colour on it.—S. BATEMAN.

[96626.]—**Steamer's Tonnage.**—Please explain terms, net tonnage, gross tonnage, tons, burdens, and displacement. How is it taken, and how much of the ship taken into account? Steamer is said to be 500 horse nominal and 3,000 effective. How is this worked on, and what do steamers work on for the East, say?—ALGOODE.

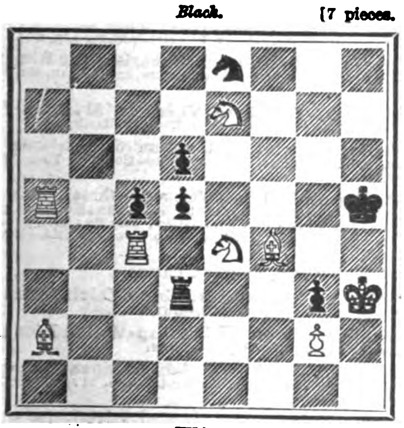
[96627.]—**Foreign Currency.**—As I expect to go to South America, please explain the working, &c., of exchange, for I see Rio is 7d. and Buenos Ayres 120. If I send out £200 and remit home, which I presume must be in dollars, 200 dollars (pesos) from Buenos Ayres and 10,000 reis ex Rio. Kindly explain working of exchange, as I should like to know before I go.—ALGOODE.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1691.—By C. A. GILBERG.

Black. [7 pieces.



White. [8 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Sept. 18.*)

Solution of PROBLEM No. 1689.—By H. VON DUBEN.

Key-move, P-R 4.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1689.—Correct solution has been received from A. Tupman, Quizco, Hampstead Heathen, Rev. Dr. Quilter, T. Clark, Richard Inwards, F. B. (Oldham).

No. 1688.—In reference to this really clever problem, Hampstead Heathen wrote last week: "It was hours before that key-move struck me." Whin Hurst, on the other hand, writes: "She (the Oracle) guessed the puzzler in a few minutes." A. T. writes: "Cannot find any solution, and, being away from home, have only just received the next number, in which I expected to find some correction. Shall await next issue with interest."

Gilding of Glass or Porcelain.—To gild glass or porcelain, instead of the ordinary mixture, a solution of gold chloride in oil of turpentine or lavender oil, to which a little bismuth nitrate and chrome soap have been added, is employed. The following mixture is said to give good results:—Lavender oil, 900 grammes; gold chloride, 100 grammes; bismuth sub-nitrate, 5 grammes; chrome soap, 50 grammes. After the application allow the mass to dry, and bake the articles in the muffle furnace. The gilt portions show a nice gloss, without any subsequent treatment.—*Neueste Erfindungen und Erfahrungen.*

Magnesium Flashlights.—A possibly useful addition to the data governing the composition of these mixtures may be found in a paper recently read before the Paris Academy of Sciences by M. H. le Chatelier, who finds a greater certainty of combustion in mixtures of the nitrate of ammonia class by making a special crystal from a solution containing potassium chlorate and ammonium nitrate. By modifying the temperature of the solution and the proportions of the ingredients, he was able to produce a crystal of definite and constant proportions; it contained five per cent. of the chlorate.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 6, and unacknowledged elsewhere:—

A. DRYSDALE.—J. M. W., Trin. Coll. Oxon.—J. Hope.—Eric.—W. H.—Sufferer.—Perplexed.—R. S. Edwards.—Rewobole.—Metal Turner.—Sawrey.—Mousetrap.—Quex.—G. F. C.—Searle.—Erin.—W. G. Black.

A. DRYSDALE.—We cannot tell you. Probably the editor replied in the paper or inserted your query. It is, as a rule, utterly impossible for editors to reply privately to non-readers of their papers.

CHAS. TURNER.—We cannot undertake to advise as to infringement of patents.

WATTY.—You can add some coal-oil to it, which will keep it "sticky" for a long time.

A READER.—Must go through a course of instruction in an assayer's laboratory; no other way, unless sufficient information can be picked up at one of the technical schools where practical work is possible. Read up the manuals on the subject.

THOMOND.—It is simply ground up with water; but a liquid Indian ink is sold at all the shops which sell artists' materials.

W. T. W.—Mr. Robertson's articles on the "Practical Construction of the Organ" commenced in No. 1597, and concluded in No. 1664. They were published in a revised form by Sampson, Low, Marston, and Co., in a volume of text and another of plates.

J. T.—Please see Hints to Correspondents, No. 4.

F. C. LAMBERT.—From any bookseller, if you mention the chart required. Proctor's Star Atlas (Longmans) may suit, or that by Peck, "The Constellations and How to Find Them," published by Archibald and Peck, Edinburgh; or "The Observer's Atlas of the Heavens," by William Peck, published by Gall and Inglis, Paternoster-square, London, E.C.

J. SMITH.—You should procure some field-glasses on trial, or if you wish to make a telescope suitable you should refer to the indices. If from the sea-level you can see the "horizon" 70 miles distant, you do not want a telescope. What is the height of the hills you can see? Many directions for making terrestrial telescopes have been published. We think Lancaster and Son, Birmingham, publish a cheap pamphlet on How to Make a Telescope. Many of the back numbers are out of print, so the query is inserted—modified.

H. PAYNE.—Unvulcanised rubber means the pure rubber, which can be dissolved in chloroform, sulphuric ether, mineral naphtha, &c.; but "curing" means mixing it with sulphur or a preparation of sulphur—sometimes sulphide of antimony. For nursing bottles the rubber should be as pure as possible. See the indices under Indiarubber, Caoutchouc, &c. The rubber should be dissolved by some agent which will evaporate and leave it practically pure after the solvent has evaporated. The best solvent, from the commercial point of view, is caoutchoucin.

N. D. P.—See back volumes for picture-frame making and cutting mounts. The frames are worked up in a mitring box, and the joints are glued and nailed. A series of articles on Picture-frame Making commenced in No. 1739 and concluded in No. 1744.

BORLASE.—There are several recipes in back volumes; but the usual method is to make the tinplate hot and brush it over with a solution of hydrochloric acid, then cooling quickly.

WM. H. O'BRIEN.—It is not easy to get into an electrical engineering works as an improver, for most employers require a premium. If you can see Southam's "Electrical Engineering as a Profession and How to Enter It," published by Whittaker and Co., you will find much useful information.

WILLIAM MORRIS.—Probably it would be "something new to the scientific world," but we cannot form an opinion until we have some data. Apparently it is a general cosmic law, but it is not quite clear what is meant.

A SUBSCRIBER'S SON.—If you mean a pharmaceutical chemist, apply to the secretary of the Pharmaceutical Society for information about the examinations. If you mean "chemist" in the proper meaning of the term, you must study at one of the schools, and, as a preliminary, pass the examinations of the Science and Art Department.

J. H.—If you are thinking of going in for the Whitworth Scholarship, better procure the special manual, which can be had from "all booksellers," or from John Heywood, Manchester; or from Eyre and Spottiswoode, East Harding-street, E.C. It is No. 455, "Prospectus of the Whitworth Scholarships," &c., post free 7d., and is the official publication.

OLD SUB.—It is a matter of personal taste. Some people mount them with a glass front, and do not use any frame.

SUPERFLUOUS.—We simply meant that all available information had been given—many times. There is really *no* permanent cure for superfluous hair but electrolysis. The ordinary depilatories depend more or less on lime or other similar ingredients, the effect of which is temporary and mostly injurious. The best remedy is shaving.

H. WOOTTON.—There has been a great deal of matter about compensation of watches, &c., in the back volumes; but if you cannot see them, you could call in at the Horological Institute, Northampton-square, E.C. (a short walk for you), and no doubt the authorities would allow you to see their library.

W. S. W.—We utterly fail to understand your question or sketch. What machine is it, and what do you mean by the "force"? If you will explain yourself, and conform to our rules by sending a comprehensible sketch on a separate paper, we will see if we can make it out, or if some of our readers can.

IN TYPE.—C. P. Pilgrim.

AN armour test was recently made at the Indian Head (U.S.A.) proving grounds of a 5½in. plate, representing 700 tons of the casemate and belt armour of the battleship Alabama. Two 6in. projectiles failed to pierce the plate, the greatest depression being 3½in., and there were no cracks.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 15, 1899.

MOTOR CYCLES.—XVII.

HAVING described the construction of both motor and tricycle, a chapter on its use and how to remedy breakdowns will be acceptable. Before proceeding with this, I may inform my readers that, in response to inquiries, I have made arrangements whereby they can obtain all the necessary castings and forgings without the trouble and expense of pattern-making. The Inflexible Works Co., of Wolverhampton, have made the patterns under my supervision, and can supply castings promptly.

Before attempting to use the motor-tricycle, I would advise learning to steer an ordinary tricycle. Riders of safety bicycles will find less difficulty than non-cyclists, though even to them the steering will come awkward at first. Having fully mastered this matter, the first thing will be to see that the petrol tank is filled. The spirit used should not exceed ·680° specific gravity, to test which a densimeter is indispensable. These can be obtained for a few shillings from most any dealer in motor-cycles. Next make sure the accumulator is well charged, and all connections clean and secure. There should be two cells in series in the accumulator, these giving 4 volts on the average. When these points are satisfactorily arranged, go all round the machine and make sure that all nuts are tight and every part lubricated. Sufficient of the best gas-engine oil must be poured into the crank-case to allow the crank-discs to dip into it to a depth of about ½in. or ¾in. Next open the compression cock, and squirt into the cylinder a few drops of paraffin to free the rings from any oil which has gummed. This should be done every time a start is made, if the machine has been standing above an hour or so, and also on putting the machine away for the night. Now put the plug into the plug-switch on the underside of top tube, and mount into the saddle. The float and carburetter being charged with spirit to the correct depth, turn on the handle-bar switch and pedal the machine smartly forward. The proper position for the air and gas levers for starting will be found by experiment. As a guide for the commencement, I should shut off all the air, leaving the gas full open. See that the sparking gear is in such a position that the spark takes place when the piston is at the top of the compression stroke, or even slightly later. If, after pedalling a few revolutions, no firing of the charge takes place in the cylinder, gradually modify the mixture of air and gas until the motor fires once or twice, when the compression-cock should be suddenly shut. Now the motor should run evenly; but if not, move the sparking-gear lever gradually backwards till it fires evenly and without any knock in the motor, helping by pedalling if required. Any knock in the engine indicates that the sparking takes place too early, driving the piston and connecting-rod down while the crank-pin is still on the up-stroke. This, besides straining the various parts, is liable to stop the engine entirely. To obtain the maximum power the mixture, must be regulated as well as the ignition. When the motor is running at its highest speed, which may reach to over two thousand revolutions per minute, the passage of the spark across the platinum points of the ignition plug takes place during the compression stroke, though the complete ignition of the charge is much later. The reason for this is that the air and gas mixture takes an appreciable time to become thoroughly ignited and to reach its maximum pressure. Now, while this burning of the charge is proceeding, the piston is travelling very rapidly; hence to insure the greatest pressure being reached at the top of the stroke, we must commence to fire the charge while the piston is still travelling upwards. The faster the speed of engine, the earlier must contact be made. On the other hand, if we advance the sparking, the motor will increase its speed up to a certain point, depending on the resistance it has to overcome. If the motor is *fully* loaded and the sparking be advanced, it is ten to one it will stop, since its speed cannot increase. Therefore, when ascending hills the "advance," or "lead," of the spark must be decreased according to the speed of the engine. With a little practice, it is astonishing what a variety of speeds can be obtained by the proper manipulation of the ignition gear. With tube ignition the motor can only fire correctly at one definite speed, any variation of which results in either miss- or back-fires.

To stop, one or both brakes should be applied, and the handle-bar switch turned off at the same time. Unless it is required to stop very suddenly, apply the band-brake on the back axle only, and that not too quickly. In emergencies only should both brakes be used. Even if the switch be not turned off, the brakes will still stop the machine. To descend a long hill, if fairly steep, I usually content myself by cutting off the current by means of the switch, and rely on the compression of the motor to check the speed. Should it become excessive, the brakes can be used in addition. When you have stopped, if you leave the machine, *take the plug out of the switch and pocket it*, then if any one, with sufficient knowledge to do so, tries to play a practical joke by running the battery down, the laugh will be all on your side.

Breakdowns and Remedies.

In spite of the most careful attention, motors, in common with all other kinds of machinery, are liable to temporary derangement. I will endeavour to point out the most likely of these, and suggest their remedies.

When the motor is new, a certain amount of metal is worn off the working faces, which mixes with the oil in crank-case and causes further wear to take place. Therefore, for the first few days, the lubricant in the crank-case should be changed every twenty or thirty miles. After about three or four hundred miles have been run, it will suffice to change this oil every fifty miles. But however well the moving parts have worn to place, fifty miles should be the maximum run with one charge of lubricant. If the cylinder head is not well cleared of particles of core sand, trouble may ensue from these particles getting into the bearings, or between the piston and cylinder, where they will cut like a file. Too much oil in the crank chamber results both in smoke and smell from the exhaust, caused by the excess of oil burning.

Many breakdowns can be traced to loose nuts and bolts or defective connections in the electric currents. Other causes are defects in (1) the accumulator, (2) the wiring, (3) contacts on motor, (4) the sparking plug, (5) the spirit. I have placed these in the order of their probability. Taking them in the above order, the accumulators should be tested both with volt and ampère meters. The former should never register lower than 1·9 volt per cell. When this is reached they require recharging. When newly charged, the ampère meter should show from five to six ampères. Two and a half or three ampères will give a spark of sufficient heat; but when the current reaches this low point the cells should be recharged, failing which only very short rides should be taken. The wiring is easily repaired, should the circuits be broken anywhere, and calls for no special remarks. The contacts of the ignition gear on the motor will require looking to occasionally to make sure they are screwed up tightly, and that the cam really makes metallic contact with both springs. In the sparking plug is an insulating tube of porcelain. This sometimes gets cracked, in which case either the insulation breaks down, or the compression of the motor is lost. A simple and at the same time effective test for this is to use a mixture of soap and water, smearing a little over the plug, when on turning the motor bubbles will be caused if there is any leakage. When on the road this would not be convenient; therefore, put in a new plug—a spare one should always be carried. It may happen in damp or cold weather that the spirit will not vaporise. In this case it will generally be found that the petrol in use has a greater density than ·680°. Remedy: Use fresh spirit. In testing the density of the spirit due allowance should be made for temperature. In hot weather spirit of ·700° density can be used; in cold ·680° should not be exceeded. These densities are taken at 15° centigrade. Each degree in temperature makes a difference of 0·8° in the density of the spirit. Another important point is that fresh spirit will not *mix* with old. It will float on the top. It will be found that after running a little while the vibration of the machine will shake up the petrol, and cause more gas to be given off. The mixture will then be too rich, hence it will be necessary to open the air-holes in the mixture-cock.

To test the contact-breaker on motor, proceed thus: Take off the ignition-gear cover, and, having removed the wire from the insulated terminal of the sparking plug, turn on the handle-bar switch, and put in the plug of plug-switch. With one hand bring the end of the wire taken from sparking plug to within about ⅟₁₆in. of any metal part of the motor; with the other hand press the two contact springs down on to the cam. At each contact a stream of good "fat" sparks should spring across from wire to motor. If no spark results, either the contacts are dirty or the circuit is broken somewhere. In either case the remedy is obvious. Should the spark be short and "thin," look to the charging of the battery. While making the above test take care not to hold the bare wire, but the insulation. Neglect of this precaution will give a nasty shock. It may be that the vibrating contact-breaker on the coil is at fault. This should be adjusted till a good hot spark is produced. See that the platinum contacts on the vibrating contact-breaker on coil are kept clean and free from roughness.

Take out the plug and see if a spark is produced across its points when the secondary of the coil is coupled up, one wire to the insulated terminal, the other to the metal body of plug. If the porcelain is cracked or loose, use a new plug. The sparking points on plug may be either too far apart or too close. They should be about one millimètre apart. The porcelain insulator should be clean and free from soot, as this may cause sufficient short circuiting to prevent a good spark being obtained. If the wiring is all perfect, the batteries well charged, the sparking plug and contacts in good order, and the contact-breaker on valve gear sleeve all right, the fault is most likely in the handle-bar switch. To test this, remove a part of the insulation from the wires which lead to the handle-bar switch, bridge them across with a piece of wire, and again press the contact-springs on to the cam. If the spark is produced, the machine can still be ridden by using the brakes for stopping, and the plug switch for cutting off the current. In the event of all the petrol being used up, and no more obtainable, common benzine may be tried; but I am not certain that it will work with the form of carburetter described—in fact, it is very doubtful.

Breakdowns caused through breakage of

any part are outside the province of these articles; but if the mishap is to the motor, its transmission gear, or the carburetter, the driving pinion can be removed and the machine pedalled along as an ordinary tricycle, though, of course, much heavier.

To summarise the foregoing. To start, charge the battery, fill the petrol tank, and see that the float and carburetter get their supply. Mount, open the compression cock, put in plug of switch, turn on handle-bar switch, put sparking gear in position, pedal forward, and close compression cock after first two or three explosions. To stop, switch off current, and put on one or both brakes.

It is proposed to supplement these articles with a description of a detachable fore-carriage, which will convert the single tricycle into a tandem quadricycle at will.

ERRATUM:—In Fig. 55, the thickness of the boss for brake fulcrum-pin is given as $\frac{1}{2}$in. each side of centre. It should be $\frac{1}{2}$in. on the side adjacent to brake-drum, $\frac{1}{4}$in. on the other.

MILLWRIGHT'S WORK.—IX.

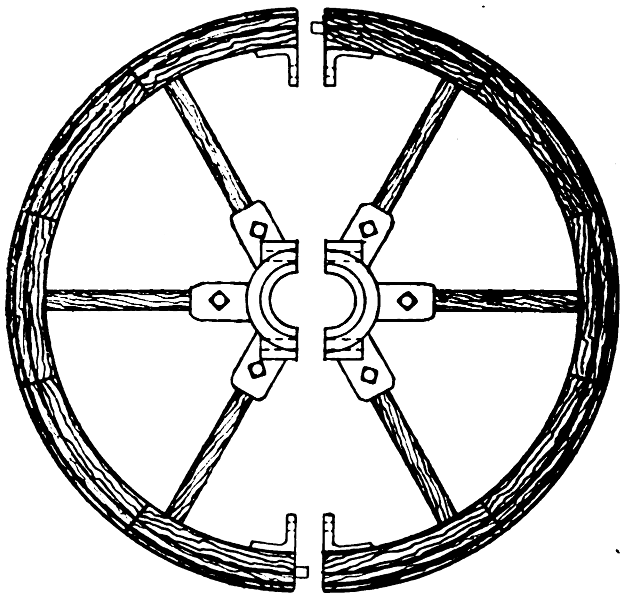


FIG. 57.

THE fast and loose pulleys used on counter-shafts have given occasion for a great variety in design. These are generally of cast iron. The pulleys shown in Fig. 52, by the Chain Belt Engineering Co., of Derby, are of a composite character, the idea being to combine lightness with rigidity. The arms and boss are of cast iron. The ends of the arms are expanded

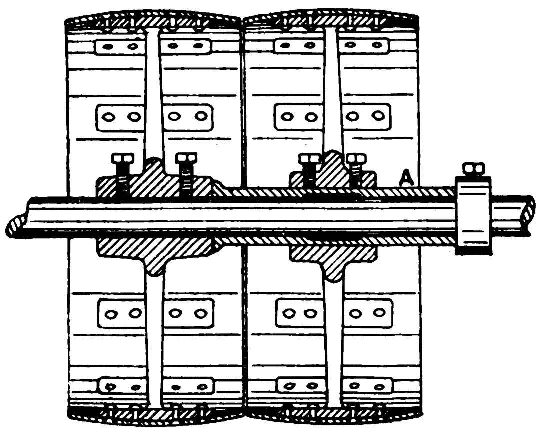


FIG. 52.

to form flanges, to which the wrought-iron rim is riveted. The figure also shows the method adopted in the fitting of fast and loose pulleys when over 30in. diameter. The latter is bored to receive an exceptionally long sleeve, A, which reduces the friction per unit on the shaft, and in

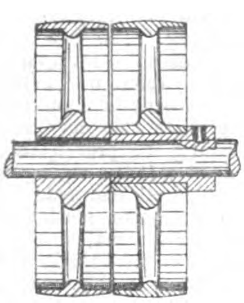


FIG. 53.

the bore, and prolongs its life. When worn too, it can be readily replaced, without throwing away the pulley.

The practise of bushing the loose pulley in some way to prevent wear on the shaft is now common, though only adopted in recent years. Fig. 53 illustrates a simple method, the bush being fitted with a collar with a flush set-screw, so serving the double purpose of bush and loose collar.

Fig. 54 shows the loose pulley of Trier Bros. A is a gunmetal bush in halves, which fits the shaft, and is bored to suit the pulley. It is gripped in place by a patent split collar B, which thus serves a double purpose.

Smith and Grace make a loose pulley with a self-oiling bush, Figs. 55 and 56. It consists of a cylinder, flanged at the ends to fit the bore of the pulley tightly. The oil is contained within the flanges, and runs through perforations in the bush on to the shaft. When the pulley is at rest the oil lies on the bottom of the chamber. It requires to be changed once only in several months, through the boss.

Few, in the absence of experience, would have thought timber a suitable material for pulleys; yet pulleys of this class, when of moderate dimensions, have grown in favour, and are used to a very large extent. They are constructed by the pattern-maker's method of building up of segments, well glued and nailed. Maple is the material used—a hard, close-grained wood, the surface of which takes a high polish. There is little risk of the pulleys going out of truth to an extent which would seriously impair their efficiency, while their lightness is a distinct recommendation, insomuch as they diminish the strain on shafts and bearings by comparison with pulleys constructed of iron.

Different methods of constructing and fitting wood pulleys are made use of. In the smaller sizes they are solid—that is, they are built up in solid bodies without arms, the smallest consisting of two halves united with screws and nuts. The nuts are imbedded in, and secured with brimstone, and the screws are turned in by their slotted heads. The joint-faces of the halves are made with irregular waved faces, in order to interlock with one another, and prevent overlapping of the edges. Another solid pulley is bolted in halves, and the heads of the bolts are incased by blocks screwed above them, giving a flush face for the driving-belt. In another type the rim is built in concentric segments, but the pulley is plated with a central web of wood, flanked with an iron centre boss, key grooved, and fitted with a set-screw. This is used for high-speed driving, such as that of dynamos, the

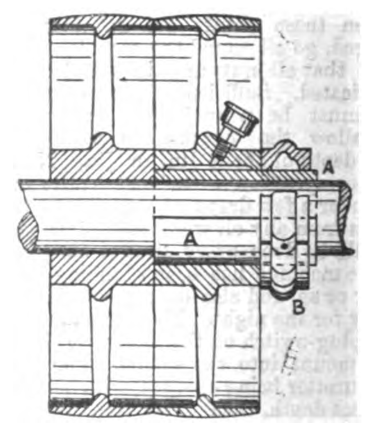


FIG. 54.

solid plate offering no resistance to the air, as arms would do. The largest class of pulley is made with straight arms, which abut at the boss, and are let into the rim, glued, and keyed. The boss is fitted with a divided iron centre, turned, bored, and key-seated. The two halves of the

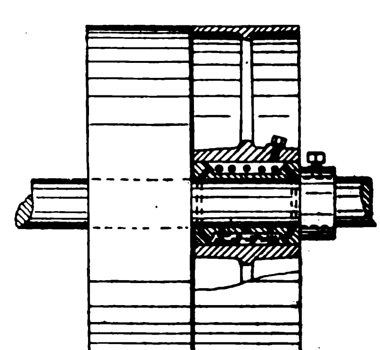


FIG. 55.

pulley are clamped with clips within the rim, and with plates next the boss. All these pulleys are fitted with bushings of wood.

The system of bushing pulleys is adopted in the case of wood pulleys. The Jones Foundry and Machine Co., of Chicago, bore all their pulleys to two sizes only; all below 24in. in diameter are bored for a 3in. shaft, all over

24in. to 3½in. Bushings of wood are then supplied to suit any or all sizes of shafts. These bushings are clamped by the tightening of the bolts next the pulley-boss. They are made of hard wood in the following way: First the stuff is dried in air, then bored approximately, removing the bulk of the material, and the stuff dried thoroughly in a kiln; then each bush is counterbored to size of shaft, put on a mandrel, and turned to fit the pulley-bore, then cut longitudinally in halves.

Caldwell and Son, of Chicago, make composite pulleys with interchangeable iron bushings, Fig. 57. The rims and arms are of wood, the arms being of circular section; the bosses are of iron, socketed to receive the arms, secured with set-screws. All these pulleys are split, dispensing with keys.

The methods by which pulleys are secured to their shafts are more varied than formerly. The time-honoured method of keying by driving a taper key in a cast-iron boss is not the best

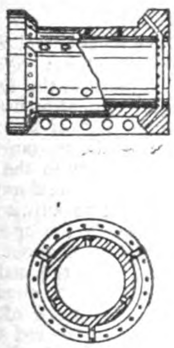


FIG. 56.

possible. It has been responsible for the splitting of many pulley bosses, and it requires a key-groove in the shaft at least twice the length of the key. Keys are expensive to fit; but there is no other method in the case of a large solid cast-iron pulleys. The smaller pulleys are held with set-screws, and also with saddle keys; but these are not suitable for large pulleys.

Large split pulleys grip the shaft by the tightening up of the boss bolts, and this is sufficient for those of moderate dimensions. In the case of those of larger size, sunk feather keys are better than taper ones. They require no special fitting, and the key-groove is only as long as the key itself.

Pulleys of small diameters are often fixed with a set-screw instead of with a key. Some firms supply an interchangeable series in which the same pulley can be used as fast or loose—the fast with a set-screw, the second with a lubricator. They are exactly alike in all respects, and the arrangement is suitable for sizes up to 24in. diameter.

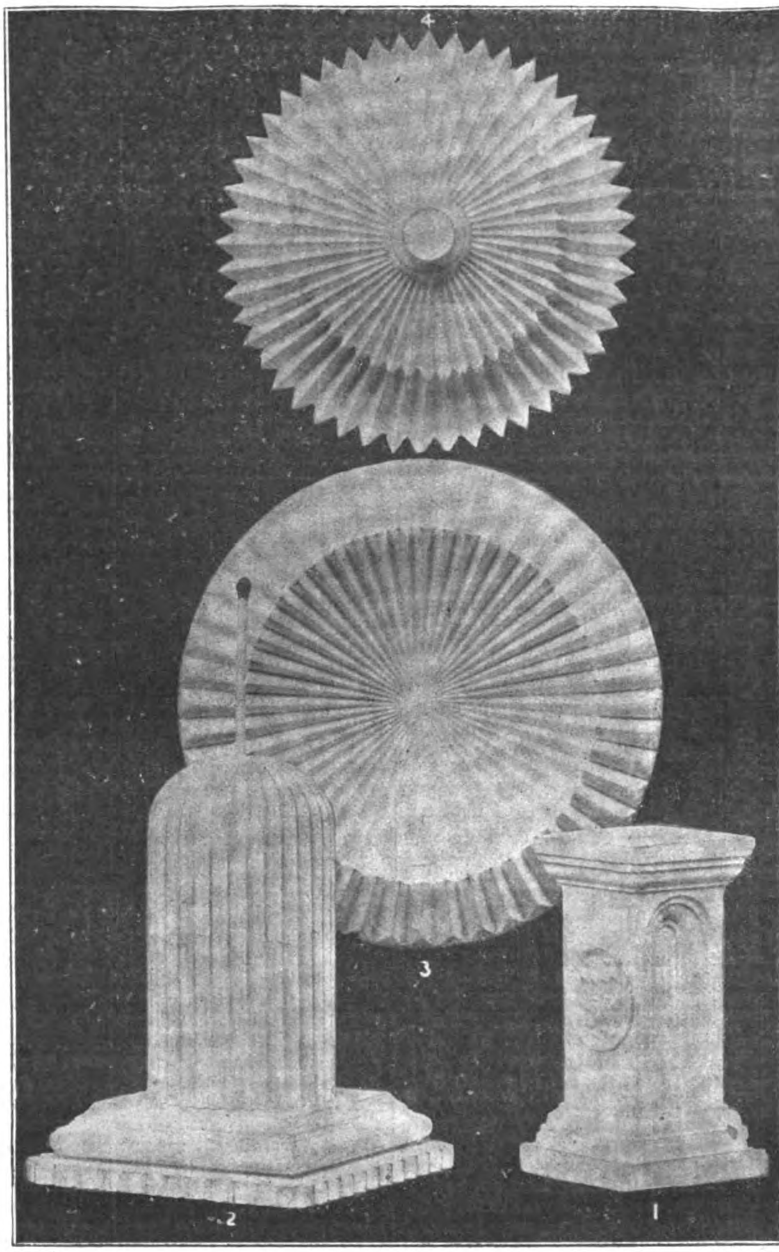
J. H.

ORNAMENTAL TURNING.—XXVII.

By J. H. EVANS.

IN pursuance of studies of the capabilities of the dome or spherical chuck, which in my last I treated as far as necessary what I may term the primary stages of its manipulation—upon again reading through the matter, I find I can yet give a few more useful hints; but as I was going well within the limits of space I generally occupy, I thought it well to shut off steam at that point. The subject, however, is, I may say, an exhaustive one, and I hope deserving of all that can be said as to its merits, and that which may lead to its further development.

My last details were applicable to the chuck when used for the shaping and decorating of polygonal figures, and upon the accuracy in the formation of such solid forms entirely depends their success and beauty. This is only acquired by the most careful attention as to the adjustment of the dome-chuck. Any error in its vertical adjustment will be fatal to good work, and will cause the mitring of the corner to be at an angle to, and not parallel with, the axis of the form. This may not, however, be visible upon the original flat facets, but will become very apparent upon the horizontal surfaces of the mouldings and fillets, which will not be in one plane round the four sides of the square. Should this defect arise, it may be assumed that there is some im-



perfection in the vertical adjustment of the chuck. The error once detected is easily remedied by a slight movement of the worm-wheel of the tangent-screw, to move the mandrel a small degree in whichever direction it is required to correct the error. The work is then cut over again, and the accurate meeting of the surfaces and mitring of the corners will certify that at last all is satisfactory. It is not a difficult job, but is one that is well worth the attention the above remarks direct.

We will now proceed to a few examples of finished work, bearing out fully the result of various settings and adjustments already referred to. As the subject of squares and polygonal figures is now uppermost in our minds, Fig. 1 will form a good subject in furtherance of our object. To reproduce this example, the dome chuck is accurately adjusted as before described. The work is turned to the bare circular form, then placed in the chuck while in the before-mentioned position. The slide-rest is set transversely across the lathe-bed, and the eccentric cutter with a round-nose tool is then placed in the slide-rest. The radius of the tool is extended to just cover the space between the base and the cornice, the work being adjusted by the main screw of the chuck to bring the centre of the face opposite the axis of the lathe mandrel. The cutter is then, while revolving at high speed, passed over the surface to be cut by the screw of the slide-rest, the penetration being adjusted to bring the corners up sharp and square, maintaining the limit of the square as large as the cylindrical form will allow.

If the height of the pedestal is greater than can be covered by one cut, then the vertical movement of the work, to above and below the centre, must be brought into play, and the process of cutting be repeated. The first face reduced satisfactorily, it only remains to treat the three remaining sides of the square in precisely the same way.

The base and capital must now claim our attention: these must be first reduced to the corresponding form. As each of these represents a much less depth, the radius of the tool may be reduced to complete the surface remaining to be cut, while the work is raised or lowered to bring that part in contact with the tool. The two thus shaped are ready to receive the mouldings. This may be done either with separate tools, in the eccentric cutter, a moulding, the figure in one tool, or a moulding drill. If the latter be employed, the work must be brought to a closer contact for the necessary cut required to complete the figure by again elevating or depressing the arm of the chuck; but when the eccentric cutter is used this may be avoided by increased radius being given to the tool.

The base and cornice of Fig. 1, now under our notice, were both cut at the same time, and to effect this I used a self-contained moulding tool, extending the radius to cover both, carefully passing the same over the whole surface of both top and bottom in one cut. This is one point, in my opinion, greatly in favour of this particular kind of tool. There are times, of course, when a series of two or three separate tools are preferred; but there are times when you would certainly wish to do as much as possible at one cut, and this is one of them, more especially as it performs the work with every satisfaction, and in considerably less time. Mouldings of this type

are also cut with the same tool, revolving horizontally in the universal cutter set in this position, the radius being adjusted to suit the material and its various proportions.

In some cases this may, perhaps, be deemed preferable, the frame of the instrument, from its construction, being less likely to come in contact with other projections on the work, which may be in close proximity to that under treatment.

Reference to the illustration will clearly demonstrate the necessity for the accuracy of the mitres, to which I have repeatedly alluded, as it will show at once that if these are not correct the whole work will be worthless.

If it is desired to further decorate facets of the figure, each one may be so embellished with a variety of patterns, the eccentric cutter becoming an important factor for the purpose. The centre of one square (*vide* Fig. 1), it will be seen, has a plain eccentric pattern cut. To effect this, the tool in the eccentric cutter is set to the centre of its own axis, while the centre of the square is adjusted by the vertical movement to agree with it. The index is placed in the 96 circle of division, or the same may, with even more safety, be still under the guidance of the segment apparatus. I say more safely, because this is one of the instances which entails an entire revolution of the dome chuck, and the weight being so much on one side, when in the horizontal position, it is likely to force the index from the hole. This, however, is a matter that, with care, can be avoided, and with the bridle on the depth screw, the left hand is free to regard this and prevent a slip. The tool is now extended to a radius of $\frac{3}{10}$, and the slide-rest moved forward $\frac{1}{10}$, then cut at every twelve holes, using a double-angle tool.

A second side of this figure, it will be observed, has been cut as a widely different example, and here is an instance of the variety of different effects obtained in numerous ways by the same tool. The identical tool was here employed by which the base and cornice were worked, and yet its present purpose is distinct in itself.

The eccentricity of the cutter is reduced to cover the width of the recess it is desired to cut, and it may be well to again remind one that by adjusting the edge of the tool to the exact axis of the spindle, it forms a drill, and can be used for this purpose.

Having so set the tool to the desired radius, the dome chuck is set to the horizontal position, and having previously devoted the time and care to its vertical adjustment, it only remains to carefully move the worm-wheel of the segment apparatus forty-five whole turns of its tangent screw, the slide-rest remaining a fixture as before. The fluting stops are fixed one on each side of the slide to arrest the longitudinal progress of the tool at the desired point, the cutter is revolved at a high speed, and traversed regularly through the necessary length.

If it is desired to cut out and decorate a panel with square terminals, the sides must be cut by the vertical transverse of the slide of the chuck, while the work must be raised and lowered for the purpose of effecting the same shape at each end.

This description of panelling may also be cut with a number of consecutive cuts seriatim, and this is a kind of decoration where the divisions on the micrometer on the main screw of the chuck are of much service. For instance, if the ends have been serrated, say at every one or two turns of the slide-rest screw, the sides must be cut in equal proportions; therefore the vertical movement must coincide with that of the slide-rest; the length and breadth of the panel or recess being arranged to receive so many cuts each way.

For works of extensive size, it is always preferable to build up the subject of separate pieces, more especially when the material used is ivory, as the reduction of the circular form to a square pedestal involves a considerable loss.

We pass now to Fig. 2, which illustrates a further and distinct mode of decoration, and, as will be readily seen, consists of a reeded spherical top, with the same figure carried through the diameter of the cylindrical body. As shown, the example represents a matchbox, being a suitable object for our purpose, and at the same time useful and decorative. The box is first turned out inside, and the lid fitted; it is then turned to the desired proportion externally while on the mandrel nose; it is afterwards mounted on the dome chuck. The dome is then adjusted by the slide of the chuck, and the reed on this part first cut, the slide-rest being set parallel with the lathe-bed; the universal cutter being the most suitable instrument to employ. This when placed in the slide-rest is set over to 90°, so that it will revolve in the vertical plane, and a double quarter-hollow tool, as shown in my last used. This must be accurately set to the test point presumably left on the dome.

The depth of penetration required must be decided by the two trial cuts, and when all is thus set, it will require three turns of the tangent screw for each successive cut. When the dome has been thus treated throughout its diameter, the slide-rest must be turned to a right angle, and fixed transversly across the lathe-bed. The dome chuck is then brought to the horizontal position by forty-five turns of the tangent screw of segment apparatus, and the universal cutter turned to zero to bring it to the position in which it revolves horizontally, the same tool being still employed.

We now have to adjust the required depth of penetration very carefully to coincide with that of the serrations on the dome at the diametrical line. This is not a difficult matter by any means; but still it requires considerable care and attention. The moulding at the base has been worked up in a somewhat different way—that is, by cutters varying in form and the manner of their application. The manipulation of the chuck also receives fresh treatment. The square is first roughly shaped, and with so much material to remove a saw may be very usefully employed. Having removed the four sides, and faced over the surface on one side, a hole about $\frac{3}{4}$in. in diameter is turned out at the centre. By this it is fitted to a short plug or chuck which for convenience must be less in diameter than the sides of the square. When it is fitted to the chuck, it is better to fix it with a little thin glue to insure its being retained in the required position. It is then reduced to the necessary thickness.

The next thing will be to mount it on the dome chuck. Again set to the vertical position, the slide-rest remaining as set at right angles to the bed, the eccentric cutter being used in exactly the same manner as detailed. Having cut the four sides square, the tool is exchanged for one with a square end $\frac{1}{10}$ wide, the work lowered in order that the facets may be further recessed, leaving the lower extremity $\frac{1}{10}$ deep. It is then still further lowered, and recessed at the upper part to remove the superfluous material, in order that the bead-tool shall not have more to do than absolutely necessary.

The universal cutter again succeeds the eccentric, and with a bead-tool of the required dimensions the base of the moulding is shaped, and again the work is depressed, and with a round-nose tool the concave curve is cut, a square fillet intervening between it and the base.

By reference to the illustration it will be seen that the extreme base is reeded. To effect this the chuck still remains in the vertical position, while the universal cutter is again set over to 90° to cut vertically, and the tool exchanged for a double quarter-hollow tool. The point is then set accurately to the centre of the square by the lateral traverse of the slide-rest, the micrometer being set to zero. The work is then spaced out to receive so many cuts on each side of the centre. When thus set, the tool is revolved at a high rate of speed, and the work passed up and down through the space to be cut by the main screw of the dome chuck. To admit of this, the nut at the back of the right-angle arm is slightly released, just sufficient to allow it to work with the necessary freedom. In the example before us there are twelve consecutive cuts in each square, the depth being determined as before mentioned, and the tool moved laterally $\frac{1}{10}$, or two turns of the slide-rest screw.

We come now to Fig. 3, and this demonstrates the use of the dome chuck as used for the decoration of concave curves, and this of very increased dimensions. Here, again, the bare form is first reduced by hand turning to the approximate proportions, it is then mounted on the dome chuck, which is adjusted so that it will allow the tool to follow the curve contained in the figure. This is a case in which the chuck that holds the work must be as shallow as possible, so that the axis of the work may be placed as far as possible from the centre of the lathe axis away from the operator. The chuck must now be fixed in the horizontal position, and the slide-rest set parallel with the lathe-bed, while the universal cutter is again set to revolve vertically with the double quarter-hollow tool, which must be extended to a radius of $\frac{1}{10}$ so that the full depth of the curve may be cut without the frame reaching the edge of the work.

The point of the tool must be accurately set by the movement of the slide-rest to agree with the test-point left for the purpose when the work is prepared by hand. The arm of the chuck is then moved along the body of the chuck until the tool will pass as nearly as possible over the desired curve, the depth again ascertained in the usual way by two trial cuts; the worm-wheel of the chuck is then moved two turns for each succeeding cut. The partial rotation of the mandrel is arrested at the centre by one of the segment-pins. When arranging this, the radius of the tool must be considered, as it should just pass out at the centre; therefore, when this is duly allowed for, the chuck will not assume the exact horizontal position each time the tool reaches the centre. The tool passing out at the diameter, it is not necessary to employ the second stop-pin, except to prevent the chuck swinging round if the hand should be inadvertently released.

To reproduce Fig. 4 and our final example, the work is as usual reduced to the required form approximately, then mounted on the dome chuck when in the vertical plane; the slide-rest still parallel with the lathe-bed, the universal cutter being again the instrument to use; but we now have a double-angle tool of 50° extended to a radius of $\frac{5}{10}$. Here again we must be careful in setting the same precisely to the centre of the test-point, and equal consideration must be devoted to the depth; to adjust the latter, the cutter is moved towards the operator, and the cutter placed over the concave curve. The work is then moved up to it by the main screw of the dome chuck, and, when deep enough, the tool is withdrawn by the guide-screw of the top slide. The worm-wheel is then moved two turns, and the second cut made. The depth is so arranged that the edges are quite sharp; each successive cut is then made by the movement of the top slide of slide-rest; the horizontal arms being rigidly fixed when all the adjustments are made.

The periphery is cut by the tool being moved on the required distance, the nut of arm released, and the work passed up and down by the screw of chuck. The points form a very effective terminal to the incision on the concave curve.

The chuck which holds the work is now placed in a deep transfer to extend the convex curve further from the axis of the lathe, and, as the illustration shows, the particular shape requires to be a portion of a large circle. The screw of the chuck is adjusted to the required position, the same tool being set to follow accurately over the curve, thus carrying out the same figure entirely over the necessary form. Many very beautiful specimens are to be produced by varying the profile of the tool used.

I have now, I hope, given all the information necessary to the manipulation and development of the valuable adjunct to the ornamental turner's outfit. I propose to follow with particulars of the spherical slide-rest, it being somewhat allied to the subject we have just completed, in so much as the results are similar, with considerably increased varieties.

THE torpedo-boat destroyer *Viper* was launched last week by Messrs. Hawthorn, Leslie, and Co. She is fitted with Parsons' steam turbines, and is guaranteed to steam 31 knots. She will be ready for speed trials in six weeks.

THE sleepers used on the Chicago and Eastern Illinois Railway are now being treated with preservatives, the zinc-tannin process being used. The wood is first steamed, and the sap extracted by a vacuum, after which three solutions are injected into the wood in succession. The first of these is chloride of zinc, which is followed by a second of gelatine, and by one of tannin. The latter do not penetrate deeply, but form a sort of artificial leather in the outer layers of the wood, and thus prevent the zinc washing out. For satisfactory results it is important that the temperature during the steaming process should not exceed 260° Fahr.

THE BRITISH ASSOCIATION.

PRESIDENT'S ADDRESS.

THE sixty-ninth annual meeting of the British Association for the Advancement of Science was commenced at Dover on Sept. 13, when Prof. Sir Michael Foster, K.C.B., Sec.R.S., delivered the address as President. Commencing with a few words of sympathetic regret at the loss of so many great men, who had in bygone years served as Presidents or otherwise, and particularly Sir Douglas Galton, Sir Michael said:—

Still older than the Association is this nineteenth century, now swiftly drawing to its close. Though the century itself has yet some sixteen months to run, this is the last meeting of the British Association which will use the numbers eighteen hundred to mark its date.

The eyes of the young look ever forward; they take little heed of the short though ever-lengthening fragment of life which lies behind them; they are wholly bent on that which is to come. The eyes of the aged turn wistfully again and again to the past; as the old glide down the inevitable slope their present becomes a living over again the life which has gone before, and the future takes on the shape of a brief lengthening of the past. May I this evening venture to give rein to the impulses of advancing years? May I, at this last meeting of the Association in the eighteen hundreds, dare to dwell for awhile upon the past, and to call to mind a few of the changes which have taken place in the world since those autumn days in which men were saying to each other that the last of the seventeen hundreds was drawing towards its end?

Dover in the year of our Lord seventeen hundred and ninety-nine was in many ways unlike the Dover of to-day. On moonless nights men groped their way in its narrow streets by the help of swinging lanterns and smoky torches, for no lamps lit the ways. By day the light of the sun struggled into the houses through narrow panes of blurred glass. Though the town then, as now, was one of the chief portals to and from the countries beyond the seas, the means of travel were scanty and dear, available for the most part to the rich alone, and, for all, beset with discomfort and risk. Slow and uncertain was the carriage of goods, and the news of the world outside came to the town—though it, from its position, learnt more than most towns—tardily, fitfully, and often falsely. The people of Dover sat then much in dimness, if not in darkness, and lived in large measure on themselves. They who study the phenomena of living beings tell us that light is the greatest stimulus of life, and that the fulness of the life of a being or of any of its members may be measured by the variety, the swiftness, and the certainty of the means by which it is in touch with its surroundings. Judged from this standpoint, life at Dover, then, as indeed elsewhere, must have fallen far short of the life of to-day.

The same study of living beings, however, teaches us that while from one point of view the environment seems to mould the organism, from another point the organism seems to be master of its environment. Going behind the change of circumstances, we may raise the question, the old question, Was life in its essence worth more then than now?

Has there Been a Real Advance?

Let me at once relieve your minds by saying that I propose to leave this question in the main unanswered. It may be, or it may not be, that man's grasp of the beautiful and of the good, if not looser, is not firmer than it was a hundred years ago. It may be, or it may not be, that man is no nearer to absolute truth, to seeing things as they really are, than he was then. I will merely ask you to consider with me for a few minutes how far, and in what ways, man's laying hold of that aspect of, or part of, truth which we call natural knowledge, or sometimes science, differed in 1799 from what it is to-day, and whether that change must not be accounted a real advance, a real improvement in man?

I do not propose to weary you by what in my hands would be the rash effort of attempting a survey of all the scientific results of the 19th century. It will be enough if for a little while I dwell on some few of the salient features distinguishing the way in which we nowadays look upon, and during the coming week shall speak of, the works of Nature around us—though those works themselves, save for the slight shifting involved in a secular change, remain exactly the same—from the way in which they were looked upon and might have been spoken of at a gathering of philosophers at Dover in 1799. And I ask your leave to do so. In

The Philosophy of the Ancients,

earth, fire, air, and water were called the "elements." It was thought, and rightly thought, that a knowledge of them and of their attributes was a necessary basis of a knowledge of the ways of Nature. Translated into modern language, a knowledge of these "elements" of old means a knowledge of the composition of the atmosphere, of water, and of all the other things which we call matter, as well as a knowledge of the general properties of gases, liquids, and solids, and of the nature and effects of combustion. Of all these things our knowledge to-day is large and exact, and, though ever enlarging, in some respects complete. When did that knowledge begin to become exact?

To-day the children in our schools know that the air which wraps round the globe is not a single thing, but is made up of two things, oxygen and nitrogen (some may already know that there is at least a third thing, argon) mingled together. They know, again, that water is not a single thing, but the product of two things, oxygen and hydrogen, joined together. They know that when the air makes the fire burn and gives the animal life, it is the oxygen in it which does the work. They know that all around them things are undergoing that union with oxygen which we call oxidation, and that oxidation is the ordinary source of heat and light. Let me ask you to picture to yourselves what confusion there would be to-morrow, not only in the discussions at the sectional meetings of our Association, but in the world at large, if it should happen that in the coming night some destroying touch should wither up certain tender structures in all our brains, and wipe out from our memories all traces of the ideas which cluster in our minds around the verbal tokens oxygen and oxidation. How could any of us, not the so-called man of science alone, but even the man of business and the man of pleasure, go about his ways lacking those ideas? Yet those ideas were in 1799 lacking to all but a few.

Although in the third quarter of the 17th century the light of truth about oxidation and combustion had flashed out in the writings of John Mayow, it came as a flash only, and died away as soon as it had come. For the rest of that century, and for the greater part of the next, philosophers stumbled about in darkness, misled for the most of the time by the phantom conception which they called

Phlogiston.

It was not until the end of the third quarter of the 18th century that the new light, which has burned steadily ever since, lit up the minds of the men of science. The light came at nearly the same time from England and from France. Rounding off the sharp corners of controversy, and joining, as we may fitly do to-day, the two countries as twin bearers of a common crown, we may say that we owe the truth to Cavendish, to Lavoisier, and Priestley. If it was Priestley who was the first to demonstrate the existence of what we now call oxygen, it is to Lavoisier we owe the true conception of the nature of oxidation and the clear exposition of the full meaning of Priestley's discovery, while the knowledge of the composition of water, the necessary complement of the knowledge of oxygen, came to us through Cavendish and, we may perhaps add, through Watt.

The date of Priestley's discovery of oxygen is 1774. Lavoisier's classic memoir "On the Nature of the Principle which Enters into Combination with Metals during Calcination," appeared in 1775, and Cavendish's paper on the composition of water did not see the light until 1784.

During the last quarter of the 18th century this new idea of oxygen and oxidation was struggling into existence. How new was the idea is illustrated by the fact that Lavoisier himself at first spoke of that which he was afterwards—namely, in 1778, led to call oxygen, the name by which it has since been known, as "the principle which enters into combination." What difficulties its acceptance met with is illustrated by the fact that Priestley himself refused to the end of his life to grasp the true bearings of the discovery which he had made. In the year 1799 the knowledge of oxygen, of the nature of water and of air, and indeed the true conception of chemical composition and chemical change, was hardly more than beginning to be, and the century had to pass wholly away before the next great chemical idea, which we know by the name of the Atomic Theory of John Dalton, was made known. We have only to read the scientific literature of the time to recognise that a truth which is now not only woven as a master-thread into all our scientific conceptions, but even enters largely into the every-day talk and thoughts of educated people, was a hundred years ago struggling into existence among the philosophers themselves. It was all but absolutely unknown to the world outside those select few.

Electricity.

If there be one word of science which is writ large on the life of the present time, it is the word "electricity." It is, I take it, writ larger than any other word. The knowledge which it denotes has carried its practical results far and wide into our daily life, while the theoretical conceptions which it signifies pierce deep into the nature of things. We are to-day proud, and justly proud, both of the material triumphs and of the intellectual gains which it has brought us, and we are full of even larger hopes of it in the future.

At what time did this bright child of the nineteenth century have its birth? He who listened to the small group of philosophers of Dover, who in 1799 might have discoursed of natural knowledge, would perhaps have heard much of electric machines, of electric sparks, of the electric fluid, and even of positive and negative electricity; for frictional electricity had long been known and even carefully studied. Probably one or more of the group, dwelling on the observations which Galvani, an Italian, had made known some twenty years before, developed views on the connection of electricity with the phenomena of living bodies. Possibly one of them was exciting the rest by telling how he had just heard that a professor at Pavia, one Volta, had discovered that electricity could be produced not only by rubbing together particular bodies, but by the simple contact of two metals, and had thereby explained Galvani's remarkable results. For, indeed, as we shall hear from Prof. Fleming, it was in that very year, 1799, that electricity as we now know it took its birth. It was then that Volta brought to light the apparently simple truths out of which so much has sprung. The world, it is true, had to wait for yet some twenty years before both the practical and the theoretic worth of Volta's discovery became truly pregnant, under the fertilising influence of another discovery. The loadstone and magnetic virtues had, like the electrifying power of rubbed amber, long been an old story. But, save for the compass, not much had come from it. And even Volta's discovery might have long remained relatively barren had it been left to itself. When, however, in 1819, Oersted made known his remarkable observations on the relations of electricity to magnetism, he made the contact needed for the flow of a new current of ideas. And it is, perhaps, not too much to say that those ideas, developing during the years of the rest of the century with an ever-accelerating swiftness, have wholly changed man's material relations to the circumstances of life, and, at the same time, carried him far in his knowledge of the nature of things.

Geology.

Of all the various branches of science, none, perhaps, is to-day, none for these many years past, has been so well known to, even if not understanded by, most people as that of geology. Its practical lessons have brought wealth to many; its fairy tales have brought delight to more; and round it hovers the charm of danger, for the conclusions to which it leads touch on the nature of man's beginning.

In 1799, the science of geology, as we now know it, was struggling into birth. There had been from of old cosmogonies, theories as to how the world had taken shape out of primæval chaos. In that fresh spirit which marked the zealous search after natural knowledge pursued in the middle and latter part of the seventeenth century, the brilliant Stenson in Italy, and Hooke in our own country, had laid hold of some of the problems presented by fossil remains, and Woodward, with others, had laboured in the same field. In the eighteenth century, especially in its latter half, men's minds were busy about the physical agencies determining or modifying the features of the earth's crust; water and fire, subsidence from a primæval ocean and transformation by outbursts of the central heat, Neptune and Pluto, were being appealed to, by Werner on the one hand, and by Desmarest on the other, in explanation of the earth's phenomena. The way was being prepared, theories and views were abundant, and many sound observations had been made; and yet the science of geology, properly so-called, the exact and proved knowledge of the successive phases of the world's life, may be said to date from the closing years of the eighteenth century.

In 1783, James Hutton put forward in a brief memoir his "Theory of the Earth," which, in 1795, two years before his death, he expanded into a book; but his ideas failed to lay hold of men's minds until the century had passed away, when, in 1802, they found an able expositor in John Playfair. The very same year that Hutton published his theory, Cuvier came to Paris and almost forthwith began, with Brongniart, his immortal researches into the fossils of Paris and its neighbourhood. And four years later, in the year 1799 itself, William Smith's tabular list of strata and fossils saw the light. It is, I believe, not too much to say that out of these geology, as we now know it, sprang. It was thus in the closing years of the eighteenth century that was begun the work which the nineteenth century has carried forward to such great results. But at that time only the select few had grasped the truth, and even they only the beginning of it. Outside a narrow circle the thoughts, even of the educated, about the history of the globe were bounded by the story of the Deluge—though the story was often told in a strange fashion—or were guided by fantastic views of the plastic forces of a sportive nature.

Biology.

In another branch of science, in that which deals

with the problems presented by living beings, the thoughts of men in 1799 were also very different from the thoughts of men to-day. It is a very old quest, the quest after the knowlege of the nature of living beings, one of the earliest on which man set out; for it promised to lead him to a knowledge of himself, a promise which perhaps is still before us, but the fulfilment of which is as yet far off. As time has gone on, the pursuit of natural knowledge has seemed to lead man away from himself into the furthermost parts of the universe, and into secret workings of nature in which he appears to be of little or no account; and his knowledge of the nature of living things, and so of his own nature, has advanced slowly, waiting till the progress of other branches of natural knowledge can bring it aid. Yet in the past hundred years the biologic sciences, as we now call them, have marched rapidly onward.

We may look upon a living body as a machine doing work in accordance with certain laws, and may seek to trace out the working of the inner wheels, how these raise up the lifeless dust into living matter, and let the living matter fall away again into dust, giving out movement and heat. Or we may look upon the individual life as a link in a long chain joining something which went before to something about to come, a chain whose beginning lies hid in the farthest past, and may seek to know the ties which bind one life to another. As we call up to view the long series of living forms, living now or flitting like shadows on the screen of the past, we may strive to lay hold of the influences which fashion the garment of life. Whether the problems of life are looked upon from the one point of view or the other, we to-day, not biologists only, but all of us, have gained a knowledge hidden even from the philosophers a hundred years ago.

Of the problems presented by the living body viewed as a machine, some may be spoken of as mechanical, others as physical, and yet others as chemical, while some are, apparently at least, none of these. In the 17th century William Harvey, laying hold of the central mechanism of the blood stream, opened up a path of inquiry which his own age and the century which followed trod with marked success. The knowledge of the mechanics of the animal and of the plant advanced apace; but the physical and chemical problems had yet to wait. The eighteenth century, it is true, had its physics and its chemistry; but, in relation at least to the problems of the living being, a chemistry which knew not oxygen and a physics which knew not the electricity of chemical action were of little avail. The philosopher of 1799, when he discussed the functions of the animal or of the plant involving chemical changes, was fain for the most part, as were his predecessors in the century before, to have recourse to such vague terms as "fermentation" and the like; to-day our treatises on physiology are largely made up of precise and exact expositions of the play of physical agencies and chemical bodies in the living organism. He made use of the words "vital force" or "vital principle" not as an occasional, but as a common, explanation of the phenomena of the living body. During the present century, especially during its latter half, the idea embodied in those words has been driven away from one seat after another; if we use it now when we are dealing with the chemical and physical events of life we use it with reluctance, as a *deus ex machinâ* to be appealed to only when everything else had failed.

Some of the Problems—

and those, perhaps, the chief problems—of the living body have to be solved neither by physical nor by chemical methods, but by methods of their own. Such are the problems of the nervous system. In respect to these the men of 1799 were on the threshold of a pregnant discovery. During the latter part of the present century, and especially during its last quarter, the analysis of the mysterious processes in the nervous system, and especially in the brain, which issue as feeling, thought, and the power to move, has been pushed forward with a success conspicuous in its practical, and full of promise in its theoretical, gains. That analysis may be briefly described as a following up of threads. We now know that what takes place along a tiny thread which we call a nerve-fibre differs from that which takes place along its fellow-threads; that differing nervous impulses travel along different nerve-fibres; and that nervous and psychical events are the outcome of the clashing of nervous impulses as they sweep along the closely-woven web of living threads of which the brain is made. We have learnt by experiment and by observation that the pattern of the web determines the play of the impulses, and we can already explain many of the obscure problems not only of nervous disease, but of nervous life, by an analysis which is a tracking out the devious and linked paths of nervous threads. The very beginning of this analysis was unknown in 1799. Men knew that nerves were the agents of feeling and of the movements of muscles; they had learnt much about what this part or that part of the brain could do; but they did not know that one nerve-fibre differed from another in the very essence of its work. It was just about the end of the past century, or the beginning of the present one, that an English surgeon began to ponder over a conception which, however, he did not make known until some years later, and which did not gain complete demonstration and full acceptance until still more years had passed away. It was in 1811, in a tiny pamphlet published privately, that Charles Bell put forward his "New Idea" that the nervous system was constructed on the principle that "the nerves are not single nerves possessing various powers, but bundles of different nerves, whose filaments are united for the convenience of distribution, but which are distinct in office as they are in origin from the brain." Our present knowledge of the nervous system is to a large extent only an exemplification and expansion of Charles Bell's "New Idea," and has its origin in that.

If we pass from the problems of the living organism viewed as a machine to those presented by the varied features of the different creatures who have lived or who still live on the earth, we at once call to mind that the middle years of the present century mark an epoch in biologic thought such as never came before, for it was then that Charles Darwin gave to the world the

Origin of Species.

That work, however, with all the far-reaching effects which it has had, could have had little or no effect, or, rather, could not have come into existence, had not the earlier half of the century been in travail preparing for its coming. For the germinal idea of Darwin appeals, as to witnesses, to the results of two lines of biologic investigation which were almost unknown to the men of the 18th century.

To one of these lines I have already referred. Darwin, as we know, appealed to the geological record; and we also know how that record, imperfect as it was then and imperfect as it must always remain, has since his time yielded the most striking proofs of at least one part of his general conception. In 1799 there was, as we have seen, no geological record at all.

Of the other line I must say a few words. To-day the merest beginner in biologic study, or even that exemplar of acquaintance without knowledge, the general reader, is aware that every living being, even man himself, begins its independent existence as a tiny ball, of which we can, even acknowledging to the full the limits of the optical analysis at our command, assert with confidence that in structure, using that word in its ordinary sense, it is in all cases absolutely simple. It is equally well known that the features of form which supply the characters of a grown-up living being, all the many and varied features of even the most complex organism, are reached as the goal of a road, at times a long road, of successive changes; that the life of every being, from the ovum to its full estate, is a series of shifting scenes, which come and go, sometimes changing abruptly, sometimes melting the one into the other, like dissolving views, all so ordained that often the final shape with which the creature seems to begin, or is said to begin, its life in the world is the outcome of many shapes, clothed with which it in turn has lived many lives before its seeming birth.

All or nearly all the exact knowledge of the laboured way in which each living creature puts on its proper shape and structure is the heritage of the present century. Although the way in which the chick is moulded in the egg was not wholly unknown even to the ancients, and in later years had been told, first in the sixteenth century by Fabricius, then in the seventeenth century in a more clear and striking manner by the great Italian naturalist Malpighi, the teaching thus offered had been neglected or misinterpreted. At the close of the eighteenth century the dominant view was that in the making of a creature out of the egg there was no putting on of wholly new parts, no epigenesis. It was taught that the entire creature lay hidden in the egg, hidden by reason of the very transparency of its substance, lay ready-made but folded up, as it were, and that the process of development within the egg or within the womb was a mere unfolding, a simple evolution. Nor did men shrink from accepting the logical outcome of such a view—namely, that within the unborn creature itself lay in like manner, hidden and folded up, its offspring also, and within that again its offspring in turn, after the fashion of a cluster of ivory balls carved by Chinese hands, one within the other. This was no fantastic view put forward by an imaginative dreamer; it was seriously held by sober men, even by men like the illustrious Haller, in spite of their recognising that as the chick grew in the egg some changes of form took place. Though so early as the middle of the eighteenth century Friedrich Caspar Wolff and, later on, others had strenuously opposed such a view, it held its own not only to the close of the century, but far on into the next. It was not until a quarter of the present century had been added to the past that Von Baer made known the results of researches which once and for all swept away the old view. He and others working after him made it clear that each individual puts on its final form and structure not by an unfolding of pre-existing hidden features; but by the formation of new parts through the continued differentiation of a primitively simple material. It was also made clear that the successive changes which the embryo undergoes in its progress from the ovum to maturity are the expression of morphologic laws, that the progress is one from the general to the special, and that the shifting scenes of embryonic life are hints and tokens of lives lived by ancestors in times long past.

If we wish to measure how far off in biologic thought the end of the last century stands, not only from the end but even from the middle of this one, we may imagine Darwin striving to write the "Origin of Species" in 1799. We may fancy him being told by philosophers explaining how one group of living beings differed from another group because all its members and all their ancestors came into existence at one stroke when the first-born progenitor of the race, within which all the rest were folded up, stood forth as the result of a creative act. We may fancy him listening to a debate between the philosopher who maintained that all the fossils strewn in the earth were the remains of animals or plants churned up in the turmoil of a violent universal flood, and dropped in their places as the waters went away, and him who argued that such were not really the "spoils of living creatures," but the products of some playful plastic power which out of the superabundance of its energy fashioned here and there the lifeless earth into forms which imitated, but only imitated, those of living things. Could he amid such surroundings by any flight of genius have beat his way to the conception for which his name will ever be known?

The Science of To-Day.

Here I may well turn away from the past. It is not my purpose, nor, as I have said, am I fitted, nor is this perhaps the place, to tell even in outline the tale of the work of science in the nineteenth century. I am content to have pointed out that the two great sciences of chemistry and geology took their birth, or at least began to stand alone, at the close of the last century, and have grown to be what we know them now within about a hundred years, and that the study of living beings has within the same time been so transformed as to be to-day something wholly different from what it was in 1799. And, indeed, to say more would be to repeat almost the same story about other things. If our present knowledge of electricity is essentially the child of the nineteenth century, so also is our present knowledge of many other branches of physics. And those most ancient forms of exact knowledge, the knowledge of numbers and of the heavens, whose beginning is lost in the remote past, have, with all other kinds of natural knowledge, moved onward during the whole of the hundred years with a speed which is ever increasing. I have said, I trust, enough to justify the statement that in respect to natural knowledge a great gulf lies between 1799 and 1899. That gulf, moreover, is a twofold one: not only has natural knowledge been increased, but men have run to and fro spreading it as they go. Not only have the few driven far back round the full circle of natural knowledge the dark clouds of the unknown which wrap us all about, but also the many walk in the zone of light thus increasingly gained. If it be true that the few to-day are, in respect to natural knowledge, far removed from the few of those days, it is also true that nearly all which the few alone knew then, and much which they did not know, has now become the common knowledge of the many.

What, however, I may venture to insist upon here is that the difference in respect to natural knowledge, whatever be the case with other differences between then and now, is undoubtedly a difference which means progress. The span between the science of that time and the science of to-day is beyond all question a great stride onwards.

We may say this, but we must say it without boasting. For the very story of the past which tells the triumphs of science bids the man of science put away from him all thought of vain-glory. And that by many tokens.

Whoever, working at any scientific problem, has occasion to study the inquiries into the same problem made by some fellow-worker in the years long gone by, comes away from that study humbled by one or other of two different thoughts. On the one hand, he may find, when he has translated the language of the past into the phraseology of to-day, how near was his forerunner of old to the conception which he thought, with pride, was all his own, not only so true but so new. On the other hand, if the ideas of the investigator of old, viewed in the light of modern knowledge, are found to be so wide of the mark as to seem absurd, the smile which begins to play upon the lips of the modern is checked by the thought, Will the ideas which I am now putting forth, and which I think explain so clearly, so fully, the problem in hand, seem to some

worker in the far future as wrong and as fantastic as do these of my forerunner to me? In either case his personal pride is checked. Further, there is written clearly on each page of the history of science, in characters which cannot be overlooked, the lesson that no scientific truth is born anew, coming by itself and of itself. Each new truth is always the offspring of something which has gone before, becoming in turn the parent of something coming after. In this aspect the man of science is unlike, or seems to be unlike, the poet and the artist. The poet is born, not made; he rises up, no man knowing his beginnings; when he goes away, though men after him may sing his songs for centuries, he himself goes away wholly, having taken with him his mantle, for this he can give to none other. The man of science is not thus creative; he is created. His work, however great it be, is not wholly his own; it is in part the outcome of the work of men who have gone before. Again and again a conception which has made a name great has come not so much by the man's own effort as out of the fulness of time. Again and again we may read in the words of some man of old the outlines of an idea which in later days has shone forth as a great acknowledged truth. From the mouth of the man of old the idea dropped barren, fruitless; the world was not ready for it, and heeded it not; the concomitant and abutting truths which could give it power to work were wanting. Coming back again in later days, the same idea found the world awaiting it; things were in travail preparing for it; and someone, seizing the right moment to put it forth again, leapt into fame. It is not so much the men of science who make science, as some spirit which, born of the truths already won, drives the man of science onward, and uses him to win new truths in turn.

It is because each man of science is not his own master, but one of many obedient servants of an impulse which was at work long before him, and will work long after him, that in science there is no falling back. In respect to other things there may be times of darkness and times of light. There may be risings, decadences, and revivals. In science there is only progress. The path may not be always a straight line, there may be swerving to this side and to that, ideas may seem to return again and again to the same point of the intellectual compass; but it will always be found that they have reached a higher level—they have moved, not in a circle, but in a spiral. Moreover science is not fashioned as is a house, by putting brick to brick, that which is once put remaining as it was put to the end. The growth of science is that of a living being. As in the embryo phase follows phase, and each member of the body puts on in succession different appearances, though all the while the same member, so a scientific conception of one age seems to differ from that of a following age, though it is the same one in the process of being made; and as the dim outlines of the early embryo become, as the being grows more distinct and sharp, like a picture on a screen brought more and more into focus, so the dim gropings and searching of the men of science of old are by repeated approximations wrought into the clear and exact conclusions of later times.

Progress.

The story of natural knowledge, of science, in the 19th century, as, indeed, in preceding centuries, is, I repeat, a story of continued progress. There is in it not so much as a hint of falling back, not even of standing still. What is gained by scientific inquiry is gained for ever: it may be added to, it may seem to be covered up, but it can never be taken away. Confident that the progress will go on, we cannot help peering into the years to come and straining our eyes to foresee what science will become, and what it will do as they roll on. While we do so, the thought must come to us, Will all the increasing knowledge of Nature avail only to change the ways of man—will it have no effect on man himself?

The material good which mankind has gained and is gaining through the advance of science is so imposing as to be obvious to everyone, and the praises of this aspect of science are to be found in the mouths of all. Beyond all doubt science has greatly lessened and has markedly narrowed hardship and suffering; beyond all doubt science has largely increased and has widely diffused ease and comfort. The appliances of science have, as it were, covered with a soft cushion the rough places of life, and that not for the rich only, but also for the poor. So abundant and so prominent are the material benefits of science that in the eyes of many these seem to be the only benefits which she brings. She is often spoken of as if she were useful and nothing more, as if her work were only to administer to the material wants of man.

Is this so? We may begin to doubt it when we reflect that the triumphs of science which bring these material advantages are in their very nature intellectual triumphs. The increasing benefits brought by science are the results of man's increasing mastery over Nature, and that mastery is increasingly a mastery of mind; it is an increasing power to use the forces of what we call inanimate nature in place of the force of his own or other creatures' bodies; it is an increasing use of mind in place of muscle.

Is it to be thought that that which has brought the mind so greatly into play has had no effect on the mind itself? Is that part of the mind which works out scientific truths a mere slavish machine producing results it knows not how, having no part in the good which in its working it brings forth?

What are the qualities, the features of that scientific mind which has wrought, and is working, such great changes in man's relation to Nature? In seeking an answer to this question we have not to inquire into the attributes of genius. Though much of the progress of science seems to take on the form of a series of great steps, each made by some great man, the distinction in science between the great discoverer and the humble worker is one of degree only, not of kind. As I was urging just now, the greatness of many great names in science is often in large part, the greatness of occasion, not of absolute power. The qualities which guide one of man to a small truth silently taking its place among its fellows, as these go to make up progress, are at bottom the same as those by which another man is led to something of which the whole world rings. The features of

The Fruitful Scientific Mind

are in the main three:—In the first place, above all other things, his nature must be one which vibrates in unison with that of which he is in search; the seeker after truth must himself be truthful, truthful with the truthfulness of nature. For the truthfulness of Nature is not wholly the same as that which man sometimes calls truthfulness. It is far more imperious, far more exacting. Man, unscientific man, is often content with "the nearly" and "the almost." Nature never is. It is not her way to call the same two things which differ, though the difference may be measured by less than the thousandth of a milligramme or of a millemètre, or by any other like standard of minuteness. And the man who, carrying the ways of the world into the domain of science, thinks that he may treat Nature's differences in any other way than she treats them herself, will find that she resents his conduct; if he in carelessness or in disdain overlooks the minute difference which she holds out to him as a signal to guide him in his search, the projecting tip, as it were, of some buried treasure, he is bound to go astray, and the more strenuously he struggles on, the farther will he find himself from his true goal.

In the second place, he must be alert of mind. Nature is ever making signs to us, she is ever whispering to us the beginnings of her secrets; the scientific man must be ever on the watch, ready at once to lay hold of Nature's hint, however small—to listen to her whisper, however low.

In the third place, scientific inquiry, though it be pre-eminently an intellectual effort, has need of the moral quality of courage—not so much the courage which helps a man to face a sudden difficulty as the courage of steadfast endurance. Almost every inquiry, certainly every prolonged inquiry, sooner or later goes wrong. The path, at first so straight and clear, grows crooked and gets blocked; the hope and enthusiasm, or even the jaunty ease, with which the inquirer set out, leave him, and he falls into a slough of despond. That is the critical moment calling for courage. Struggling through the slough, he will find on the other side the wicket-gate opening up the real path; losing heart, he will turn back, and add one more stone to the great cairn of the unaccomplished.

But, I hear someone say, these qualities are not the peculiar attributes of the man of science; they may be recognised as belonging to almost everyone who has commanded or deserved success, whatever may have been his walk of life. That is so. That is exactly what I would desire to insist, that the men of science have no peculiar virtues, no special powers. They are ordinary men, their characters are common, even commonplace. Science, as Huxley said, is organised common-sense, and men of science are common men, drilled in the ways of common-sense.

For their life has this feature. Though in themselves they are no stronger, no better, than other men, they possess a strength which, as I just now urged, is not their own, but is that of the science whose servants they are. Even in his apprenticeship the scientific inquirer, while learning what has been done before his time, if he learns it aright, so learns it that what is known will serve him not only as a vantage ground whence to push off into the unknown, but also as a compass to guide him in his course. And when fitted for his work he enters on inquiry itself, what a zealous, anxious guide, what a strict and, because strict, helpful schoolmistress, does Nature make herself to him! Under her care every inquiry, whether it bring the inquirer to a happy issue or seem to end in nought, trains him for the next effort. She so orders her ways that each act of obedience to her makes the next act easier for him, and step by step she leads him on towards that perfect obedience which is complete mastery. Indeed, when we reflect on the potency of

The Discipline of Scientific Inquiry,

we cease to wonder at the progress of scientific knowledge. The results actually gained seem to fall so far short of what under such guidance might have been expected to have been gathered in, that we are fain to conclude that science has called to follow her, for the most part, the poor in intellect and the wayward in spirit. Had she called to her service the many acute minds who have wasted their strength struggling in vain to solve hopeless problems, or who have turned their energies to things other than the increase of knowledge; had she called to her service the many just men who have walked straight without the need of a rod to guide them, how much greater than it has been would have been the progress of science, and how many false teachings would the world have been spared! To men of science themselves, when they consider their favoured lot, the achievements of the past should serve not as a boast, but as a reproach.

If there be any truth in what I have been urging, that the pursuit of scientific inquiry is itself a training of special potency, giving strength to the feeble and keeping in the path those who are inclined to stray, it is obvious that the material gains of science, great as they may be, do not make up all the good which science brings or may bring to man. We especially, perhaps, in these later days, through the rapid development of the physical sciences, are too apt to dwell on the material gains alone. As a child in its infancy looks upon its mother only as a giver of good things, and does not learn till in after days how she was showing her love by carefully training it in the way it should go, so we, too, have thought too much of the gifts of science, overlooking her power to guide.

Man does not live by bread alone, and science brings him more than bread. It is a great thing to make two blades of grass grow where before one alone grew; but it is no less great a thing to help a man to come to a just conclusion on the questions with which he has to deal. We may claim for science that while she is doing the one she may be so used as to do the other also. The dictum just quoted, that science is organised common-sense, may be read as meaning that the common problems of life which common people have to solve are to be solved by the same methods by which the man of science solves his special problems. It follows that the training which does so much for him may be looked to as promising to do much for them. Such aid can come from science on two conditions only. In the first place, this her influence must be acknowledged; she must be duly recognised as a teacher no less than as a hewer of wood and a drawer of water. And the pursuit of science must be followed not by the professional few only, but, at least in such measure as will insure the influence of example, by the many. But this latter point I need not urge before this great Association, whose chief object during more than half a century has been to bring within the fold of science all who would answer to the call. In the second place, it must be understood that the training to be looked for from science is the outcome not of the accumulation of scientific knowledge, but of the practice of scientific inquiry. Man may have at his fingers' ends all the accomplished results and all the current opinions of any one or of all the branches of science, and yet remain wholly unscientific in mind; but no one can have carried out even the humblest research without the spirit of science in some measure resting upon him. And that spirit may in part be caught even without entering upon an actual investigation in search of a new truth. The learner may be led to old truths, even the oldest, in more ways than one. He may be brought abruptly to a truth in its finished form, coming straight to it like a thief climbing over the wall; and the hurry and press of modern life tempt many to adopt this quicker way. Or he may be more slowly guided along the path by which the truth was reached by him who first laid hold of it. It is by this latter way of learning the truth, and by this alone, that learner may hope to catch something at least of the spirit of the scientific inquirer.

This is not the place, nor have I the wish, to plunge into the turmoil of controversy; but, if there be any truth in what I have been urging, then they are wrong who think that in the schooling of the young science can be used with profit only to train those for whom science will be the means of earning their bread. It may be that from the point of view of the pedagogic art the experience of generations has fashioned out of the older studies of literature an instrument of discipline of unusual power, and that the teaching of science is as yet but a rough tool in unpractised hands. That, however, is not an adequate reason why scope should not be given for science to show the value which we claim for it as an intellectual training fitted for all sorts and conditions of men. Nor need the studies of humanity and literature fear her presence in the schools, for if her friends maintain that that teaching is one-sided and therefore misleading, which deals with the doing of man only, and is silent about the works of Nature, in the sight of which he and his doings shrink almost to nothing, she herself would be the

first to admit that that teaching would be equally wrong which deals only with the works of Nature and says nothing about the doings of man, who is, to us at least, Nature's centre.

Science Works for Good.

There is yet another general aspect of science on which I would crave leave to say a word. In that broad field of human life which we call politics, in the struggle not of man with man, but of race with race, science works for good. If we look only on the surface it may at first sight seem otherwise. In no branch of science has there during these later years been greater activity, and more rapid progress, than in that which furnishes the means by which man brings death, suffering, and disaster on his fellow-men. If the healer can look with pride on the increased power which science has given him to alleviate human suffering, and ward off the miseries of disease, the destroyer can look with still greater pride on the power which science has given him to sweep away lives and to work desolation and ruin; while the one has been slowly learning to save units, the other has quickly learnt to slay thousands. But, happily, the very greatness of the modern power of destruction is already becoming a bar to its use, and bids fair—may we hope before long?—wholly to put an end to it; in the words of Tacitus, though in another sense, the very preparations for war, through the character which science gives them, make for peace

Moreover, not in one branch of science only, but in all, there is a deep undercurrent of influence sapping the very foundations of all war. As I have already urged, no feature of scientific inquiry is more marked than the dependence of each step forward on other steps which have been made before. The man of science cannot sit by himself in his own cave weaving out result by his own efforts, unaided by others, heedless of what others have done and are doing. He is but a bit of a great system, a joint in a great machine, and he can only work aright when he is in due touch with his fellow-workers. If his labour is to be what it ought to be, and is to have the weight which it ought to have, he must know what is being done, not by himself, but by others, and by others not of his own land and speaking his tongue only, but also of other lands and of other speech. Hence it comes about that to the man of science the barriers of manners and of speech which pen men into nations become more and more unreal and indistinct. He recognises his fellow-worker, wherever he may live and whatever tongue he may speak, as one who is pushing forward, shoulder to shoulder with him, towards a common goal, as one whom he is helping and who is helping him. The touch of science makes the whole world kin.

The history of the past gives us many examples of this brotherhood of science. In the revival of learning throughout the 16th and 17th centuries, and some way on into the 18th century, the common use of the Latin togue made intercourse easy. In some respect in those earlier days science was more cosmopolitan than it afterwards became. In spite of the difficulties and hardships of travel, the men of science of different lands again and again met each other face to face, heard with their ears, and saw with their eyes what their brethren had to say or to show. The Englishman took the long journey to Italy to study there; the Italian, the Frenchman, and the German wandered from one seat of learning to another; and many a man held a chair in a country not his own. There was help, too, as well as intercourse. The Royal Society of London took upon itself the task of publishing nearly all the works of the great Italian Malpighi; and the brilliant Lavoisier, two years before his own countrymen in their blind fury slew him, received from the same body the highest token which it could give of its esteem. In these closing years of the nineteenth century this great need of

Mutual Knowledge and Common Action

felt by men of science of different lands is being manifested in a special way. Though nowadays what is done anywhere is soon known everywhere, the news of a discovery being often flashed over the globe by telegraph, there is an increasing activity in the direction of organisation to promote international meetings and international co-operation. In almost every science inquirers from many lands now gather together at stated intervals in international congresses to discuss matters which they have in common at heart, and go away each one feeling strengthened by having met his brother. The desire that in the struggle to lay bare the secrets of Nature the least waste of human energy should be incurred is leading more and more to the concerted action of nations combining to attack problems the solution of which is difficult and costly. The determination of standards of measurement, magnetic surveys, the solution of great geodetic problems, the mapping of the heavens and of the earth—all these are being carried on by international organisations.

In this and in other countries men's minds have this long while past been greatly moved by the desire to make fresh efforts to pierce the dark secrets of the forbidding Antarctic regions. Belgium has just made a brave single-handed attempt; a private enterprise sailing from these shores is struggling there now, lost for the present to our view; and this year we in England and our brethren in Germany are, thanks to the promised aid of the respective Governments, and no less to private liberality, in which this Association takes its share, able to begin the preparation of carefully organised expeditions. That international amity of which I am speaking is illustrated by the fact that in this country and in that there is not only a great desire, but a firm purpose, to secure the fullest co-operation between the expeditions which will leave the two shores. If in this momentous attempt any rivalry be shown between the two nations, it will be for each a rivalry, not in forestalling, but in assisting the other. May I add that if the story of the past may seem to give our nation some claim to the seas as more peculiarly our own, that claim bespeaks a duty likewise peculiarly our own to leave no effort untried by which we may plumb the seas' yet unknown depths and trace their yet unknown shores? That claim, if it means anything, means that when nations are joining hands in the dangerous work of exploring the unknown South, the larger burden of the task should fall to Britain's share; it means that we in this country should see to it, and see to it at once, that the concerted Antarctic expedition which in some two years or so will leave the shores of Germany, of England, and, perhaps, of other lands, should, so far as we are concerned, be so equipped and so sustained that the risk of failure and disaster may be made as small, and the hope of being able not merely to snatch a hurried glimpse of lands not yet seen, but to gather in with full hands a rich harvest of the facts which men not of one science only, but of many, long to know, as great as possible.

Another international scientific effort demands a word of notice. The need which every inquirer in science feels to know, and to know quickly, what his fellow-worker, wherever on the globe he may be carrying on his work or making known his results, has done or is doing, led some four years back to a proposal for carrying out by international co-operation a complete current index, issued promptly, of the scientific literature of the world. Though much labour in many lands has been spent upon the undertaking, the project is not yet an accomplished fact. Nor can this, perhaps, be wondered at, when the difficulties of the task are weighed. Difficulties of language, difficulties of driving in one team all the several sciences which, like young horses, wish each to have its head free with leave to go its own way, difficulties mechanical and financial of press and post, difficulties raised by existing interests—these and yet other difficulties are obstacles not easy to be overcome. The most striking and the most encouraging features of the deliberations which have now been going on for three years have been the repeated expressions, coming not from this or that quarter only, but from almost all quarters, of an earnest desire that the effort should succeed, of a sincere belief in the good of

International Co-operation,

and of a willingness to sink as far as possible individual interests for the sake of the common cause. In the face of such a spirit we may surely hope that the many difficulties will ultimately pass out of sight.

Perhaps, however, not the least notable fact of international co-operation in science is the proposal which has been made within the last two years that the leading academies of the world should, by representatives, meet at intervals to discuss questions in which the learned of all lands are interested. A month hence a preliminary meeting of this kind will be held at Wiesbaden; and it is at least probable that the closing year of that nineteenth century in which science has played so great a part may at Paris during the great World's Fair—which every friend, not of science only, but of humanity, trusts may not be put aside or even injured through any untoward event, and which promises to be an occasion not of pleasurable sight-seeing only, but also, by its many international congresses, of international communing in the search for truth—witness the first select Witenagemote of the science of the world.

I make no apology for having thus touched on international co-operation. I should have been wanting, had I not done so, to the memorable occasion of this meeting. A hundred years ago two great nations were grappling with each other in a fierce struggle, which had lasted, with pauses, for many years, and was to last for many years to come; war was on every lip, and in almost every heart. To-day this meeting has, by a common wish, been so arranged that those two nations should, in the persons of their men of science, draw as near together as they can, with nothing but the narrow streak of the Channel between them, in order that they may take counsel together on matters in which they have one interest and a common hope. May we not look upon this brotherly meeting as one of many signs that Science, though she works in a silent manner and in ways unseen by many, is steadily making for peace?

Looking back, then, in this last year of the eighteen hundreds, on the century which is drawing to its close, while we may see in the history of scientific inquiry much which, telling the man of science of his shortcomings and his weakness, bids him be humble, we also see much, perhaps more, which gives him hope. Hope is indeed one of the watchwords of science. In the latter-day writings of some who knew not science, much may be read which shows that the writer is losing or has lost hope in the future of mankind. There are not a few of these; their repeated utterances make a sign of the times. Seeing in matters lying outside science few marks of progress and many tokens of decline or of decay, recognising in science its material benefits only, such men have thoughts of despair when they look forward to the times to come. But if there be any truth in what I have attempted to urge to-night, if the intellectual, if the moral influences of science are no less marked than her material benefits; if, moreover, that which she has done is but the earnest of that which she shall do, such men may pluck up courage and gather strength by laying hold of her garment. We men of science, at least, need not share their views or their fears. Our feet are set, not on the shifting sands of the opinions and of the fancies of the day, but on a solid foundation of verified truth, which by the labours of each succeeding age is made broader and more firm. To us the past is a thing to look back upon, not with regret, not as something which has been lost never to be regained, but with content, as something whose influence is with us still, helping us on our further way. With us, indeed, the past points not to itself, but to the future; the golden age is in front of us, not behind us; that which we do know is a lamp whose brightest beams are shed into the unknown before us, showing us how much there is in front, and lighting up the way to reach it. We are confident in the advance because, as each one of us feels that any step forward which he may make is not ordered by himself alone, and is not the result of his own sole efforts in the present, but is, and that in large measure, the outcome of the labours of others in the past, so each one of us has the sure and certain hope that as the past has helped him, so his efforts, be they great or be they small, will be a help to those to come.

THE OLDEST IRON STEAMSHIP IN THE WORLD.

Of the United States steamer *Michigan*, on Lake Erie, which is the oldest iron steamship in the world, her commander, Lieutenant-Commander C. P. Perkins, gives the following particulars in *Cassier's Magazine* for September:—

The vessel was constructed at Pittsburgh, Pa., in 1841-43; the parts were transferred to Erie, put together and launched on December 5, 1843. The original machinery, with the exception of the boilers, is still in her and in good condition. The vessel is an iron paddle-wheel steamer of 685 tons displacement; length of keel, 156ft. 4in.; length between perpendiculars, 162ft. 6in; breadth of beam, 27ft.; depth of hold, 12ft. 5½in.

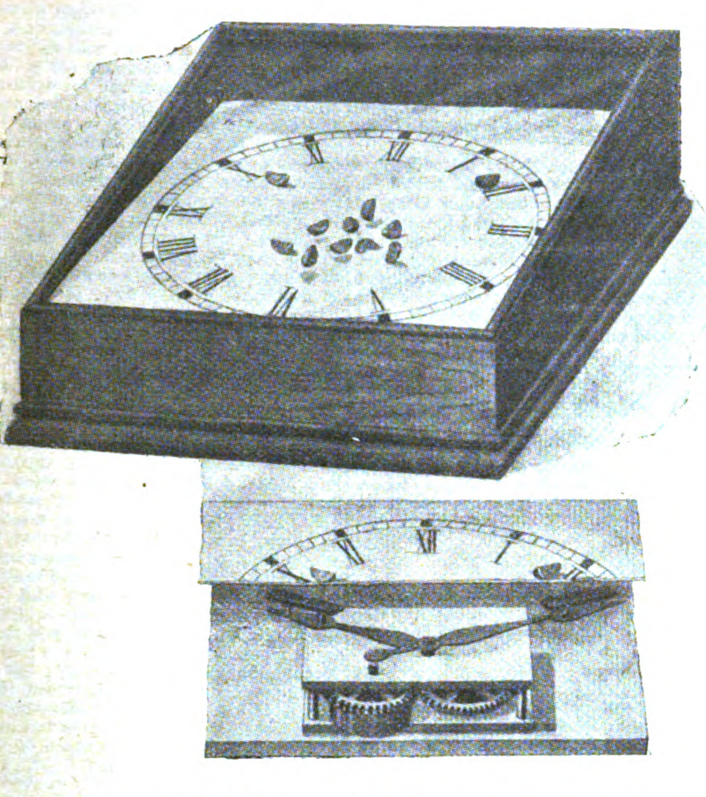
There are two inclined direct-acting engines. The paddle-wheels are of the usual radial kind, 21ft. 6in. diameter, with 16 paddles, 8ft. long by 1ft. 4in. wide. There are two steel boilers of the flue and return fire-tube type, 9ft. 6in. in diameter by 15ft. 2¾in. in length over all; two furnaces in each boiler, 6ft. 6in. by 3ft. 6in. in diameter, and have each a grate surface of 22·75sq.ft. The total grate surface is 91sq.ft., and the heating surface, 1,286sq.ft. There is one smoke-pipe, 4ft. 4in. in diameter, at a height of 42ft. 2in. above the grates. Total weight of boilers, 47 tons.

There are five heavy box keelsons, which run the whole length of the vessel. The distance from centre to centre of frames is 24in.; frames of T-iron, 4½in. by 4in., with reserve bars, 4in. by 2½in.; keel plates, ⅝in. thick; bottom and bilge plates, ⅜in. thick; side plating and run aft, $\frac{5}{16}$in. thick; stem and stern-posts, 6½in. by 1½in.; shear strake and plating carried up to the rail, ⅜in. thick; deck beams are of T-iron.

This vessel has been in continuous service to the present time, over fifty-five years, and is apparently as good for service as ever. During all these years of service no signs of weakness were exhibited.

Her armament at the present time consists of six 6-pounders, two 10-pounder rapid-fire guns, and two machine guns. Of late years her principal occupation has been in the instruction of the United States naval militia at the different Lake ports, and surveying.

At the Brooks Locomotive Works a large locomotive is just being completed for the Illinois Central Railroad. The cylinders are 23in. diameter and 30in. stroke; the drivers are 57in. diameter, and the total weight of the engine, without the tender, is 97 tons.



A MEXICAN BEAN CLOCK.

A FEW years ago public curiosity was excited by the curious beans called the "devil beans of Mexico," which shopkeepers placed in their windows. They somewhat resembled roasted coffee-beans in shape and colour. They were also known as the "jumping-beans," owing to the fact that from time to time they made spasmodic movement which propelled them quite a little distance. The beans grew on a small bush in the Mexican mountains, and it is conjectured that they belonged to the order Euphorbiaceæ. The bean really consisted of three similar pods, which formed a single bean. It is usually a third of the bean which was exhibited as a curiosity. On opening the pods it was found that it contained a small larva, something like that frequently found in chestnuts. It is this little occupant which gives motion to the bean by its jerks and thumps against the side of its home. If the bean is slightly warmed, it begins to turn from side to side, and perhaps with a sudden jump, turns completely over and stands on one end, and then, by successive jumps, moves quite a distance.

Those who are not in the secret are often greatly puzzled by this strange bean. An enterprising jeweller devised a scheme of utilising them to make a magic clock. He accomplished this by imitating the shape of two of the beans, making the dummy beans of soft iron; one he gilded and the other he silvered. The prepared iron beans were placed with the ordinary jumping-beans on a thin white piece of pasteboard, outlined and numbered like the dial of a clock, but devoid of the hands. This dial was located over the works of a large clock, which was placed face upwards on the floor of the store window. He fastened small magnets to the ends of the hands. The works were of course carefully hidden from view. All that was in evidence was the cardboard clock-dial and the jumping-beans, among which were the gold and silver painted iron beans. These were placed on the cardboard over the concealed hands with the magnets attached. The magnets were moved by the hands of the clock so that they were almost in contact with the cardboard. As they moved round they carried the iron beans with them, thus telling the time of day, and the public was greatly interested by the intelligence shown by the two beans, which distinguished themselves from their lively associates.—*Scientific American.*

A MAP OF THE WORLD ON A UNIFORM SCALE OF 1 : 1,000,000.*

THE seventh International Geographical Congress will meet in Berlin on Sept. 27, and among the more generally interesting subjects to be discussed—a list of which has already appeared in the journals of all the principal geographical societies—will be the proposed map of the world on a uniform scale of 1 : 1,000,000. At the fifth congress, held at Berne in 1891, Prof. Albrecht Penck, of the Geographical Institute of the University of Vienna, proposed the construction of a map of the world on this scale, and it was subsequently recommended that the scale be adopted for the purpose by a large and influential committee, whose report was read at the sixth International Geographical Congress held in London in 1895. It was also recommended by this committee that Governments, institutions, societies—in fact, all publishers of maps—should be invited to fall in with the idea of the scheme as far as possible, and adopt this scale, where practicable, in the future, so that there might be in course of time a sufficient area mapped on this scale to bring the accomplishment of the design within measurable distance and warrant the adoption of practical measures.

It was not, of course, to be expected that map-makers would at once set about reconstructing their work on the proposed lines, but it will be seen from what follows that the pronouncement of the congress has apparently influenced those responsible for a very considerable number of maps. As might have been expected from the reputation which it has earned for pioneering in all useful geographical movements, the Royal Geographical Society stands well in the forefront of those who have assisted, either purposely or by force or other circumstances, in contributing towards the accomplishment of this great work. Since the ventilation of the project in 1981 the society has published more than 20 maps on the scale of 1 : 1,000,000. Some of these, it is true, especially those of portions of eastern Africa, may have been plotted on this scale simply for convenience, as the ground-work, in the form of an older map by Mr. Ravenstein, on the required scale, was already in existence. But still the fact remains that this large number of maps on the scale of 1 : 1,000,000 has been brought out by the society. The well-known firm of Justus Perthes, of Gotha, and Diedrich Reimer, of Berlin, have also contributed good work on this scale, the former in *Petermann's Mitteilungen*, and the latter both independently and in conjunction with Dr. Danckelmann in his "Mitteilungen aus den Deutschen Schutzgebieten." Valuable maps, too, have been sent out from Stanford's geographical establishment.

Some idea of what this scale means may be gathered from the fact that the distance from Berwick to Land's End would be represented by a line about 26in. in length; while Africa, from Cape Blanco to Cape Agulhas, would measure 26½ft., and from Cape Verd to Cape Guardafui 24½ft. It will be seen, therefore, that for small countries the scale is not so well suited for general maps of reference, as in the case of larger areas. In all the larger European countries, except Russia, the scale seems to have been pretty generally adopted by the authorities in the construction of maps specially designed to show means of communication and so forth. Thus there is the official railway map of Austria-Hungary published by Artaria, of Vienna, in 1897, for the department of the Government Inspector of Railways. All the lines of communication, railways, canals, postal routes, and telegraph lines are shown on the map, as well as on the railway map of France, brought out in the same year by Mabyre under the auspices of the Ministry of Commerce, which, in addition to the hydrography, shows a large amount of detail, and is hypsometrically coloured. Maupin's map of France appeared in 1892; and a telephone map of the same country has been produced this year; the former of these was published for the Railway Department of the Ministry of Public Works, and the latter for the Post Office. The French General Staff, however, have not adopted the scale, their older railway map, which is now in use, being on the scale of 1 : 1,250,000, while the war map in course of construction is on a scale of 1 : 800,000. In Germany both the firms of Mittler and Son and of Max Pasch have lately published maps for the Railway Department of the Prussian Ministry of Public Works, while in Italy the Military Geographical Institute at Florence produced, in 1894, a map showing railways and navigable waterways—all three of which are on the scale of 1 : 1,000,000, and show a considerable amount of detail. Finally, in Spain, the War Office published a railway map last year which also shows the hydrography; and the postal authorities in Turkey produced a map of 1894 on this scale. All these maps are constructed for special purposes to the exclusion of topographical and orographical detail, and the smaller countries naturally choose larger scales.

Of ordinary maps of European countries showing full detail, very few have been produced on this scale since 1891. Messrs. Reimer and Co. published, in 1895, a map of the German Empire, reduced to the scale of 1 : 1,000,000 by the late Dr. Kiepert and his son; in 1892, August Hahr's map of Sweden, Norway, and Denmark was brought out by the Beijers, of Stockholm, followed in 1895 by Dr. Roth's map of Norway, published by Norstedt; and the Royal Geographical Society have lately brought out a map of Iceland. With these, and possibly one or two other exceptions, the Continent of Europe has not, since 1891, been mapped on this scale. There are, however, several older maps which might be made use of—and in the case of Spain would have to be brought into requisition, as the topographical survey is very far from completion—if it were determined to begin the construction of the map of the world within the next few years. The General Staff map of Sweden, published in 1870, could be used if necessary, and Coello's map of Spain. Then, again, in 1889, Lluillier published a general map of France, by Mezère and Hansen, and in 1885 the Italian Military Geographical Institute brought out a general map of Italy. Both these are on the required scale, and so, too, are the old General Staff map of the Netherlands, which bears the date of 1884, and Bianconi's 1885 map of Servia, published by Chaix, of Paris, as well as Kieppert's Turkey.

With regard to the continent of Asia, the Royal Geographical Society produced in 1893 a map of the Chin and Lushai hills with part of Manipur, followed by Col. Sawyer's reconnaissance survey of the Bakhtiari country in 1894; in 1896 the society published Mr. (now Lord) Curzon's excellent map of the Pamirs and the adjoining territories of Central Asia and India, as well as another map showing Mr. Littledale's routes in Tibet. In 1893 Challamel, of Paris, brought out, under the auspices of the French Foreign and Colonial Offices, the large map embodying the results of what is known as the Pavie Mission to Indo-China, and a new and revised edition of this has recently appeared, which includes all the most recent geographical work derived from English, French, and Siamese sources. This map, which is also on the scale of 1 : 1,000,000, extends as far north as Bhamo and a little further west, so as to include the eastern portion of Burma, while on the south it takes in a good portion of the Malay Peninsula. Further north we have Richthofen's map of the province of Shan-tung published last year by Reimer, and Gustav Kreitner's map, in 17 sheets, of Szechenyi's explorations by Hölzel in 1893. The Japanese Government, also, has brought out a map of Korea, Manchuria, Chi-li and Shan-tung on this scale; and Asia Minor, in several sections, appeared with Murray's new guide to those regions.

The Royal Geographical Society has published a large number of maps of various portions of eastern and south-eastern Africa on the scale of 1 : 1,100,000. In 1891 the map of Jackson's expedition to Uganda appeared, followed in 1892 by one illustrating journeys up the River Tana and to Mount Kenia undertaken by Capt. Dundas, R.N.; and in 1893 came in quick succession a map of the River Jub, also by Capt. Dundas, another of a journey to the east of Mount Kenia done by Lieut. von Höhnel, of the Astor-Chanler Expedition; then the results of the Mombasa-Victoria Railway Survey by Captains Macdonald and Pringle, and a map of the Anglo-Portuguese boundary. In 1894 the society brought out a map of Gregory's journey to Mount Kenia and Lake Baringo; in 1895 one of Mashonaland and Manika, including the lowlands to the Zambesi and Beira, from Selous's surveys. In 1896 Dr. Donaldson Smith's routes in Somaliland and to Lake Rudolf were published, followed, in 1897, by Captain Gibbons's work in Barotseland

* From *The Times.*

and Lieutenant Vandeleur's surveys in Uganda and Unyoro; while a map of Nyasa, by Rhoades and Phillips, and of a part of British Central Africa west of the Loangwe River, by Hoste, were issued last year, and a map of the Nyasa-Tanganyika Plateau, by the members of the commission for the delimitation of the Anglo-German boundary, has only lately appeared, as well as a map of Lake Choga and district by Captain Kirkpatrick. In addition to these the Royal Geographical Society also published in 1895 a map of part of the south-eastern portion of the Congo Free State to illustrate Mr. Hinde's explorations, and another of Morocco to accompany a paper by Mr. Harris. It will be seen that nearly all these will serve to bring up to date the large map of Eastern Africa, to which allusion has already been made, and which was compiled by Mr. Ravenstein and published, under the authority of the Royal Geographical Society, by Mr. Stanford in 1882. This map extends from 10° N. to 20° S. and from 25° E. to the Indian Ocean, and includes the Horn of Africa. Included in the same area are three maps published by Justus Perthes in *Petermann's Mitteilungen*—viz., Emin's routes to the west of Lakes Victoria and Albert, which appeared in 1892, Kolb's map of Ukambani and the Kenia district, which came out in 1896, and Count Wickenburg's routes in Somaliland, mapped by Paulitschke in 1898. The same compiler's map of the routes of Hoyos and Condenhove appeared in the "Mitteilungen aus den Deutschen Schutzgebieten" in 1894. In that year also the Italian Ministry of War brought out a map of Ethiopia in two forms, planimetria and altimetria, which embraces the area contained between 5° and 19° N. and 35° and 47° E. In 1896 the Portugese Government began the publication of a map of their Eastern African possessions, which is not yet completed, though the portion south of the Zambesi has been done. In 1891 and 1893 there appeared in the bulletin of the Italian Geographical Society the Somaliland explorations of Bricchetti - Robecchi. In 1893 Bandi de Vesme's routes from Berbera to Bur Dap were published by Guido Cora in Cosmos, and in 1896 a map showing the route of the second Bottego Expedition as far as Sankurar appeared in the memoirs of the Italian Geographical Society. Murray's 1897 "Handbook" contains a map of Egypt and the Nile as far as Khartum on the scale of 1 : 1,000,000, and there is also one of Lower Egypt in Baedeker's 1895 edition. Stanford's large map of Rhodesia, in six sheets, covers the country between 8° and 23° and 20° and 37° E.; this came out in 1896, and the same publisher's "Transvaal Goldfields" in the same year; while his "Western Somaliland" appeared in 1898, and his enlarged map of the South African Republic has just been brought out. A map, on the scale of 1 : 1,000,000, of the railway from Delagoa Bay to Johannesburg accompanied a consular report which appeared in 1894; Carl Wiese's explorations in the Western Nyasaland Goldfields were published by Rugg in 1892, and finally Ghika's routes in Somaliland were mapped by Paulitschke, and published by Bannwerth, of Vienna, in 1897.

Turning to the West of Africa, we have De Roquevaire's excellent map of Morocco, published by Barrère, of Paris, in 1897; Binger's map of the Upper Niger, reaching south to the Gulf of Guinea, produced by the Service Géographique des Colonies in 1893; Vuillot's course of the Niger, which was brought out by the Paris Geographical Society in 1894, and the same author's lake region of Gundam, which appeared in the *Bulletin du Comité de l'Afrique Française* in 1896. In this magazine also appeared a map of Chanoine's Gurunsi mission last year, while Eysserio's Ivory Coast journeys were published in the "Annales de Géographie," and Wauters brought out a map of the lower Congo, illustrating the railway works, in the "Mouvement Géographique," Brussels. In his book describing his ninth journey in the Sahara, Foureau has a map on this scale covering a considerable tract of country.

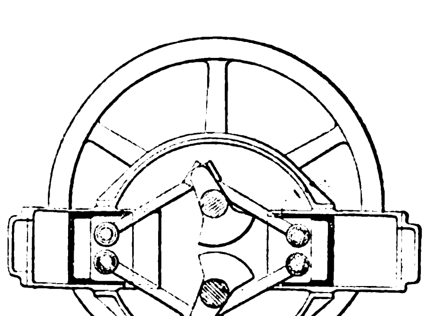
In Central America we have Bianconi's commercial map of Honduras and Salvador, dated 1891, and a map of Costa Rica by Colonel Church, brought out by the Royal Geographical Society in 1897. In South America, which has now almost robbed Africa of its title of "the Dark Continent," there are a few maps on the scale of 1 : 1,000,000, notably Dr. Brackebusch's Argentina, which was published by Hellfarth, of Gotha, in 1891. Siemiradzki's map of the Limay district of north-west Patagonia appeared in *Petermann's Mitteilungen* in 1893; while Dr. Fischer's map of the results of his Rio Palena expedition was published at Santiago in 1894. In the following year Capello produced his map of the route between Callao and Ucayali at Lima; and Steffen's map of the Rio Puelo come out in Petermann. Finally, Regel's journeys in the north-west of the United States of Colombia were illustrated by a map on this scale, which was published in the Verhandlungen of the Berlin Geographical Society.

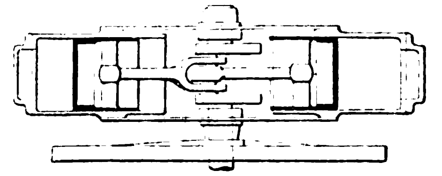
In the Australasian Archipelago there are also three maps which deserve attention—viz., Nijland's Java, which appears as an inset in his map of the East and West Indies, and was brought out b Breijer, of Utrecht, of 1891—a series of twelve sheets which cover the islands of Sumatra, Bangka, and the Riouw archipelago, executed by Dornseiffer and De Geest, and published by Seyffardt, of Amsterdam, in 1892 and 1896; and the results of the explorations of the brothers Sarasin in Celebes, which appeared in the *Zeitschrift* of the Berlin Geographical Society.

It will be seen that most of the better-known geographical societies of the Continent contribute something to this somewhat formidable array of maps, the output of nearly nine years; and this is, perhaps, one of the most encouraging deductions to be drawn from a perusal of the list. Another has already been mentioned—namely, the adoption of the scale by the various departments concerned in the production of special maps constructed to show chiefly the means of communication.

BALANCED ENGINES FOR MOTOR-CARS.

THE annexed illustrations show a balanced engine patented in this country, which the *Practical Engineer* says has been used with great success for





propelling motor-cars. The two crank-shafts being geared together, the gears not showing, equal quantities of angular momentum are imparted to each. Both the reciprocating and the turning moments are balanced and neutralised, or nearly so. The gist of the invention is contained in the patent claim, which is as follows:—"In motive-power engines, a method of balancing by arranging two oppositely rotating crank-shafts between them, and connecting the piston of each cylinder by two connecting-rods, one rod to each rotating crank-shaft. A motor constructed in this manner runs with practically as little vibration as a rotary engine or turbine."

MUSICAL PITCH.

THE question of musical pitch has, through the action of some of the leading pianoforte-makers, been again introduced into public discussion, says Mr. A. J. Hipkins, in *Nature*. That it should end in the general adoption of the French diapason normal hardly admits of a doubt, especially as it is in the United Kingdom only there remain any advocates for the high pitch formerly general. France introduced by law the diapason normal in 1859, and has been gradually followed by Belgium and Italy, Germany and Austria, Russia and the United States of America, leaving this country in musical isolation from which a great effort has yet to be made to bring it into uniformity with other musical countries, so that the note A will be approximately the same here as anywhere else, and not give the impression or a transposition. The difference of vibration number is not so very much; if it were a semitone it might be easier rectified—at least in concert organs; it may be stated at $\frac{5}{8}$ths, or at most $\frac{2}{3}$rds, of an equal semitone. It is measurement and the important consideration of temperature that justify the admission of a subject, at the first aspect merely artistic, into the columns of *Nature*. Temperature has as yet met with insufficient consideration. It is hardly alluded to in the "Sensations of Tone" by Helmholtz; it meets with a bare mention only, although somewhat extended, in the footnotes of the English translator, the late Dr. A. J. Ellis, who refers (p. 90, second edition) to the experimental work in that direction of Mr. Blaikley.

It is well known that the Paris diapason normal is stated as A = 870 vibrations a second at 15° C. As we reckon by complete vibrations, we take this number at one-half (435), with the temperature by the Fahrenheit thermometer (59°). Although this is a very good temperature for open-air music, as military bands, &c., it is not high enough for operas and concerts taking place in confined spaces with audiences and artificial lighting. The opera and concert orchestras have, therefore, everywhere to find their own pitch evolved from the Paris standard to suit an average increase of temperature. If the French Commission had decided upon 20° C. (68° Fahr.), the necessity for an empiric proceeding would have been avoided. They might very well have adopted Scheibler's suggestion, made in 1834 at Stuttgart, of A = 440. It is known that he worked at a temperature of about 70° Fahr. To him we owe the only facile tonometer, for which his pitch was really A = 439·5. It is well to go back to the protocols of the Congress at Vienna in 1885, which led to the adoption of the French pitch in Austro-Hungary. After a unanimous acceptance of the diapason normal at 15° C. it was proposed that, in order to keep the wind instruments in performance to the initial standard vibration number, A = 430, the brass and wood wind instruments, and also the organ, should be made for 24° C. (75.2° Fahr.)!—thus introducing a second standard to be used concurrently with the first, the necessity attributable to the vibration number being increased automatically by the heating and rarefaction of the air increasing its velocity, and with the orchestral wind instruments by the breath and handling of the players. Mr. Blaikley has shown the velocity of air in pipes is always less than in free air, possibly through the friction of the walls; but in the organ flue-pipes it comes so near to free air that the organ may be almost regarded as a thermometer. So high a temperature as 24° C. was not left unchallenged; a wiser determination was urged of 20°, which in practice would have proved right. However, the great differences likely to arise in average temperatures due to climatic conditions, and to warming and lighting apparatus, as for instance, gas or electricity, prevented a decision from being arrived at; so that Vienna is now, as London was, pending the decision of the Philharmonic Society, using a convenient empiric pitch of about A = 440 for concert performances. Ingenious as the Viennese plan in 1885 would have been, it is wiser to have one standard, with one note A for its expression, and one mean temperature. For brass instrument makers a B-flat fork may be used, and to suit the old custom of organ-builders and pianoforte-makers, a C fork; but in preparing them equal temperament should be rigidly observed.

In 1879, at the instance of Mme. Adelina Patti, the Covent Garden Opera adopted French pitch; a recent trial in performance satisfied me that it was at A = 440, the temperature being about 70° Fahr., and that there had been no departure from the intention of using the French standard. Little notice has at any time been taken of this important change at the Opera; but when the Queen's Hall was opened in 1893, Mr. Newman, the manager, and Mr. H. J. Wood, the conductor, lost no time in introducing the diapason normal for all performances for which they were responsible, the proprietors going to the expense of having the organ, which had just been built at the high pitch, lowered. Mr. Henschel, in his symphony concerts at St. James's Hall, and in founding the Scottish orchestra, speedily followed. But the decisive point for this country was reached when, in July, 1896, the Philharmonic Society, the most eminent musical institution in this country, elected to adopt the French diapason normal, and in the following November decided to have a standard tuning-fork for their concerts. Having consulted me, the directors accepted my suggestion for that pitch that it should be A = 439 at 68° Fahr. Forks made for the Society by Valantine and Carr, of Sheffield, were verified by me with the aid of the Scheibler tonometer in the Science Department, South Kensington, and besides the one retained by the Society, accurate copies were presented by the directors to the Science and Art Department, the Society of Arts, the Royal Academy of Music, the Royal College of Music, the Guildhall School, Trinity College, London, and myself; the last being accessible on all lawful days at Messrs. John Broadwood and Sons, 33, Great Pulteney-street, W. The B flat is stated in the same minute of the Society as = 465, the C = 522—this last happens to be a just minor third above A = 435, an accidental, although useful, coincidence.

The vibration number 439 is really the French standard raised to an average performing temperature, theoretically by my coefficient of a thousandth part of a complete vibration a second for one degree Fahrenheit, so that for 435 the rise for the next degree is ·435. In a variety of ways I have sought an average concert temperature, which I have finally taken at 68°, at which strings, wind, organ, and piano should be in tune. According to my coefficient A = 435 at 59° should be A = 438·98 at 68°. The round number 439 is more convenient. Briefly expressed, my coefficient is ·5 per degree for C = 500, nearly, if not quite, the rise in free air.

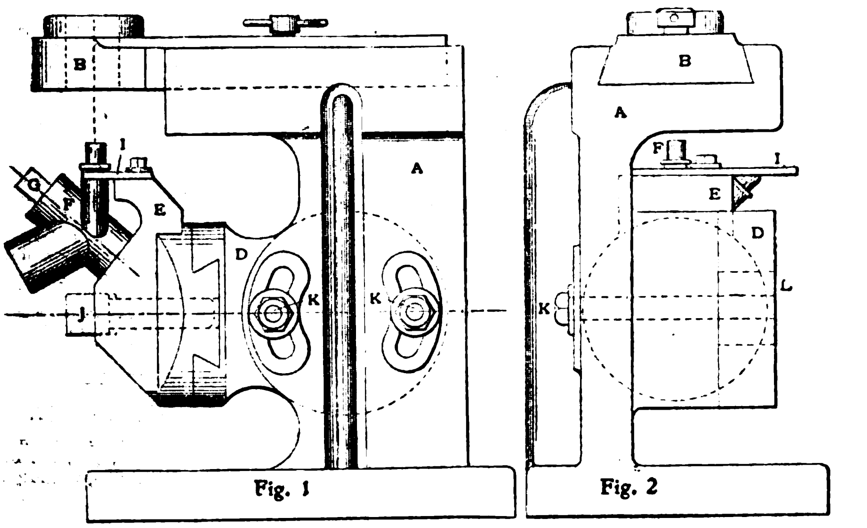


Fig. 1 Fig. 2

According to Helmholtz, the velocity of sound in dry air is at 0° C. (32° Fahr.) 322 mètres = 1,089·3ft., say 1,090ft.; according to Dr. Ellis, at 60° Fahr. the velocity is 1,200ft. per second—with this my coefficient practically agrees. In further justification, I quote the Covent Garden A = 440; the same vibration number for pianos, communicated to me by Herr Seuffert (Bösendorfer's), Vienna; the clarinet of Herr Mühlfeld, of Meiningen and Bayreuth, A = 439·5, it being understood when warm; a comple trial of all the wind instruments of Mr. Henschel's orchestra with a piano tuned to A = 439 in a room exactly at 68° Fahr.; and, lastly, the crowning triumph of the Lamoureux orchestra from Paris joining forces with the Queen's Hall orchestra in London this year, the accuracy of pitch in the performance being unassailable, A = 439! I should like to add for organs my trials of the St. James's Hall organ, at 52° C = 531 and at 72° C = 541, as one of the many comparisons of this nature; and conclude with Prof. Blaserna's report of a trial at Vienna, 1885, when A = 435 at 15° C., warmed to 30° C., became A = 457·7, equivalent to raising A to a tempered B flat. If a piano were supplied for a concert intended to be French pitch, at the standard fork A = 435, in London or Paris, Berlin or Vienna, it would be too flat for performance. It would be a concession of great importance, which the musical world could not be too grateful for, if the Paris diapason normal were revised for the higher temperature, 20° C., and legalised A.D. 1900, for France at A = 439. Our Philharmonic Society has shown the way, the rest of the world would soon follow. Neither the stability of pitch of the tuning-fork nor that of a pianoforte during a concert need be considered. Dr. Ellis gives the flattening of tuning-fork as 1 in 16,000 per degree Fahrenheit; Mr. Blaikley and myself in one trial only of a concert pianoforte, ·025 per degree; but for the short time a concert lasts this must be imperceptible, the elasticity of the music-wire having to be reckoned with against the least change of tension.

The objections to the A = 439 that have been urged are that wind instrument makers may take it as a starting-point for a lower temperature than 68°; but not if they are conscientious? We can legislate for this no more than we can for the tendency to exceed the present high pitch, as is shown by our military bands, and the majority of the brass bands in this country, in spite of Kneller Hall, which is bound to maintain the old Philharmonic pitch until the War Office releases the army from it, and provides or sanctions French pitch bands. Organ-builders who can work with accurate)rks and a thermometer will have no difficulty with th French pitch; indeed, nearly all are in favour of it, as are the pianoforte-makers and dealers generally; but there are some who seem to fear their instruments will suffer in brilliancy of effect by the reduction. When, however, we consider the rise in the tension of pianos during the last thirty years, due to improvement in music-wire and to a great change of construction, causing in grand pianos a rise in tension equivalent to a minor third in pitch, or more; and when we reflect that the difference of pitch proposed in tuning to the new Philharmonic is only ⅔ths of an equal semitone, we may see in the change more a gain than a loss by a possible increased fulness of tone-quality, and, above all, we shall have uniformity with the rest of the musical world.

A DE LAVAL steam-turbine motor has been used in a slate mine for running a ventilating plant. The high speed of the turbine is reduced by means of gearing, so that the actual speed of the fan is about 1,000 revolutions per minute.

AN ADJUSTABLE JIG.*

THE jig described in this article is for doing work on the bicycle part known as the seat-post union, and is so constructed as to get the cuts on different sized pieces, and also the different cuts on the same piece with one jig. This jig was designed by Mr. J. R. Foster, the foreman of the machine shop in the Peoria Rubber Company. Anyone familiar with the requirements in this will appreciate the ingenuity displayed in providing for the peculiar difficulties presented by the angles of the piece F. The drawing describes the jig pretty completely, but a few parts may be mentioned.

The frame A carries an adjustable slide B for moving the bushing forward or back; also a sub-frame D carrying another sliding-piece E. D swivels on the solid post L, a part of A being held in position with the bolts K K. The different positions of the parts when once made for different operations are carefully marked, so that resetting for any part of the work is easy. The work being handled in lots, resetting is but little trouble.

H, Fig. 3, is a post with an expansion-screw G for holding the work, and I is a sliding gauge for locating the arms of F, first for one side and then

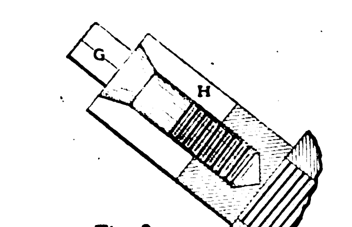
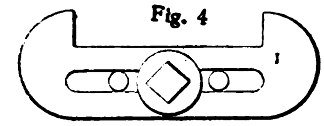


Fig. 3

Fig. 4



for the other. The set-screws C and J secure the sliding-pieces B and E in position very effectively and simply by bottoming on the castings A and D.

I intended to mention in a former article that the band-saw blades used in the manufacturing department, after being dulled somewhat for that class of work, do good service in the machine shop, being used in a Stover Novelty Company's hack-saw machine.

This is provided with a box for holding a continuous saw blade, and while it is not so rigid as some other machines, and does not cut off large work so straight, is very convenient for smaller work, and the saws mentioned are broken off and moved along with the least inconvenience.

* By A. H. CLEAVES, in *American Machinist.*

PROMOTION FOR SPIDERS.

THERE are signs that in the twentieth century the humble spider, whose creative talents have long been wasted in spinning endless traps to catch miserable little flies, will be promoted to a higher sphere of usefulness. He seems predestined to furnish the lov·li·r part of humanity with her most choice apparel, although the sceptical might fancy that a dress of cobweb, h·wever suitable to fairies, would scarcely pass muster in the City of London. Adopted by man, and relieved from the necessity of earning a precarious livelihood by expedients of doubtful morality, the spider is capable of much. Already the French military balloonists are breeding and taming spiders to yield fibres for their balloon cords. About a dozen tame spiders furnish the fibres to make a thread. The spiders are placed in a machine, and the fibre is drawn out automatically a certain length at a time. These fibres are pink in colour, and after being washed, to remove the sticky matter on them, are united in a thread, and these threads are spun into cords for balloons, which for their weight are much stronger than silk. Several species of the insect are adapted for this domestication, but the most promising is the "Halaba," or silk-spider, of Madagascar.—*Cassell's.*

THE SCREW PROPELLER.

WITH reference to the question "Who made the Screw Propeller a Success?" there will probably always be as much diversity of opinion as about the best form of the "propeller" itself, and every marine engineer knows that that is a good subject for discussion if it is desired to make a meeting "lively." Who first invented or suggested the use of the screw as a means of propelling vessels through the water has always been a matter of dispute, and now it seems that the question of who made the propeller a success is coming up again. Hooke (1680) and others subsequently suggested the use of the screw; but it would appear that the credit of the first application of the propeller to sea-going vessels is due to Col. John Stevens, of Hoboken, New Jersey, who, in 1804, constructed a boat, still preserved in the Stevens Institute of Technology, which is said to have attained "considerable speed" in that year. There is an English patent granted in 1794 to Lyttleton; but Stevens (followed by Fulton) seems to have been the first to make really practical trials. F. P. Smith obtained a patent in this country in May, 1836, and Ericsson obtained another in July, 1836. The fact appears to be that many inventors had turned their attention to the subject, and in the "Life of Isambard Kingdom Brunel" (London: Longmans, 1870) there is an account of Brunel's interview with the Admiralty, when a model of "Mr. Brunel's mode of applying the screw to Her Majesty's ships" was presented to his view for the first time. That was in 1841, and Sir G. Cockburn, the first Naval Lord, asked Mr. Brunel: "Do you mean to suppose that we shall cut up Her Majesty's ships after this fashion, sir?" Mr. Brunel said he knew nothing about the model, and whilst an inquiry was being made, quietly cut off the inscription with his knife. That anecdote, which is well known, shows how the opposition of the officials of the Navy often prevented, or tried to prevent, improvement. We mentioned last week that "Justice" (p. 68) had sent us some papers on the subject, one of which is a letter addressed by Mr. Henry Wimshurst to *Engineering*, dated March 5, 1879, in the course of which he says:—"The screw propeller had been under experiment for very many years before either Mr. Smith or myself were known to it, although these experiments ended in failure. My claim to merit does not, therefore, rest upon its introduction, as claimed for others by your correspondents, but from my having found it wrongly shaped, and applied in a wrongly-shaped boat, and from that position I elevated it to a better form, and applied it in a better manner, in a properly-formed ship, thereby making the use of the screw a commercial success, so much so that the second screw vessel which I designed and built, I, as the owner, sent under charter to foreign ports. The facts are as follow, and most of them are even yet capable of proof:—In 1836 Mr. Smith (who was then a draper and silk mercer at Hithe, and afterwards a farmer at Hendon) did, with the assistance of Mr. Wright, banker, and others, raise some £2,000 to test the merits of the screw as a propeller. They then had a little boat built by a boatbuilder at Wapping named Gulliver. This boat was about 30ft. in length, 9ft. in breadth, and 4ft. in depth. The propeller conpeller consists of a short log of elm cut to form one whole turn round the shaft, and it was situated in an aperture, or well, 7ft. forward of the sternpost. The boat where cut to form the aperture presented partial bulkheads—the one before and the other abaft the propeller—thus having a part only of the screw effective as a propeller. When this boat so finished was tested, no good result could be obtained, and a committee of four gentlemen, on behalf of the Licensed Victuallers Company—viz., Messrs. J. Ferguson, pilot; Charles Cutts, shipwright; Samuel Seaward, engineer; and E. Pascoe, N.A.; was thereupon formed to look into the matter, to make further tests, and report progress. Their report was in all respects so thoroughly unsatisfactory to the screw as a propeller that it was determined to go no further with the screw, and as the company were then wanting a passenger steamer, it was determined that the boat should be paddle-wh·el, and she was afterwards named the *City of Boulogne.*" Mr. Wimshurst then proceeds to tell how he com-

menced to build the *Archimedes* in May, 1838, and how he made a propeller having two blades, each less than a half-turn in length, which gave an increased speed to the vessel. Messrs. Ericsson, Woodcroft, Lowe, and others, were present at most of the experiments. Mr. Wimshurst advertised in the *Times*, December, 1842, challenging the production of any paddle-wheel vessel then afloat of twice the horse-power of the *Novelty*, which he had built, and which made the first commercial voyage with the propeller. The challenge does not seem to have been accepted, although the odds were against the screw.

The reprint from the *Nautical Magazine* of 1876, referred to by "Justice" on p. 68, contains diagrams of the propeller as fitted to the earliest ships in this country, and will be useful to those who wish to understand the history of the invention. Meantime we quote the following article from the *Times* of April 12, 1855, which may be of interest, apart from its special subject, because it shows how the leading newspapers dealt with technical matters in those days.

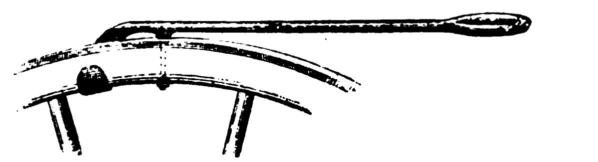
"Few great inventors have possessed the practical talents for business of Watt or Wedgwood. It is with the pioneers of science as with the pioneers of civilisation. They point out the way and clear the paths along which others are to travel with more fortunate results, at least, to themselves. Such has been the well-nigh universal story until quite in modern times. We, however, affect in this respect to be better than our fathers. We say, 'Let us be made aware of the real merits and claims of men who have rendered eminent service to their country, and adorned their age by great scientific discoveries, and, if they cannot help themselves, they shall not remain without fitting reward. They may be able, single-handed, to enrich themselves by means of commerce—we will help them with our patent laws and injunctions. They—the men of speculation—may have the good sense to take into partnership men of action and everyday sagacity, and so by united efforts promote the profit of both. But, failing all this, they shall not be left without compensation. If nothing else can be done, at least a definite sum of money may be collected, in proportion to the importance of their discoveries; and thus they themselves will be rewarded, and other men encouraged to proceed in the same course.' We live in age of 'testimonials,' as they are called. They are forced upon Protectionist squires in return for their patriotic services in promoting the best interests of the country, rightly understood. Slippers by the thousand pairs, worked by taper fingers innumerable, are unctuously laid at the feet of the Rev. Josiah Boltall. The originator of potichomanie has not been forgotten, nor the most finished adept in the science of picking locks. Churchwardens, demagogues, cotton-spinners, soldiers, have all had their turn; no one, in fact, seems to have been forgotten, save the man who has contrived the greatest mechanical improvement of which the present age has yet had notice. It may seem incredible, but it is nevertheless true, that the only man overlooked in this age of testimonials, distinctions, and honorary rewards, is the inventor of the screw-propeller—Mr. Smith. The object of our remarks this day is to bring the case of this gentleman—for surely it involves a great anomaly—before our readers. The point is forced upon our attention by the circumstances of the time. There was lately an announcement to the effect that the *Trafalgar*, a splendid three-decker enough as ships went in former days, had just reached England, having been 84 days out from Malta on her homeward voyage. Well-nigh three months, in other words, were spent upon a run which, by the help of Mr. Smith's invention, might easily have been accomplished in ten days. Consider, again, the list of those 'leviathians afloat' which have just left the shores of England for the Baltic campaign. A large draught of the entire naval force of England is there, and the power of this draught has been multiplied tenfold by the use of the screw-propeller. It is, indeed, scarcely fair, in such a case as this, to speak of the multiplication of strength in a tenfold—aye, or in a fiftyfold degree. More correct is it to say that the conditions of naval warfare have been altogether altered, and in every way to the advantage of this country, by this new application of mechanical power. To naval armaments has been communicated well-nigh the gift of ubiquity. They are no longer at the mercy of contrary winds; they cannot be detained in distant ports at a critical time when their presence is needed elsewhere. If we are to find a Troy in the Crimea, at least there is no Aulis for the British fleets. Again, they can undertake services which they dared not have attempted, even under the guidance of a Nelson or a Troubridge, when Sir John Jervis held the command of that wonderful Mediterranean fleet. The screw defies the perils of a lee shore. An enemy can now be brought to action from whatever quarter the wind may blow; henceforward there need be little or no manœuvring for the weather gauge. Let the enemies of England but dare to show themselves on the open sea—let them venture but for half a day from behind the protection of their batteries and stone walls, and we think we may without arrogance venture to say it, they will have but little inclination to bless the name of the inventor of the screw-propeller.

"Of course, now the thing is done, it appears to be a simple matter enough—quite as obvious as printing, or gunpowder, or steam-power, or the electric telegraph. Very second-rate men can readily make improvements on the original idea, but the question is, who first showed them the ground upon which they could plant a stable foot? Most of us have been acquainted at one time or another of our lives with inventors. There are plenty of them about, for nothing is more common than a moderate capacity for mechanics. It is grievous to add that persons possessed of this faculty in a minor degree are among the most tiresome and pedantic of companions. They will insist upon cramming their crude suggestions down the throats of men who are honest enough to admit that they know nothing about the matter, but are content to leave it in the hands of suitable persons. Now we cannot remember any point in the whole range of all possible mechanical improvements upon which there has been more discussion than upon new methods of propelling steamships through the water. The defects of the old paddle were obvious even to unscientific men; the question was as to the fittest substitute. There were innumerable propositions for modifying the action of the floats upon the water. Motive power was to be applied by wheels rotating astern or forward. The paddle-wheels amidships were to be protected in a hundred different ways from the peril of hostile shot; but why dig out exploded projects from the limbo of oblivion? Many of these inventions may, no doubt, have possessed merits which we are not in a condition to appreciate, through our own defects of knowledge; all persons who may be curious on such points can see hundreds of them embodied in the form of models in the Museum of the Society of Arts, or at the Polytechnic Institution. Thus much, however, is clear—not one of them found general acceptance with the world until Mr. Smith took the matter in hand, and invented the form of propeller now in use. On such a point surely success is the best test of merit. Even if his successors improve upon his model, the fact will still remain unchanged that he pointed out the way and set their brains to work. Upon the advantages which have resulted from this important discovery it would be a simple insult to the understanding of our readers if we were to say another word. They are not confined to war and warships alone. Merchant vessels can now reckon upon secure runs. The greatest portion of their time may be still spent under canvas, should the heavens prove propitious; but when adverse gales or tedious calms threaten to prolong the voyage, and to add indefinitely to the expenses of the owners, the steam is got up, the screw let down, and away goes the good ship on her appointed path, in defiance of obstacles which ten years ago would have proved insurmountable to the most skilful seaman with the means then at his disposal.

"Under these circumstances it is not without sufficient cause if we bring the case of Mr. Smith before the notice of Englishmen. Where so many miserable quacks and impostors have partaken largely of the public bounty, surely it were no unfitting thing if a provision were made for a man who has conferred so great and substantial a benefit upon his country. No doubt, it is perfectly right that all persons who may be inclined to take the matter in hand should be satisfied that Mr. Smith is really the originator of the idea, and that he has not as yet reaped from it any such benefit himself as he was entitled to expect. Let these and similar points receive the most ample and the most public discussion. If we thought that the gentleman of whom we write had any occasion to shrink from the most absolute publicity, we should not have troubled our readers with two lines upon the subject. But, should it prove that these allegations are, in point of fact, strictly true, it will remain a permanent disgrace to the country if a man who has been so greatly its benefactor be suffered to pine away in obscurity without any adequate reward for his successful industry and skill in contriving and perfecting an invention which has added in so high a degree to the wealth, the power, and the security of the British Empire."

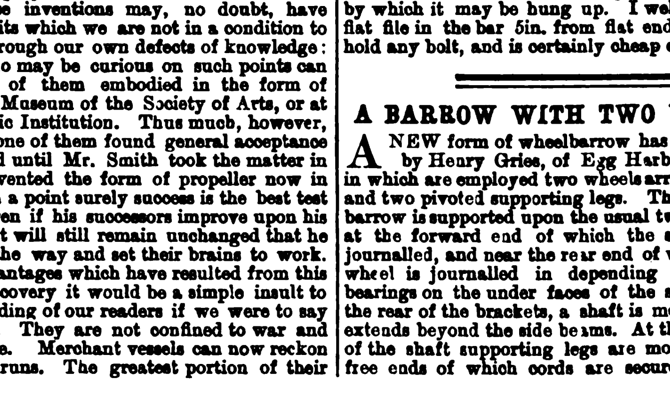
TIRE BOLT-HOLDER.

THE tire bolt-holder shown in the annexed engraving is considered a very good one by Mr. E. Bemis, of Pison, Ohio, who, writing to the *Blacksmith and Wheelwright*, says:—"I herewith send you a rough sketch of one that I have used for at least twenty years, it being home-made. I never saw one like it. It will hold any bolt in any size rim, so that it is impossible for it to turn, and if sufficient pressure is used will cut a slot in the head of the bolt like a screw-head. The handle is made of ½in. or ⅝in. round iron, 20in. long, or more; with end flattened and twisted so as to fit around the felloe; the other end being welded into a ring by which it may be hung up. I welded a piece of flat file in the bar 5in. from flat end and this will hold any bolt, and is certainly cheap enough."



A BARROW WITH TWO WHEELS.

A NEW form of wheelbarrow has been invented by Henry Gries, of Egg Harbor City, N.J., in which are employed two wheels arranged tandem and two pivoted supporting legs. The body of the barrow is supported upon the usual two side beams, at the forward end of which the small wheel is journalled, and near the rear end of which a larger wheel is journalled in depending brackets. In bearings on the under faces of the side beams, at the rear of the brackets, a shaft is mounted, which extends beyond the side beams. At the extremities of the shaft supporting legs are mounted, to the free ends of which cords are secured, which are reeved through eyes on the body and side beams, and provided with rings adapted to engage with pins on the ends of the handle. When the barrow has received its load, the cords are drawn back and attached to the side beams, thus carrying the legs out of contact with the groud, as shown by dotted lines in the illustration. When the barrow is not in motion, the cords are disconnected and the legs permitted to drop to the ground. The legs are held in their supporting position by means of removable pins passed through above the shaft. Stops on the side beams, in front of the shaft, prevent the barrow from moving forward.



A barrow thus constructed, it is claimed, will enable one to carry heavier loads with less fatigue than heretofore, because the larger rear-wheel supports the entire weight.—*Scientific American.*

PENNY-IN-THE-SLOT TELEPHONES.

IT is most astonishing, but a fact nevertheless, that in matters electrical Great Britain is moving very slowly indeed, being continually outdistanced by the United States, Germany, and even France.

As a novelty, we hear, says *Commercial Intelligence*, from Berlin of the introduction of automatic telephones on the penny-in-the-slot principle, which by way of trial are being put up at various public places and pleasure resorts by the German Post Office authorities.

These little apparatuses are connected with the nearest telephone exchange, at which, on the insertion of a nickel ten-pfennig piece (about a penny) into the slot, a bell is set ringing, when the wants of the customer are inquired into, and communication established between him and any telephone subscriber in the Berlin district, for a period of not more than three minutes.

Should this experiment prove a success, of which there can be scarcely any doubt, it is the intention of the German Post Office to establish this means of communication broadcast all over Germany.

Meanwhile, here in London every foreigner shrugs his shoulders at our ridiculously costly and inefficient private-capitalist-throttled telephone system.

USEFUL AND SCIENTIFIC NOTES.

A CANADIAN has invented an electric foghorn. It consists of two funnels made of ⅛in. copper. The funnels project 6ft. 6in. from a stand at right angles to each other. In each of these funnels or horns a vibrator or sound-producer is placed, the object being to use them alternately or simultaneously, as may be desired. A group of electro-magnets, made up of laminated iron cores wound in the ordinary way, is employed, and the instrument is operated by means of alternating currents.

A FRENCH magazine, devoted to the clockmaking trade, gives the following process for restoring nickel, and the majority of metals subject to tarnish, to their original colour:—Dissolve 0·40 to 0·45 gramme of cyanide of potassium in half a glass of water, plunge the objects into this solution, and withdraw them immediately. A simple rinsing with water suffices to remove every trace of acid. Next plunge them in spirit of wine, and dry them in sawdust to preserve from rust.

THE Bethlehem Steel Company recently despatched from its works the shaft of an engine for the Boston Elevated Railroad. This shaft and the parts attached weighed 170,400lb., which is said to have been the heaviest load ever sent by rail, except the Krupp gun which the Pennsylvania Railroad carried to the World's Fair. The shaft was taken from Bethlehem by the Philadelphia and Reading Railroad, and was carried on two cars. It was made for an engine built by the Corliss Steam-Engine Company, is 37in. in diameter at the middle, and hollow forged, with a 17in. bore. It is 27ft. 10in. long.

To secure the smokeless working of passenger engines on the Cincinnati, New Orleans, and Texas Pacific Railroad, the fireboxes are fitted with hollow brick arches, and four holes are made in each side of the firebox for the purpose of admitting air, and four tubes run through the arch. The outside air passing through these tubes is heated to a high temperature. This heated air supplies oxygen to the unconsumed gases, and is said to produce complete combustion. The four holes in the side of the firebox are placed 12in. above the grates, and into these openings are inserted air-tubes for deflecting the air to the fire.

Aluminium for Cooking Vessels.—Prof. Chatterton, of the College of Engineering and the School of Arts, Madras, writes to the *Madras Mail* stating that the manufacture of domestic utensils, and the like, of aluminium, is making a great stride in India. The work was originally started at the School of Art, but there are now several other centres of manufacture, and the more general adoption of the metal is being hastened by the prevailing high prices of copper and tin. A large order for cooking vessels for the 28th Madras Infantry has recently been filled at the school. These vessels have almost of necessity to be made by hand, since each native regiment has its own patterns. The production of a suitable water bottle is, however, a difficulty, as the flat pattern is not easily made in aluminium since soldering cannot be used; whilst a cylindrical pattern cannot be conveniently carried. Aluminium has also recently been used as a bearing metal for shafting in the Madras College of Engineering, and has proved satisfactory. The school has also recently supplied a complete set of railway carriage fittings made of this metal, and for taps, cocks, and other small articles, it is, Prof. Chatterton states, superior to brass.

SCIENTIFIC NEWS.

IT is announced that another small planet has been observed by M. Jean Mascart, of the Paris Observatory, on Aug. 26.

The *Bulletin* of the Société Astronomique de France for September contains an article on "La Photographie des Spectres d'Etoiles," by M. A. Cornu, and one on some new observations of the planet Mars made at Juvisy by MM. Flammarion and Antoniadi, which will be of great interest to students of Areography. There is a paper by M. Em. Touchet on "La Lumière de Vénus et l'Ombre qu'elle produit," and another by M. L. Rudaux on "Des Satellites de Jupiter," which will attract attention.

Dr. A. M. W. Downing, F.R.S., superintendent of the *Nautical Almanac*, has published, through Neill and Co., Limited, of Edinburgh, "Precession Tables adapted to Newcomb's Value of the Precessional Constant." The epoch adopted is 1910, but the tables are so constructed that they can be used with facility for at least ten years before and after that date. The tables have been arranged so as to give the values of the precessions corresponding to Newcomb's value of the precessional constant as deduced by him in accordance with the request made at the conference held in Paris in 1896.

The San Francisco correspondent of a morning paper says that: "Prof. Campbell announces that the Lick telescope has resolved the Polaris into a triple system, including two bodies which revolve round each other in a period of four days. Simultaneously, they revolve together around a third body, as the stars and moon revolve around the sun. It is improbable that any of these bodies are ever separately visible, their existence being revealed by spectroscopic methods. Fourteen discoveries like this have been made at the Lick Observatory, but this is the most interesting, surpassing even that of Capella."

The death is announced of M. Gaston Tissandier, the famous aëronaut and the founder and editor of *La Nature*. He made forty-four ascents, in one of which (1875) his companions Sivel and Croce Spinelli were suffocated. M. Tissandier had reached the age of fifty-six.

The Congress of the Royal Institute of Public Health will be held in Blackpool, Sept. 21 to 28, under the presidency of the Marquis of Lorne. There are four sections, one of them being devoted to engineering and building construction.

The distribution of medals and prizes to the students of the Royal College of Science will take place in the lecture theatre of the Victoria and Albert Museum on Oct. 5 (Thursday), when Prof. Rücker will deliver the address.

Lieut. Peary's expedition to the Polar regions does not seem to have been remarkable, although it is stated that it reached 50 miles further north than Nansen's. Lieut. Peary, however, was not bent on reaching the Pole, and has done some good work in exploring Grimell Land and its western extremity. The *Windward* returns in the spring, when Lieut. Peary will commence the three years' further prosecution of his search for the Pole.

All hope of finding Andrée's expedition seems to be abandoned, the Danish expedition under Lieut. Amstrup having returned to Mandal, after a year's absence, without having found a trace. A Reuter message from Malmo gives a similar account of the expedition under Prof. Nathorst. The Swedish expedition reports that it explored Franz Josef Fjord, on the east coast of Greenland, and there discovered a whole series of new inlets, the positions of which were charted. An interesting ethnographical collection relating to the now extinct Esquimaux population was secured in that region by the explorers.

The experiments in wireless telegraphy which were to be made at the meeting of the British Association may have to be postponed, as Signor Marconi is leaving for America in order to consider the question of the possibility of obtaining wireless communication between America and this country. It is stated that direct communication has now been established between Boulogne and Dover. Until the present trials it was believed that these cross-Channel communications would have to be retransmitted through the South Foreland, but direct communication has now been obtained between Boulogne and Dover, which is another scientific triumph for the new telegraphy. These interesting effects are to be demonstrated during the meeting of the British Association, the installation being placed in a railed inclosure, so that the members generally can see the operations. At the South Foreland the top of the pole is about 550ft. above sea-level. In the valley at Dover it is only about 150ft. above the level of the sea, and yet with all this difference it has now been proved that the results which can be obtained are equally efficient. "Such are the possibilities of wireless telegraphy that it would appear that a new development might at any time occur which would place the curvature of the earth to a great extent out of the question and permit infinitely greater distances to be traversed," so says the *Times*; but it would be wise to doubt the "infinitely greater distances."

In a memoir presented to the Paris Academy of Sciences, M. Maltézos points out that the ordinary equation gives no explanation of the phenomenon of beats in vibrating strings, and it appears from his investigations that it is nearly impossible to explain all the phenomena of beats in vibrating strings. It is certainly impossible to explain them from rigidity alone.

The first subaqueous tunnel in Germany is at the present time in course of construction under the River Spree in Berlin. It is intended to accommodate a tramway route connecting the Silesian railway-station with the suburb of Treptow, and has a total length, including approaches, of 2,020ft., 1,500ft. of which constitute the tunnel proper. Since the introduction of iron as a substitute for the older stone or brick linings of tunnels, the usual method has been to construct them of cast-iron segments, which are bolted together through flanges and lugs provided for the purpose. In the tunnel under the Spree cast-iron is discarded for steel, which forms a cylindrical casing having an internal diameter of 13ft. 2in. The lowest part of the tube is 35ft. beneath the mean water-level of the river, so that, given a depth of water of 11ft., there remains a thickness of the same amount between the upper part of the tunnel and the bed of the stream. Steel plates 2ft. 3in. in length, with their butt joints covered by double-angle steel, are built up to form the lining, and are protected externally from corrosion by a thick layer of cement. In the lower part, or invert, concrete is used to bring the floor of the tunnel up to track level, below which is laid a longitudinal drain to carry off any water that might accumulate, which will be pumped out as required by electric power. The piercing of the tunnel was effected by the shield and compressed air through strata composed of mud and dirty sand of a most unfavourable description, the maximum hydraulic pressure available amounting to 900 tons. The work was commenced in 1895, and it is expected that the tunnel will be opened for traffic next year.

According to a Reuter's message, the Dowager Empress of China has requested Mr. Pritchard Morgan to proceed to China, and to commence mining operations in the province of Szechuan. Mr. Morgan will, it is stated, leave in time to reach Pekin by the end of October, and will take a staff of geologists under the direction of Dr. R. L. Jack, formerly Government geologist of Queensland.

It is announced that the German Post-Office is about to introduce "self-propelled" vehicles, using electro-motors for the parcel waggons, and some "benzine" motor waggons will also be employed. In this country the motor-car post-office waggons are to be shelved, for the present, as they have not been altogether satisfactory in keeping time.

The following paragraph is at once a curiosity and a revelation:—"Mr. F. Coburn, a local naturalist and taxidermist, gives in the *Birmingham Mail* an account of a visit recently paid by him to Northern Iceland to study the nesting habits of certain birds that visit our shores, and to obtain specimens. He prides himself on having by his two-months' expedition cleared up many points relating to the habits and ways of birds that have long been in dispute, and to have established the error of several prevalent impressions. He has brought home with him 323 specimens belonging to fifty different species, besides eggs and nests. In Iceland, singular as it may seem, the law governing the shooting of wild birds is stricter even than ours. Some you are not permitted to touch at all; others are protected by a close season; and others, again, are only to be taken with the authority of the land-

owner, who is the tenant, for in Iceland they have anticipated the social reformer of our own country, and the land belongs to the people. Mr. Coburn added, as a curious fact (!), that during the whole of the time he was in Iceland he neither saw nor had occasion to use artificial light. He worked at any part of the night or day by the light of the sun."

Mr. Frank E. Lowe, writing from St. Stephen's Vicarage, Guernsey, says that the "long-tailed blue" (butterfly) has been abundant:—"On Sept. 1, I took eleven, including two females, and daily since I have taken some. On Sept. 1, I netted thirty-three specimens in all. This species is very rare in Northern and Central Europe, though not uncommon on the Mediterranean coast and Asia, extending to Australia and the Cape. Its sudden appearance, therefore, in numbers in this little spot, in spite of its reputed tendencies for migration, is very perplexing. Messrs. Newman and Tutt, in their respective 'Histories of British Butterflies,' quoting evidently the same authority, say, 'In 1859 the species was abundant in the Channel Islands.' Perhaps this refers to Jersey, but as to Guernsey, I believe the facts are these. In 1859 Miss Renouf took eight specimens of L. Bœtica, and one more in August, 1872. The next recorded capture is one by myself in this same garden on Sept. 15, 1892. About two years earlier, a schoolboy is reported also to have taken a battered specimen on the sea-coast. Thus it will be seen that it is forty years since more than one specimen has been taken in the same season in this island, and now they are to be had *ad lib.*"

According to a report by Lieut.-Col. Addison issued on Saturday, the collision at Wimbledon on May 8 would seem to have been due to a "want of care." The inspector says: "I have to point out that while the second, and fatal, collision was due to most regrettable want of ordinary care on the part of more than one of the company's servants, the first collision—which was the originating cause of the second one—must, in my opinion, be largely attributed to an unsatisfactory system of working, and, to some extent at any rate, to the station staff being inadequate to the requirements of this busy place. The system is plainly very defective, when it admits of the signalman pulling off a signal for an engine to move in one direction at the same time that a shunter may be, unknown to the signalman, taking another engine across, or foul of, the road made for the first one. I consider that a thoroughly experienced shunter should be in charge of the yard, under whose orders the signalman should set the points, pull off signals, &c., and the shunter should be the only person authorised to allow any train or engine to be put in motion. Had shunter Kimber remained in the sidings with engine No. 668, I think the first collision could hardly have occurred, but even then the system in vogue would seem to have permitted Kimber and Webber (with the goods train) to be acting independently—which should not be the case. Kimber left his engine because, as I have already pointed out, his services were required in the station. A man cannot advantageously perform the double duties of a shunter and platform porter, and the serious attention of the company should be drawn to the necessity for making proper provision for these duties with as little delay as possible." It remains to be seen what the directors of the company will do.

In his article on "Climbs in the Andes in 1898," in the *Alpine Journal*, Sir Martin Conway tells us that Lake Titicaca is fourteen times as large as the Lake of Geneva, and lies at an altitude of 12,600ft. above the level of the sea. A mountain railway finds its way up to this great lake, and the passengers are transferred to a steamboat if they wish to cross Titicaca.

The Great Salt Lake, in Utah, 4,000ft. above the sea-level, is dwindling. For three decades its shore line has been steadily contracting and its depth growing less. The Mormon system of irrigation cuts off the fresh supplies from the mountains, the lake consequently lies stagnant, at the mercy of the sun. Four rivers empty themselves into the lake, which it used to be thought, was fed also by hidden springs. From these rivers comes all the water for the irrigation of the Jordan valley in Utah. The evaporation is not regarded as very serious; the lake is a wonder and a salt factory only. But should the fresh waters of Utah Lake also dry up, thousands of square miles would cease to be habitable.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE AUGUST PERSEIDS, 1899.

[42810.]—It is a pity some of your correspondents did not commence their observations a few days earlier, as possibly we might have had an additional feature or two. To me the forerunners of the shower began to arrive as early as the 4th, on which date I saw two—one a stationary at 10h. 11m., this is the fourth time—from the usual centre near Eta. On the 8th I counted ten Perseids, radiation diffuse. On the 10th and 11th the meteors fell pretty constantly, but they did not seem so strong as in previous years. I placed the maximum at 60 per hour at 11 till 11.30 local time on the 11th. Display fell off next evening, and by the 14th everything was much as usual. The sub-radiants noticed were one near Beta Andromedæ at 10° + 38°, and one at about 70° + 55°.

If Mr. Beasley's dozen radiants are all Perseids, the stream, as we traverse it, would seem to consist of threads of meteors, each thread giving its own radiant—hence number and variety.

Belfast, Sept. 10. **W. H. Milligan.**

WEATHER OF AUGUST, 1899.

[42811.]—Supplementary to the usual letters about the phenomenal weather of the past month of August, it may be of interest to add that the amount of evaporation from a 6in. gauge here exhibits also high figures of 1·925in. or ·065in. per diem. This is higher than that for August, 1898, 1·460in. or ·047in. per diem, and for August, 1897, 1·225in. or ·040in. per diem, and for August, 1896, 1·410in. or ·042in. per diem. The present excess of one third more of evaporation is evidently exceptional, and may be due to the greater receptivity of the air occasioned by a general anti-cyclone of dry atmosphere continuing for about 21 days—a longer period than usual.

The relation between the rainfall and the evaporation is interesting as showing their interdependence, as there was in May a heavy fall here of 3·130in., followed in June by an evaporation of 1·950in. or ·065in. per diem, and a heavy rain in July of 4·230in., followed by an evaporation of 1·925in. or ·068in. per diem in August.

The total rainfall here for May, June, July, and August was 8·405in. or ·068in. per diem, and the total evaporation here was 7·265in. or ·060in. per diem, so that it would appear that all the rain has not been evaporated by the abnormal heat, and that there would be no occasion to consider the advent of any drought in this quarter. Some rain is estimated, therefore, to have been left here for the supplies of springs and streams, and thus to dissipate any grounds for apprehending an inconvenient drought over the country side, as it has a substantial balance of 1·140in. to go on with for the following month. **W. G. Black, F.R.M.S.**

Edinburgh, Sept. 3.

METEOROLOGY AND WEATHER PREDICTION.

[42812.]—There is no doubt something of a science of meteorology, but as to weather prediction it is no further advanced than it was in the time of Admiral Fitzroy. The following is a specimen of what is published about weather:—"Now what does all this point to? Clearly to greater stability and constancy in the climate. 'Is this not so?' asked a newspaper representative at the Metereological Office. 'Well, all I will say,' was the reply, "is that, not now particularly, but frequently during past years, I have noticed 'tendencies' to wet cycles of years, dry cycles of years, and so forth.'

"'And the reason?'

"'Ah! well, now you are asking a poser; it is a secret locked in the bosom of Nature; something, I should think, to do with the comparative distribution of atmospheric pressure over the Northern Hemisphere.'

"By the way, the present summer has been the driest experienced for 30 years."

The meteorological records for fifty and more years show conclusively that to predict weather is hopeless, unless the district is specified; for considering that in so small a piece of the earth as England, there is annually a difference of about 100in. in the rainfall (say between Cumberland and Norfolk), any prognostication must be local, and then what becomes of the cycles? I note that Mr. McDowall's latest (p. 60) refers to "London" winters, which seems a more scientific way of treating the matter than to speak as if "weather" applied all over the globe, or even all over Europe. **M. E. V.**

THE BRITISH ASTRONOMICAL ASSOCIATION AND THE ROYAL ASTRONOMICAL SOCIETY.

[42813.]—The comments of the "Fellow of the Royal Astronomical Society" (p. 88) on this subject are what might have been expected, and it remains only for me to assure him that the passage referred to is correctly quoted. When noticing such matters I make a practice of cutting the paper in which the sentences appear, and do not trust to transcribing. It is pardonable for printers to make errors in setting up type from manuscript, but not when set from print. As a matter of fact, I cut out the passages referred to before breakfast, and I believe they are correctly printed. They should be, as they were taken bodily from the paper in which they appeared, and I quite agree that the critic "is talking nonsense, pure and simple."

To the comments of "Eel Hay" (p. 89) I have nothing to say. **An Old Printer.**

GREGORIANS—γ^2 ANDROMEDÆ—TO "ELL HAY."

[42814.]—This contributor will be pleased to know that at the earliest opportunity I shall make my best endeavours to assist him in releasing himself from the unfortunate tangle into which he has allowed himself to fall among the uncompromising facts concerning the Gregorian telescope adduced by me in 42757 and elsewhere.

"Ell Hay" has entirely forgotten that the authorities I gave by name in 42757 as *observers* who favoured direct vision were all famous *practical* astronomers, and that those given as *opticians*, in the true sense of that term, were all quite as famous with their hands as with their heads. "Ell Hay's" assertion that the entire lot were "mere theorists like 'H.' himself" (see 42783) bodes ill for the validity of his other conclusions. For if such men as Dr. Robinson, of the Armagh Observatory, Sir G. Airy, the late Astronomer Royal, Barlow, Potter, Pritchard, Coddington, &c., all thoroughly *practical* authorities on the questions raised by your correspondent, are to be considered "mere theorists," as "E. H." says, "where be we?"

For the numerous kind things which "E. H." has said of me, I hope I am truly grateful; but when he classes me among the above-named illustrious "theorists," I must perforce disclaim, for, like all competent practitioners, these men were one and all perfectly at home in theory as well as practice, while poor "H." himself has always held his theoretical equipment as but very inferior to his instrumental and practical one, under which circumstances alone perhaps "E. H." ought to sympathise with, rather than ridicule, him. The practical work of the observatory, the use of graduated instruments of precision, and of telescopes of all kinds, from the actual construction of every part of some of which he has derived much pleasure, have together taken up very much more of "H.'s" time than optical theory has ever done (it is, I believe, of this particular "theoretical" shortcoming he stands accused). But need he complain, since to be thrown into the company he falls into in letter 42783 is only too flattering a compliment?

Need it be here repeated that Lord Rosse's requirements, his facilities, and the scale on which he worked made it almost a necessity that the telescope he constructed should be a Newtonian or a Herschelian. I thought this had been already sufficiently made plain; but, of course, Rosse being perhaps the most exclusively "practical" man, astronomically as well as optically, on my list, his corroborative testimony *in favour of direct vision telescopes*, where possible, had to be quibbled aside, as it is in "E. H.'s" reply (42783).

The question concerning the particular "green" of γ^2 Andromedæ (which Halley the second denies, see 42783), although perhaps already explained to the entire satisfaction and comprehension of the average reader, is I find placed again before me by that correspondent, and, as formerly, I shall not spare myself trouble in trying to gratify his wishes, as soon as opportunity offers, on which occasion I shall also clear off his entire score, and the mysterious "friend," so frequently spoken of, can then start in whenever he likes. **H.**

THE COMET AND THE DELUGE.

[42815.]—Cometary astronomy has made, strictly, only one advance since Newton's time,

namely, to prove comets vastly more numerous than he or anyone of his time fancied. Encounters between them and the earth are probably a hundred times more frequent than his data would enable us to reckon.

The foundations for believing an encounter in 3102 B.C. are really Halley's and his own, with several added from geology. We have numerous geological proofs of a world-wide catastrophe 50 centuries ago, or, at least, less than 60. But there was no catastrophe in 2358 B.C., because Hindoos, Chinese, and other ancient nations have older records. Morever, the fact of the Jews altering their Genesis is well known. But a Deluge in 3102 B.C. is recorded by all ancient peoples; and the Hebrew story thereof was not only believed by Christ, but made by Him a basis of His religion. Two Gospels, Matt. xxiv. 38, and Luke xvii. 27, make this plain. In fact, if the story were allegorical, as Mr. May thinks, there could be no Christianity whatever, as he must be well aware.

Breakneck Lyell invented this fallacy, which Darwin afterwards believed; but both were supreme asses for not seeing that cometary astronomy utterly clashes with them. Darwin, in his famous but absurd book, the "Origin of Species," wants "300 million years" for denuding the English weald; but what of the *hundreds* of comets encountered in that time? We are meeting, at least, four per million years. He was much honester in collecting facts than Lyell, and hence his books will always be valuable; but his origin of species by natural selection is ridiculous. Christians ought to have seen this, long before he wrote his "Origin of Species." E. L. Garbett.

REDUCING INTENSITY OF LIGHT—HELPS TO DOUBLE-STAR SEPARATION.

[42816.]—IN view of several recent communications bearing upon the initial part of above heading, among which are those of "J. F. B." (42628), "A. S. L." (42649), Wm. F. A. Ellison (42662 and 42752), R. J. Ryle (42688), "U" (42694), S. B. Gaythorpe (42711), N. Maclachan (42716), and "J. M. W." (42729), it might not be altogether out of place were I to add my little quota. Space sternly prevents me from entering into anything like a proper discussion of the various methods put forward in above-quoted letters, but it may be permissible to add some remarks upon a few points which have been either passed over perfunctorily, or have escaped notice altogether, omitting the costly polarisation methods.

First, we may, I think, take it as settled by general experience that, except for very small apertures, or in combination with other means the "dark-glass" method of reducing brilliancy is unsatisfactory, and not altogether free from risk to the observer's eye.

Second—that the "dark glass" as "fitted into the ordinary draw tube" or into short tubes to fit the field-lens settings of the eye-pieces, as made by Ross for some of his customers, although free from above risk, is less satisfactory than the first plan optically, from the fact that its situation causes it to intercept the rays at different angles to its surface at a place where these rays are far from being parallel, a disturbance resulting which does not occur when the pencils consist of parallel rays (or nearly so) as they do *outside* the eye-lens. (Of course the working of special curves on the dark glass would obviate the disturbance, but this, I believe, is never done; and even if done, the dark glass would then only act perfectly with one eyepiece.)

Third—that the introduction of a diaphragm to limit the aperture, admitting as it does of very great diversity of effect, depending upon the situation as well as the size and shape of the opening, has, as might be expected, given rise to considerable differences of opinion as to its effects.

Fourth—that diaphragms with multiple openings otherwise "perforated screens," to use the customary parlance, have, from their more varied effects, given rise to a still greater difference of opinion—some well-known authorities recommending them with much confidence, others, considering themselves "observers," as confidently condemning their use.

Fifth—that revolving screens, of variously shaped aperture, have also received consideration theoretically at least, but that practice is almost silent on this method.

Such, I take it, has been the experience or reading of your various contributors. In dismissing the method of intercepting the light between the eyelens and the eye, let me, however, observe that one very effective means of doing this has been left, if I mistake not, unmentioned by any of your correspondents—I mean the fluid cell, the performance of which I have personally found most satisfactory. The darkening medium, a filtered dilution of common iron ink with distilled water, first recommended, I believe, by Sir Wm. Herschel, is inclosed between two parallel plates fitted into the ends of a short cylinder or ring of from about $\frac{1}{2}$in. to $\frac{3}{4}$in. in length, and a small hole in the ring fitted with a watertight screw gives means for filling, for altering depth of shade, or emptying. When long out of use it must, in fact, be emptied and washed out, as there is a tendency to incrustation or deposit on the glass if left filled for a protracted period. By this means solar observations become most pleasant, the comparatively *cool* image of the sun being reduced to an intensity suited to ordinary vision, while its colour appears perfectly natural, being almost pure white.

As the athermanous action of plain water is to that of the much-praised "alum solution" as 11 to 13, by recent determinations, the above "cooling" effect can be understood. There is, however, one drawback concerning its use with *refractors*—viz., the required thickness of medium, including that of the retaining glasses, permits of its use only with very low powers, if the field of view is to be serviceable. On the other hand, with the *compound* reflector its thickness is no obstacle, and even with the highest powers available, its use is perfectly satisfactory. (See letter on construction of Gregorian eyepiece.) Were this fluid cell to be placed between the lenses, or in front of the field-lens, its surface would, as in the case of the above-mentioned dark glass, require to be worked to special curves. I have computed such curves, but have never found reason to depart from its use between the eye-lens and the eye. I can thoroughly recommend its use to amateur observers of solar spots, &c. It might be thought that heat currents set up in the liquid by the passing rays would disturb vision; but in practice I have never been able to notice such a defect.

Coming now to the third class of devices—viz., diaphragms, it may be noted that, as most of us know, this is the means taken to preserve the "webs" of transit instruments, altazimuths, &c., from destruction when they are used for solar observations; the heat, as well as the light, being diminished with the aperture, or rather as the square root of the aperture. The usual perforated lens-cap serves this purpose, the full aperture never being used on the sun. But still the dark-glass must be used also, for the diminution of light required by the eye would need an aperture (if used without the dark-glass) too small to allow of decent definition of the sun's limb. It is needless also to say that as possibly no object-glass is so thoroughly corrected for spherical aberration as to give the same focal length, masked and unmasked, the necessary shift of the "web" (a matter seldom possible) must, unless carefully made allowance for, introduce serious errors into micrometer work. Positions for the diaphragm, other than just in front of the object-glass, introduce too many complications to receive further notice here.

The fourth method, or that of the "perforated screen" placed usually near the object-glass or over the open end of the reflecting telescope, next claims attention.

To start with, I may mention that long before I became acquainted with Mr. Dawes's use of this method (although his aim was somewhat different), I saw a most accomplished mathematician and careful practical observer, lately deceased, frequently use it in the form of a Cambric handkerchief thrown over the object-glass of his instrument, when observations were made on the sun. I confess these observations were ostensibly for "position" only, and not for the examination of physical details, for which latter purpose I consider the method but imperfectly suited, although for the sun's limb, or as I shall show for double-star work, the definition is very perfect. Indeed one of your contributors, Mr. Wm. Rowland, of Leeds, mentions this very method, with "fine Brussels net" in letter 38652, May 1, 1896.

I can quite substantiate Mr. Dawes's opinion of the "screen" as already quoted second-hand in your pages from "Chambers's Handbook of Astronomy," p. 285.

There Dawes is stated to have found this expedient to be "capable of producing a sharpness of definition he considered to be very marked."

Dawes used "cardboard, such as that employed in Berlin-wool work," placed just in front of his object-glass. My own experience has been in favour of fine "net," having meshes about $\frac{1}{25}$in. wide, which upon the whole I find to answers best; but different telescopes apparently require different sizes of mesh. For detail upon *surfaces* of sensible extent, I have not found, as might be expected from the diffraction phenomena developed, the screen an improvement to definition—rather the reverse; but for double-star work I have found it of great benefit, where the light will permit of the consequent diminution in intensity. The effect seems to be the following:—The greater part of the field, with the exception of a well-marked dark area just round the star, is filled with a dim, hazy light, from the very considerable increase in the number of diffraction rings, and their complicated interferences, many of which produce the appearance of minute hazy ghost images of the star being examined. Round the star itself, however, the small area of almost perfect blackness, with the cutting off of any "fringes" which the opens lens may show, and the very decided diminution of the star discs, conspire to admit of the best possible scrutiny of the adjacent points of light, to which as almost mere points the star discs are now reduced. Sir J. Herschel says, in the case of a mist or cloud, to which the gauze screen is in some respects similar, "the intervention of a cloud which reduces their brightness *reduces also their apparent discs* (italics mine) till they become mere points." Sometimes I have been able to separate difficult double-stars by using a screen when the naked object-glass or speculum showed only a doubtful elongation. Readers may recollect than in the case of some uncharitable criticisms recently seen in "Ours" upon the work of certain double-star observers, I said in letter 42048, Feb. 17, "I am inclined to think that some of our contributors are not in ignorance of the effect of a muslin screen, else their remarks would be less confident," meaning by that that in using the means just discussed, they may have been able to see with their apertures what others, observing by the only means *they* knew of, failed to make out. H.

EFFECTS OF CHANGE OF TEMPERATURE.

[42817.]—IF Mr. Tanton has correctly quoted, this textbook is certainly wrong. Chasles' law should run: "If the pressure remains constant, an increase of temperature 1° C. produces in a given mass of any gas an expansion of ·003665 of its volume at 0° C."

What Mr. Tanton has assumed is that an increase of temperature by 1° C. produces an increase of ·003665 of the volume of a certain mass of gas *at any temperature*, other than 0° C. Here lies the error.

Trin. Coll. Oxon. J. M. W.

[42818.]—MR. W. E. Tanton (letter 42807) I fear has rushed into print without properly thinking out his subject. He says let V = original volume, a = coefficient of expansion, r = volume of 1c.ft., after the temperature has been raised 1° Then he goes on to say: "V r = the volume after the t has been raised 1°." But according to his formula V r would surely be the "original volume. The volume after the temperature has been raised 1°."

The proper way to state the case is thus: "That the relation between volume and temperature is such that if a given volume of gas be raised at constant pressure, from 0° C to 1° C., it will increase in volume by approximately $\frac{1}{273}$ of its original volume at 0° C." (*Vide* "Heat and Light," by R. Wallace Stewart, B.Sc., W. B. Clive and Co.)

At 100° C. the volume would be $\frac{100}{273}$ of its volume at 0° C., and so on. Hence −273° C. is denominated absolute zero. Theoretically the volume would then be reduced to nothing. But that is physically impossible. Air liquefies at a given temperature, and lower still becomes solid, when of course different laws must govern its expansion and contraction. W. F. Webb.

[42819.]—MR. W. E. TANTON has not as yet seriously threatened the veracity of textbooks on heat. (See letter 42807, p. 93.) The reason for his conclusions being wrong is that he improperly uses the coefficient of expansion. In other words, he arrives at the volume for an increase in temperature of 1° C. by the correct coefficient, and at the volume for increases of temperature of more than 1° C. by the correct coefficient plus one. Also he multiplies by his coefficient instead of adding.

Let me try to make this clear by working the formula—

Let V = original volume of gas in cubic feet.
a = coefficient of increase of volume of gas.
t = increase of temperature.

1c.ft. of gas increases for a rise of temperature of 1° C. by a c.ft.
Therefore V c.ft. of gas increase for a rise of temperature of 1° C. by $a \times$ V c.ft.
Therefore V c.ft. of gas increase for a rise of temperature of t° C. by $a \times$ V $\times$ t c.ft.
Therefore volume of V c.ft. of gas after a rise of t° C. is V + $a \times$ V $\times$ t c.ft., or $Vt = V(1 + at)$.
For a fall in temperature, formula is $Vt = V(1 - at)$.

If Mr. Tanton will work examples with these formulæ, he will see that the textbooks are perfectly right, and absolute zero is a possibility if Charles' law is perfect. W. B. M. M.

WHO MADE THE SCREW PROPELLER A SUCCESS?

[42820.]—"JUSTICE," in your issue of Sept. 1 (42769, page 681) says, "We are seeking facts, and to speak from memory is apt to mislead."

In my previous letter (42728, page 40) I wrote entirely from memory, as the subject is so accurately engrafted in my brain that I could not possibly make a mistake in reference to it, and as "Justice" has thought fit to send reprints of the press of 1876 and 1879 to substantiate his views on the subject, which no doubt have reference to

Mr. Wimshurst's statements contained in a printed paper on the subject (I have documents that will refute such statements) to the Right Honourable W. E. Gladstone, M.P., &c., in 1872 or thereabouts, I have now turned up my papers and correspondence which has lain dormant for many years, and forward a cutting from the *Times* of April 12, 1855, which leaves no doubt whatever as to who was the promoter and perfector of the screw-propeller. May I ask you to insert it? I could also forward copy of the *Daily News* of May 17, 1856; the *Sun*, April 18, 1855; *United Service Gazette*, April 21, 1855, and May 19, 1855; the *Bankers' Journal*, April 14, 1855; *Herapath's Journal*, April 15, 1855; *Naval and Military Gazette*, May 19, 1855; the *Engineer*, May 2, 1856; the *Observer*, May 19, 1856, and can produce many others of an anterior date, all of which give the credit of perfecting the screw to a practical development to Smith. None of them have any reference to Wimshurst whatever. Anyone desirous to verify the above could obtain those reports.

I think, Mr. Editor, that I have stated sufficient proof, and can more if required, as to who made the screw-propeller a success, and desire to close this controversy.

King's Lynn, Sept. 4. **C. P. Pilgrim.**

[See p. 111 for an article on the subject. Those who are interested have now practically all the data, and must form their opinions according to the statements published.]

WORKERS FOR SCIENCE.

[42821.]—I HAVE been more interested than I can say in Sir Michael Foster's Presidential address yesterday at Dover, abstracts of which I have read to-day in the daily papers, and a fuller *résumé* of which I trust you are giving this week in accordance with your usual practice.

The point which specially impresses me is the regret expressed by the President that, comparatively, so few devote themselves to the pursuit of the knowledge that after all is surely the only subject worthy of the attention of mankind. Politics, trade, law, letters, and the like engross the attention of nine-tenths of us, and the recruits for science are few and far between. Is it not time something were done to alter this, and to train up the coming generations in the service of science, that the abundant promise of the last hundred years may bear fruit a hundredfold during the coming century?

I feel sure there are thousands of fathers who will feel as I do, after reading Sir Michael Foster's address, and I venture, therefore, to ask for a little information. A middle-class man with a fairly large family of boys, most of whom have done fairly well—generally after wriggling their round selves out of the square holes into which I had fitted them, I want to know how I could start the youngest, a boy of 16, of average intelligence, but no special bent, and educated at one of our second-rate public schools, in some career in which he might work for science and—earn a modest living?

It is possible that some of your readers who have been through the mill may give hints. They would, I feel sure, be welcomed by many well-meaning parents. I am not pleading for facilities for the embryo giants of science. Their abilities will find recognition and encouragement, like those of Faraday and many others have done in the past. I only ask, in the first place, how it is possible to start average lads in the pursuit of some branch of scientific work which shall yield bread and cheese, and the prospect of really benefiting their fellows, instead of robbing them; and, next, is it not time the British Association, or some other organisation, devoted attention to, and sought means for the establishment of facilities for accomplishing this end? **Kappa.**

AHAZ'S DIAL.

[42822.]—BOTH "Little Bookham" and Mr. Wilmay, on p. 92, may be quite positive they are wrong about Isaiah's miraculous prediction of the shadow going back on the dial. It was a rare atmospheric effect that I had the good fortune to see reproduced at Portsea on 29th of March, 1848, and in the *Philosophical Magazine* of that June, p. 434, they will find my description of it. But the fact of its involving the same occurrence as that of Hezekiah's time was quite unknown and unsuspected by me till after 1860.

The cause of this phenomenon, called *parhelia* or *mock-suns*, and in some parts of England *sun-dogs*, is a state of the air filled with crystals of ice, like microscopic prisms; and when these have their axes turned in all directions indifferently, the effect is comparatively common, being merely a bright circle of 22½° radius round the sun or moon, called a halo. But when some electrical condition of a still atmosphere causes all or most of these prisms to be turned up vertically, several other circles appear, and at their intersections bright spots called mock-suns, of which there were six at Portsea. Most of these were far too faint to cast shadows; but there were two dazzlingly bright that concentrated all the light of a halo into two parhelia, right and left of the true sun, at his own altitude, and distant from him just a quarter of a quadrant. Now clouds floating about the lower air might hide either of these, or the true sun. If the sun and eastern parhelion were hidden, the western would cast shadows in the position the true shadows would have one hour and a half later. But if the true sun and western parhelion were hidden, the eastern would cast shadows such as the true sun cast one hour and a half earlier.

The phenomena were only perfect when the sun was at a certain altitude. I saw them first at 11 a.m., but afterwards at 1 p.m. for a longer time. Hours are not mentioned in any book earlier than Daniel; but the distance between the true sun and a mock sun being always a quarter of a right angle, if this quadrant was divided into 40° (a favourite number with the Hebrews), Isaiah could be ordered to offer Hezekiah the choice, Shall the shadow go forward 10°, or backward 10°?

As everyone connects this event in some way with Joshua's supposed miracle of stopping the sun and moon, I would here add that no such thing ever happened, or was related in any Scripture. First, the Samaritan book of Joshua notes nothing of the sort, though it relates the battle at greater length than the Hebrew book. The Samaritan's Bible consists only of the Pentateuch and this book of Joshua, which is not only much longer than ours in the part relating to Joshua, but adds brief accounts of all the chief political conquests of Palestine, down to Titus's conquest, the book not being finished till his time. Next, the New Testament has no reference to this miracle (even in Hebrews xi.), though the Son of Sirach believed in it, and monks have even believed repetitions of it as late as four centuries ago. In an account of the funeral of St. Peter of Alcantara, they had long ceremonies, and were astonished to find the sun not yet setting.

But there *was* a miracle at Gibeon, which was thus related. After the storm of hail had defeated the Amorites, and "they were more that died with the hailstones than they whom the children of Israel slew with the sword"; then spake Joshua to *the Lord*, "and He (the *Lord*) said in the sight of Israel, Sun of Gibeon, be silent, and thou moon of Aijalon Valley." And the sun was silent and the moon silent, until the nation had covenanted with their enemies. Therefore it is written in the Book of Jashar, "and the sun stayed in mid-heaven, &c." But the *Lord* said nothing about the sun in heaven, but the sun in Gibeon. The idolatrous Gibeonites had two oracular temples in Gibeon and Aijalon, but they had entrapped the Israelites and Joshua into a treaty of friendship (Chap. IX) No violence then could be used against them, and without a miracle, these heathen temples must always have stood. The *Lord* commanded this sun and this moon to be silent. The quotation from the Book of Jasher (or of the Upright) was not to cite it as authority, but to show why it was rejected. It was written after David's time, and never accounted Scripture. The silencing of these oracles was miraculous, because nothing in history is more certain than that oracles did exist in heathen countries. Such men as Crœsus and Cæsar would not have believed in mere frauds. Miraculous predictions were uttered by mediums (as we should now call them) in the names of the Sun, Moon, and various gods; but never later than our Lord's birth. Now, Joshua was a notable type of Him. His name ultimately became Jesus. It is most proper, therefore, that he should occasion the ceasing of these oracles; as afterwards, at our Lord's birth, all the oracles were silenced.

The division of a circle or a quadrant into 40 parts, as the Hebrews of Hezekiah's time divided it, can be done by compasses, with about four openings; whereas our division into 90 cannot be done geometrically at all.

Sept. 8. **E. L. Garbett.**

[42823.]—MANY thanks to "Wilmay" (letter 42797), but I do not think that the return of the shadow on the sundial of Ahaz can be explained by the occurrence of a partial solar eclipse, which would hide the upper portion of the sun's disc. Hezekiah's illness is fixed by Demetrius as having occurred about the time of such an eclipse, which happened on Jan. 11, 689 B.C., at 11.30 a.m. My Bible dates the incident 712 B.C. The prophet Isaiah would have foreseen an eclipse, and the whole affair would have been no miracle, but a neat fraud. Now what would happen if the South Magnetic Pole was moved a thousand miles nearer the North Pole? The question does not entangle the Southern Pole of the earth's axis of rotation, or the experiment would fail; and also what is the meaning of Revelation x. 6: "That there should be time no longer." What antics would the shadow make in this condition? We do not want another Deluge, but a reversal of the process.

Little Bookham.

THE NUMBER 666—THE DELUGE.

[42824.]—WILL Mr. Garbett tell me whether the original of the word in Daniel viii. verse 25, which is translated *prosperity* in the margin, bears the same meaning as Ευχορία? If so, it has some bearing on his contention, which, however, he must forgive me for saying, he seems to be running to death. Will he contribute an article dealing with the geological indications of—(1) a deluge such as described in the Bible, (2) the existence of a lower sea level in ante-Silurian times—such, for instance, as the 600ft. deep cliff line mentioned on p. 92? If he would do this, giving references to authorities for otherwise *ex cathedrâ* statements of fact, it would be certainly of interest, and probably instructive. **Glatton.**

MICRATOMIC ETHER.

[42825.]—REFERRING to a few of "G. M. W.'s" statements, I should like to say a few words. In the first place, he says that the all-pervading ether is not matter, because it has none of the properties of ordinary matter. Let me ask him what properties water has in common with a mixture of oxygen and hydrogen, which it does not share with other elements and compounds. Light is energy, as is shown by the photometer and other instruments. Can energy be transmitted through a void, a vacuum of all matter? Decidedly not, and yet light is transmitted from the sun to the earth.

Magnetism is, and it can be proved quite easily, an ethereal disturbance, and that disturbance is energy. Other energy is consumed when iron is magnetised. If iron is attracted, you get mechanical energy; but you lose some magnetism.

Electricity in a current, as far as I can see, is a molecular disturbance, accompanied by an ethereal disturbance. Can anyone kindly explain how it is that these two disturbances are always in the same proportion to each other? Magnetism retains only the ethereal energy. Secondly, he tries to point out that it is against the laws of nature for an element to combine with itself, as would be the case if all matter were built up of micratomical ether; but do not two atoms of oxygen *combine* to form one molecule?

If "Lucretian's" theory be not correct, how can the periodical arrangement of elements, according to their atomic weights, be accounted for, and also the relations between atomic weights of elements in the same group?

Is not the difference between, say, Australian and Californian golds due to atomic and not molecular differences, and would not this tend to show that the difference between various atoms was only one of degree? I think that if "J. M. W." considers what I have said he will agree with "Lucretian" on some points.

To R. A. Kenedy: Is not the pitch of sound equivalent to the colour of light? **W. Howse.**

MOTOR CYCLES.

[42826.]—I BEG to draw your attention to a slight error with reference to the above articles. In Aug. 4th issue, bottom of first column, p. 542, driving-wheels are given as 26in. dia. In Sept. 1st issue on general arrangement of tricycle, driving-wheels measure 30in. dia. Would the writer kindly say which is correct in paper?

An Interested Reader.

[42827.]—"THE WRITER &c." asks me (p. 41, 42735) what are my objections to flanges on a brake-drum? It seems to me that they entail needless weight and work, and diminish the available brake surface. For instance, the brake on the differential of the Decauville consists of two ½ bands, with a flange between them, and are on each side. If these were absent, and a single band used (which would be better than two narrow ones), there would be about ⅜ more driven surface available. There is also a certain amount of friction against the flanges, tending to draw the brake on, and they make it difficult to adjust the band so that it does not rub against the drum when "off," a common fault with band-brakes, especially if weakened by many rivets.

I have ridden many tricycles with band-brakes, but cannot remember any with flanges. I think it would be an improvement to fix the band by its centre, it being either tapering in thickness either way from the middle, or made of two superimposed leaves of unequal length, like a carriage spring, and strong enough to fly open when released, so as to form its own spring, the ends being drawn together by a double-acting lever, as in the "Writer's" drawings. It would then not only act either way, but would be much less likely to bind than the usual pattern. The spring used to release a brake should be close to the latter—not close to the handle, as some makers put it. This prevents rattle in the joints of the brake-rods, for it keeps them all pulled tight in the same direction as they are when the brake is applied. **Faber.**

[42828.]—I BEG to call "The Writer of the Articles'" attention to what I think is a slight mistake, which appeared in last week's issue on

p. 78. In the description of Fig. 106, at the bottom of the third column, you say: "The thin lines are the primary wires, and the thick the secondary." Now, according to both the diagram and also the succeeding explanation, the *thick* lines are the *primary*, and the *thin* are the *secondary*. I hope you will pardon me for making known this mistake.

A. Drysdale.

MOTOR-CARS.

[42829.]—I HAVE been very much interested in the articles and correspondence appearing in your paper relating to the Motor Cycle.

I think it might help the writer of the article, "R. J. V.," to unravel the mystery of the long cylinder bolts, to know that I came across a Loyal petrol motor with them; but I do not know if it was made before the date of the De Dion Patent, which is No. 19735 of 1895. Can the writer of the article, "Monty," or any of "Ours" tell me if there are any patents on the Benz motor-car, as I hear The British Motor Co. claim to have some rights on this car?

H. C.

BOILERS FOR MOTOR-CARS.

[42830.]—I AM much obliged to Mr. Allison (42792) for his reply to my letter on the above subject, and would like to have further information, if not too much trouble. I am not quite clear whether it is to be vertical—i.e., with the end plates on top and bottom or horizontal, as it appears to be by the drawing. And will not coal do with it, as oil-burners seem to be costly and complicated? Also has it been tried and found practicable? I hope Mr. Allison will forgive my troubling him again, but I believe there are many others besides myself who would be glad of information.

Water Tube.

BOLLEE MOTOR-CAR.

[42831.]—I HAVE been much interested in the articles running in the "E. M." on the construction of a motor tricycle, and should be glad to know whether an article will follow on the construction of a small motor-car on the Bollée style. There must be a good number of readers who would like to make such a machine, so that they could take out their wives with them for a spin, and to such I think the articles would be a boon. I have mentioned the Bollée pattern because this seems to be the simplest type to make. If the author of your articles cannot see his way to give a series of articles, would he kindly inform me where I could obtain working drawings, and also, if possible, where reliable castings may be obtained?

Machinist.

PRINCIPAL AND INTEREST.

[42832.]—I AM afraid I do not yet understand Mr. Garbett's views on the subject of capital; but I presume he repudiates the theories of Mr. Henry George, to which I chiefly referred. Demetrius was evidently an employer of labour, and probably a capitalist, to the extent of purchasing the silver required for his purpose and providing the means of working it. But whether he paid wages to his workmen, or gave them a share of the profits, does not appear. Indeed, he rather speaks as if the Ευπορία was theirs as well as his. If so, I hardly see the point of Mr. Garbett's Mark of the Beast. And then what became of capital during the time that elapsed between Demetrius and Franklin? Or why is Franklin singled out except for kite experiment, which had nothing to do with Ευπορία?

As to the talents and the pounds, did not the servants in both instances (except the unprofitable servant) use the money as capital, and are they not commended for so doing?

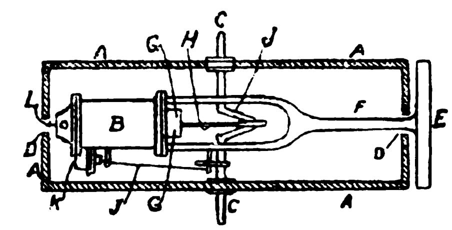
Moreover, lending money at a fixed rate of interest is not the way to acquire great wealth. The interest at the present day will be very low unless the investment is of such a character as to involve risk to the principal—as, for example, preference shares or debentures in some concern that may fail and pay nothing. Men who have realised great fortunes, and either retained them or lost them again, have always adopted different modes of acquisition from lending at a fixed rate of interest. Indeed, in the latter case the borrower, rather than the lender, acts the part of the capitalist. It is the borrower who employs labour, makes a profit, and pays the interest out of his profits. I think your readers will hesitate before finding the mark of the Beast in the forehead of every person who has a few pounds at a fixed rate of interest in a Post Office Savings Bank.

I fail to see why a landlord is to be regarded as a capitalist. In any event, when the intended tenant comes to take the land, he can (in a country where there is free contract) make his own bargain. He can purchase part of the land out and out if he has the money and the landlord is willing to sell. He can agree to pay a definite proportion of the produce, or a fixed rent, or a fixed portion of the produce, or a rent varying with the price of farm produce, or a rent below the estimated value together with a fine. If fixed rents are more common, it is probably because both landlord and tenant find them convenient. A rent consisting of a fixed portion of the produce is common in France. Has the system such an advantage over ours that we can find the Mark of the Beast in the one but not in the other? If Mr. Garbett was merely arguing for an extension of the co-operative system, I should not be disposed to quarrel with him; but I think co-operative societies would often find it very inconvenient to be deprived of the power of borrowing money at fixed rates of interest.

W. H. S. Monck.

A SMALL ENGINE.

[42833.]—I AM sorry Mr. Haig (letter 42764) does not understand Mr. Gibson's sketch. He thinks 99 per cent. will be in the same position. Perhaps the accompanying sketch may help him. I must be



A, flywheels; B, cylinder; C, axle; D, edge of rim of flywheels; E, standard bed-plate; F, standard supporting-engine; G, piston; H, connecting-rod; I, crank; J, slide-valve or ignition controlling-rod; K, valve-case; L, exhaust.

No. 100 per cent., as I see what Mr. Gibson means. Will Mr. Gibson please say if sketch and explanation are correct? I think this engine would work well.

A Drysdale.

[42834.]—I DO not wonder at Mr. Haig (letter 42764) being unable to understand my sketch, as it has been printed lying on its side. The flywheels inclose everything except the bottom of the column.

Also in my reply No. 96501 there has evidently been something omitted. I meant correspondent to understand that although most of the sizes would do, it would be advisable to strengthen others.

W. Ewart Gibson.

A MODEL ENGINE.

[42835.]—THE sketch of Mr. Gibson's has several uncommon points about it. The design shown would, I think, do very well for a model engine, but would, of course, be of no use for, say, a ½B.H.P. engine and upwards, because the moving parts are too much out of sight and inaccessible. Personally, I always like to be able to feel the bearings of an engine when running if they get hot, and oil them, which, of course, in Mr. Gibson's design, is out of the question. The best compromise would be to make the flywheels with three or four arms instead of solid, unless one or both flywheels were made detachable. The bedplate is of unusual form and light. I have often wondered why oil-engine makers stick like wax to the heavy cast-iron foundations for launch engines where weight is so important. Yes, I know oil-engines are single-acting, and want a firm foundation. Girder frames and cast steel rockers are now very fashionable for passenger steamers, fast fruit boats, &c., where they save a lot of weight and give satisfaction. All new Government warships, from the biggest ironclad indicating thousands of horse-power, down to the smallest launches, are built on this principle. I have worked on them. So why not oil-engines? Where G. A. Haig's (page 67) difficulty in understanding the sketch comes in I don't see. Two flywheels as described, anyone, who has done any drawing, can see with half an eye.

O. G. A. P.

STEREOSCOPES.

[42836.]—YOUR correspondent of Aug. 25 tells us how to see stereoscopic views without a stereoscope, and instructs us to do it by converging the eyes—which means, in plain English, by an inward squint. May I be allowed to point out that squinting inwardly does not produce the true stereoscopic effect, because the vision crosses, so that we see with the left eye the picture that we ought to see with the right, and vice versâ, the result being a sort of reversal of the perspective—curious with geometrical figures, but false and quite unnatural with ordinary views. To get the true stereoscopic effect it is necessary to squint *outwards*, just enough to bring the two pictures into one. This is by no means such an easy feat as the other, and I cannot do it myself; but I have seen it done by an accomplished photographer, who habitually tests his stereoscopic work in this way. To make sure that you are squinting outwards it is necessary, at the outset, to place a partition between the eyes reaching from the nose nearly to the line between the two pictures. Possibly many have the power of squinting outwards at will, but it does not strike me as a very wholesome exercise to squint either way—for young people, at all events.

R. S. D.

LEGAL REMEDY.

[42837.]—IF "Hear Both Sides" can point out any mode of recovering money from a person who has not got it, he will confer a benefit on the community. As to costs, which are not allowed against the other side, I think most readers will admit that if a litigant will insist on having almost daily conferences with his solicitor about the progress of the case, on retaining two or three of the most eminent counsel that can be procured, and, generally, on incurring heavy expenditure, with a view of "making assurance doubly sure," it would not be fair to onerate his opponent with the whole of the costs thus incurred, more especially if he only succeeds in establishing a part of his demand. Many writers on the subject write as if the case was transparently clear. If so, would not one or two interviews with the solicitor and one counsel at the trial be sufficient? Heavy expenditure usually means that the case is not clear, and, as already intimated, the success is perhaps only partial. If I demand £100 and am awarded £50, is it fair that my opponent should have to bear all the costs incurred by both sides?

W. H. S. Monck.

USEFUL AND SCIENTIFIC NOTES.

A DAM is to be constructed by the Great Falls Power Company, across the Potomac, at the Great Falls, together with a canal to convey the water to a power-house some distance below the dam.

THE following are the principal dimensions of a type of compound locomotives made by the Baldwin Company for the Erie Railroad. The engines have a total weight of 67½ tons, with a stroke of 26in., and 13in. and 22in. cylinders. The driving-wheels are 76in. in diameter, and the working steam pressure 200lb. Other particulars are as follows:—Tubes: Number, 271; material, iron; outside diameter, 2in.; length, 15ft. Fire-box: Length, 96in.; width, 96in.; material, carbon steel. Tank capacity, 6,000gals.; coal capacity, 8 tons.

ACCORDING to an American contemporary, the maximum spans possible for wires of different materials on a basis of a factor of safety of four is as follows:—Cast-steel wire, 3·42 miles; silicon-bronze, 1·56 to 1 mile, depending on quality; wrought iron, 1·02 miles; and soft copper, 0·53 miles. These maximum spans, it is said, are independent of the cross-section of the wire, for although the weight of the wire increases with the cross-section, its strength increases in the same proportion. The spans given do not allow for wind-pressure, snow, or ice.

Indiarubber.—The constantly-increasing importance of indiarubber renders of peculiar interest the experiments which have been made by the Asam Forest Department on the cultivation of *Ficus elastica*. According to a correspondent of the *Field*, the initial attempts to start successful plantations all resulted in failure, and it was not until 1879 that any success was attained. At the outset an attempt was made to imitate Nature by planting the seeds in clefts of trees, in the hope that the *Ficus* might, in germinating, become epiphytic on its host, but failure was the result. Planting cuttings was next resorted to, but though these struck readily, the resulting tree was almost devoid of aërial roots, which are an important factor in its after-life. In the end, the plan was adopted, and has succeeded, of raising the plant from seed and transplanting it as its stage of growth requires. Thus, the seedlings, when 2in. to 3in. high, are transplanted to nursery beds, where they are inserted in ridges about 1ft. apart, and remain here till a height of 12in. is attained. Each plant is then transferred to a bed 5ft. square, where it remains till a height of 10ft. to 12ft. is reached, having in the mean time been protected by fences from injury by animals. At this stage of the growth, the final transplantation is made. The roots being cut back to within 18in. of the stem, the tree is dug up and transferred to its final resting-place in the forest, and when an age of twenty years is attained will be ready to tap. The capital outlay is not large, but the money expended being locked up so long is a drawback; still, the plantations which have now reached the tapping stage are showing an excellent return on the original outlay, which amounted to £4 9s. 3d. per acre. The net profit, on the other hand, after paying expenses of collecting the rubber and freight to London has been £2 3s. 7d. per acre.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96373.]—**No Dead-Centre (U.Q.)**—In an ordinary single-cylinder engine the dead-centre is overcome by the momentum of the flywheel. If the querist has an invention which does away with the dead-centre, he would in all probability dispense with this wheel, which, up to the present time, has been looked upon as a vital necessity in single-cylinder engines; and although this is an inventive age, it is very doubtful if it will ever be supplanted—certainly not by any additional mechanism, the increased friction of which would lessen the effective power of the engine without yielding the other advantages which the flywheel possesses. MARLBOROUGH.

[96418.]—**Balance Gear.**—This query does not appear to have anything to do with balance gear, but rather with the methods adopted to get railway wheels round curves. Driving wheels fixed on an axle cannot revolve at different velocities; but the tires are coned, and the wheel on the outside of the curve covers more "ground" than that on the inside of the curve. There are plenty of manuals which explain this matter; but there are certainly not any ratchet-wheels on the axle, if a locomotive is meant. There cannot be any "fog" about the matter. The subject of coning railway wheels has been thrashed out years ago. MOTION BAR.

[96423.]—**Filtering Water.**—For an illustration of rainwater separator, see p. 379, June 9 last, and look as far back as 1870. What is wanted is a tilting arrangement which will (after the roofs and pipes are washed by the first of the rain) turn the following water into the butt or tank. There should preferably be two butts, in the upper of which the rainwater can be filtered into the lower. The late Shirley Hibberd had an excellent one fitted up at his house in Lordship-lane, Stoke Newington. Look through the back volumes if the device shown in the number for June 9 does not suit. M. T.

[96468.]—**Indiarubber Stamps.** — "Regent's Park," in his answer, says a dentist's vulcaniser is used for this. Really it is altogether the wrong thing. He says the mass is to be poured over the type. What mass is it? He says the stereotype plate is not to become dry, but is laid on a plate of vulcanised caoutchouc. The fact is, the mould must be thoroughly dry, and the rubber must be the *un*vulcanised. He gives 305° F. for curing heat, which is only suitable for making hard rubber; the soft is cured about 290°. He gives a long method of rectifying alcohol to mix with carbon disulphide as a solvent for rubber, whereas the carbon liquor dissolves pure rubber easily. With these few exceptions, his answer is not very far incorrect.
West Didsbury. M. COLE.

[96471.]—**Loan Amortisation.**—I have not one original question of "X.'s" to refer to now, but have before me his elaborate tables at p. 71. He thinks that the loan to be extinguished on one "amortisation" principle, as illustrated in the first table, is more favourable to the borrower than the loan as treated in the second table. Truly, that is so, as the first loan is at the rate of 3½ per cent. interest, and the second one at 4½ per cent. "X." will perhaps understand better if he looks at the matter from the lender's point of view. He lends £1,000 to pay himself at the rate of 3½ per cent.; repayments to be made in 44 annual equal payments of £45 each, to include interest and principle. Out of each annual £45 he puts £35 into his pocket, as and for 3½ per cent. interest, and the remaining £10 annual surplus he reinvests at the same rate—viz., 3½ per cent., which, with compound interest, will amount in 44 years to £1,000, which is the recoupment of his lent capital, so that £35 per annum is interest at 3½ per cent., and £10 per annum (total £45) is the annual sinking fund to be improved at 3½ per cent. compound interest to repay the £1,000 loan at end of 44 years. The second table shows the same annual payment £45, but states that the rate of interest is 1 per cent. more—viz., 4½ per cent., so that the £45 per annum is entirely absorbed by the interest, leaving no surplus to be reinvested to replace the capital. The equal annual repayment for 44 years for a loan of £1,000 at 4½ per cent. would be £59 6s.—viz., £45 for interest, and the surplus £14 6s. to be reinvested to accumulate at 4½ per cent. compound interest to replace the capital. As to the building society case of a loan, £1,000 to be extinguished during 20 years by 240 monthly payments of £7 each, that would be nearly at the rate of 7 per cent. For instance, if we treat it as 20 annual payments of £84, those payments would be worth in present money, to pay a purchaser 7 per cent., £1,011. Of course, 12 monthly payments would be worth a little more than one yearly payment, so that the percentage to to be returned by purchasing 240 monthly payments, instead of 20 yearly payments which £1,000 would purchase, would have the effect of increasing the interest which the purchaser (in this case the building society) would receive. There are other complications—e.g., the calculation may be made on the footing of pocketing one rate of interest and reinvesting the surplus to replace capital at another—a lower and more available rate. But if "X." desires to better understand these and similar questions, he cannot do better than first make himself acquainted with the use of logarithms, and study "Inwood's Tables," or, preferably, "Biden's Valuation Tables," and "Biden's Practical Rules for Valuers"—these last two out of print, but may perhaps be borrowed—and he should not omit to peruse "Compound Interest and Annuities" by Fedor Thoman, who treats largely of amortisation. "X." will perceive that the third column of his table is (or should be, if correctly calculated) £10 per annum improved for 44 years at 3½ per cent. compound interest, and that it will total to £1,000. Thus the first amount is £10, the second sum is £10·35; that is, the second annual £10 with interest at 3½ per cent. on the first £10 added; the third figure is £10·71, which is the third annual £10 with interest at 3½ per cent. on the sum of the two previous figures—viz., £20·25, and so on. It is an increasing series, each term augmented by the addition of £10, plus interest at 3½ per cent. on the sum of the preceding terms. A. H.

[96471.]—**Loan Amortisation.**—In "X.'s" original query it is stated that "£1,000 is borrowed *at 4½ per cent. interest*, the capital to be paid out of the interest in 44 years by a sum amounting to £1967·57." This is impossible. If we borrow £1,000 at 4½ per cent., and at the end of each succeeding year pay £45, our indebtedness will remain as at first. It is quite obvious, therefore, that if we pay *less* than £45 yearly, our indebtedness will increase; and if we pay more than £45 yearly, our debt will gradually decrease, and ultimately vanish. The more we pay over and above the £45, the sooner we shall be free. If, however, we take "X.'s" query with its supplement (p. 71), we perceive the fact is that £1,000 is borrowed, to be repaid by annual instalments equal to 4½ per cent. of the original loan. This is quite a different thing to borrowing at 4½ per cent. interest. The loan is, according to his own showing (supplement), borrowed at 3½ per cent. But as the repayment chances to be 4½ per cent. of the loan, the querist has got a bit mixed. The amortisement, or sinking fund, is created by the borrower when the lender is averse to receiving back his principal in driblets or annual instalments. In this case it is £10 yearly, the difference between the yearly repayment and one year's interest of the original loan, 45 − 35 = 10, and £10 invested at the end of every year for 44 years at 3½ per cent. will amount to £1,000, wherewith to repay the loan. It very frequently happens, however, that the sinking fund has to be invested at a lower rate than that paid for the loan, then either the sinking fund must be increased or the time extended. In this case, if the sinking fund could only be invested at 3 per cent., then it must be—

$$\log. 1{,}000 = 3\ 00000$$
$$\log. a = 8\ 61521$$
$$\log. R^{-n} = 9{\cdot}43516$$

$$\log. S = 1\ 05037$$
$$S = £11{\cdot}23,$$

instead of £10, thereby causing the repayment to be £46·23, instead of £45. The time required at 3½ per cent. is not exactly 44 years—more correctly, 43·642. In answer to his further query, p. 71, with the aid of monthly logarithmic tables, compiled some years ago, I make the interest in the building society transaction 5·714 per cent., and the monthly sinking fund £2·2383. GARSDALE.

[96478.] — **Poultry.** — When Mr. Turner has caught the sinner, let him, with a sharp knife, pare the upper portion of the bill till it is but very little longer than the lower. This remedy is effectual with egg-eaters also, and in both cases is always adopted by GARSDALE.

[96515.]—**Model Steamer.**—Boiler of locomotive will do for steamer described; but it will not be easy to keep up enough steam for at all a long run. Certainly, put another tube through—two more, if there is room. The single-action oscillators are very wasteful of steam; much better fit one slide-valve instead. A second safety-valve is not absolutely necessary, but it is always advisable. A piece of knitting-needle, or bicycle-spoke, makes a good propeller-shaft. Make it as short as possible; not more than 5in. Let it run in a tube nearly as long as itself, with brass bush at each end. Fill tube with vaseline, and it will be perfectly water-tight, besides lubricating the shaft. A powerful lamp, which will go on burning for some time, and will not cause conflagration, is to be desired. I will send sketch of one I fitted to a boat some years ago, which went very well, if querist wishes.
No. 7.

[96521.]—**Speed of Falling Chain.**—In my previous note I showed how the falling chain gradually attains its limiting velocity $v = \sqrt{g h}$. In the issue of Sept. 8 "P. B.," employing the principle of the conservation of energy, arrives at the conclusion that the speed of the chain is $v = \sqrt{2 g h}$. But "P. B." has fallen into error, because he has not taken account of all the forms in which the potential energy reappears. The application of the principle of the conservation of energy to mechanical problems always requires the greatest caution. The present problem affords an excellent illustration of the need of caution. If m be the mass of unit length of the chain, and h be the distance through which the chain descends, then the work done by gravity on the chain per unit length is $m g h$. The kinetic energy of the chain per unit length is $\frac{1}{2} m v^2$. This kinetic energy is "destroyed," so far as mechanical effect is concerned, by the impact of the chain with the ground. The energy, of course, is not lost; it appears as heat. The top of the chain has still to be considered. Here each link is started suddenly; at one instant it is at rest, and at the next instant it is moving with the velocity v. The process is, in fact, the exact reverse of that occurring at the ground, and thus it may be foreseen that heat will be produced at the top of the chain at the same rate as at the bottom of the chain. A detailed examination will make this plain. The momentum of unit length of the chain is $m v$, and v units of length are started per second. Thus $m v^2$ units of momentum are given per second to the chain by the tension at the top of the chain, and hence $m v^2$ is the measure of that tension. The work done by the tension while unit length of chain is uncoiled is $m v^2$; but the amount of kinetic energy taken up by this unit length is only $\frac{1}{2} m v^2$. The difference, $\frac{1}{2} m v^2$, is the amount of mechanical energy which has been converted into heat. Since the chain is supposed to have acquired its limiting velocity, the kinetic energy of the part of the chain actually in motion is constant. The work done by gravity must therefore find its equivalent in the heat produced at the top and at the bottom of the chain. Thus we have $m g h = \frac{1}{2} m v^2 + \frac{1}{2} m v^2$, or $v = \sqrt{g h}$. G. F. C. SEARLE.
Calshot House, Ryde.

[96521.]—**Speed of Falling Chain.**—Mr. D. J. Carnegie finds correctly that the acceleration of the falling chain is $\frac{g}{3}$ before the lower end reaches the bottom of the pit. It is not true, however, that after the lower end has reached the bottom of the pit, the velocity remains constant. If h be the vertical distance between the platform on which the chain is coiled and the bottom of the pit, the differential equation satisfied by the velocity of the chain, at any time after the end has touched the bottom of the pit, is—

$$v^2 + h \frac{d v}{d t} = g h \text{..............(1)}$$

The solution of this equation is—

$$v = \sqrt{g h} \cdot \frac{C e^{2 t \sqrt{\frac{g}{h}}} + 1}{C e^{2 t \sqrt{\frac{g}{h}}} - 1} \text{ ....(2)}$$

when C is a constant. If the time is reckoned from the instant when the end of the chain touches the bottom of the pit, and if the chain be supposed to have started from rest originally so that the velocity at the instant of contact is $\sqrt{\frac{2}{3} g h}$, then the value of C is found to be—

$$C = -\frac{\sqrt{3} + \sqrt{2}}{\sqrt{3} - \sqrt{2}} = -9{\cdot}8988 \text{ ......(3)}$$

and thus—

$$v = \sqrt{g h} \cdot \frac{9\,8988 e^{2 t \sqrt{\frac{g}{h}}} - 1}{9\,8988 e^{2 t \sqrt{\frac{g}{h}}} + 1} \text{ ....(4)}$$

After an infinite time $v = \sqrt{g h}$, as may also be seen by putting $\frac{d v}{d t} = 0$ in (1). Thus the velocity of the chain, after the lower end touches the ground, increases from $\sqrt{\frac{2}{3} g h}$ to $\sqrt{g h}$; these velocities are those of a freely falling particle which has descended from rest through distances $\frac{1}{3} h$ and $\frac{1}{2} h$ respectively. To find the amount of chain paid out in any time it is necessary to integrate the expression (2). The length of chain paid out since the end has reached the bottom of the pit is thus found to be—

$$x = h \log. \left(\frac{C e^{2 t \sqrt{\frac{g}{h}}} - 1}{C - 1}\right) - t \sqrt{g h}.$$

When t is large this takes the form—

$$x = t \sqrt{g h} - h \log. \left(1 - \frac{1}{C}\right)$$
$$= t \sqrt{g h} - {\cdot}0964\, h$$

with the value of C adopted above.
Calshot House, Ryde. G. F. C. SEARLE.

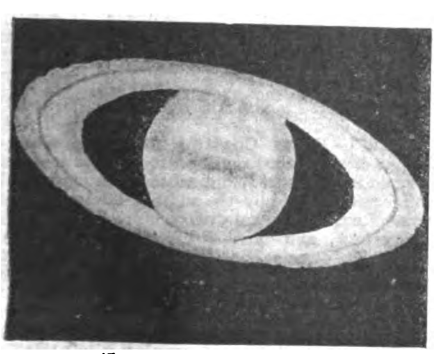
[96526.]—**Fly Catchers.**—Strong solution of

white arsenic (say 1 drachm to the pint) sweetened with moist sugar, molasses, or honey. Molasses, honey, moist sugar mixed with one-twelfth their weight of king's yellow or orpiment, very poisonous. Quassia chips ½oz., water 1 pint, boil ten minutes, strain, and add molasses 4oz. Black pepper 1 teaspoonful, cream 4 teaspoonfuls, brown sugar, 2 teaspoonfuls, mix with sweets. Fly-paper: Quassia wood ¼lb., water 1 quart, pour water on wood and allow to stand over night. Strain and boil liquid down to one pint; boil wood again with one pint of water until half-pint remains. Mix the two infusions, add ¼lb. sugar. When the sugar has dissolved, pass the paper through the liquid, drain, and dry free of poison. Or oil paper with turpentine varnish; or quassia chips 150, chloride cobalt 10, tartar emetic 2, tincture of pepper (1 to 4 proof spirit) 80, water 400; or pour a little simple oxymel into tumbler, place in glass a piece of cap paper, made into shape of upper part of a funnel, with hole at bottom to admit flies; smell attracts them, and they readily enter; or take earthenware pot, half fill with soapy water; cover with piece of paper, tied down or tucked under rim. Rub paper inside with wet sugar, molasses, honey, or jam, cut small hole in centre for fly to enter; fly settles on top, crawls through hole, warmth of weather causes soapy water to ferment, produces gas overpowering fly. REGENT'S PARK.

[96539.]—**Ebonite Boxes.**—In this reply on p. 95, what is meant by "resin," or is there some error? There are several resins, but I suspect that rosin is the substance meant; if so, why not say so? Many of these replies are useful when understood, no doubt; but it takes a good deal to understand them, and as it seems useless to appeal to the writer for the requisite information, I must ask readers generally. N. S.

[96546.]—**Motor Batteries.**—Mr. Saurez states in above query that he ran 500 miles by means of his De Dion quad motor. May I ask for a little information as to the character of construction of the above-mentioned motor, and how propulsion thereby is perfected, and the weight of same? The dry batteries spoken of are, I presume, for the purpose of ignition, not as a means of propulsion of tricycle. Kindly give dimensions of cells and the number required, also the price of motor. PHOTO.

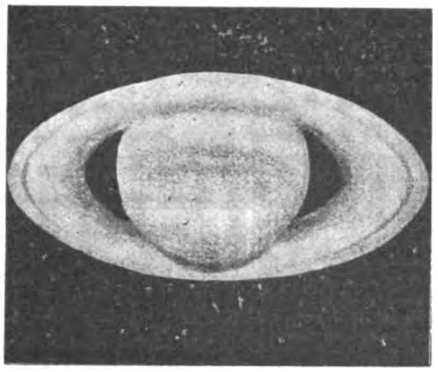
[96547.]—**Saturn.**—In spite of its low declination, I have had several splendid views of Saturn, especially on July 8th, when the definition was excellent and quite steady, allowing me to employ a power of 170 on my 3·1in. refractor. It was a splendid sight, but nothing abnormal was to be seen. The N. polar region appeared distinctly shaded. There was a broad and easily seen dusky band crossing the ball at about the centre of the



disc. The shadow of the crape ring on the ball could be faintly seen. The outer ring appeared distinctly dusky, and its outer edge was diffuse. The inner ring was bright and sharp. Cassini's division could be traced a long way round both ansæ. I have been obliged to heighten the contrast in the sketch for purposes of reproduction.

Trin. Coll. Oxon. J. M. W.

[96547.]—**Saturn, 1899—The Ring Nebula—A Large Magnet.**—The accompanying drawing may give some idea of the appearance of Saturn at the time of last opposition, June last, when opportunities of getting good views were less infrequent than lately. Good definition could never be bad; but, on one occasion, at any rate, powers of 100 and 200 were borne for a very short time. The broad duplicate belt to the N. of the equator was always seen, even in the poorest air, and is an easy feature. I wonder if any reader can give me some idea of the magnitude of the star immediately following the Ring Nebula? It is quite an easy object with any 5in. mirror, but appears in former years to have been of 14th magnitude, if we can take the observation recorded in Webb as correct. It is considerably brighter than the minute stars between ϵ_1 and ϵ_2 Lyræ, which are about the *min. vis.* of my instrument. The large magnet referred to by "F.R.A.S," formerly owned by Lord Lindsay, and now in the Royal Observatory, Edinburgh, is hardly, I think, so powerful as he suggests. A bunch of keys requires to be held fairly close to the poles before they will fly towards them. An iron bar placed

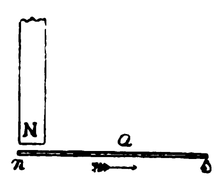


upon the poles, however, requires very considerable force to remove it. CHARLES F. SMITH.

[96549.]—**Encke's Comet.**—I am thankful to "F.R.A.S." for his confirmation of last perihelion passage on May 24th, 1898, but my object was to get a nearer approximation. J. R. Hinde, in "Comets" (Ency. Brit.) gives the perihelion passage 1875, April 13 0682, and I was in hopes some of "ours" could supply a like fraction to the date I gave. W. S.

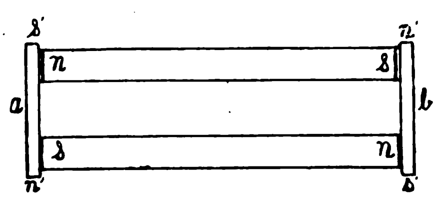
[96552.]—**Cigarettes for Asthma.**—Tobacco 90 grammes, extract stramonium 5 grammes, iodide potassium 5 grammes, nitrate potassium 5 grammes, alcohol 45 grammes. Mix, dry, and make a hundred. Use small hand machines, sold everywhere. REGENT'S PARK.

[96554.]—**Magnetism.**—Either a horseshoe or bar-magnet may be used, according to whichever is most convenient. For magnetising a compass-needle a bar-magnet might do better. The simplest method is that of single touch as in sketch. If a



a, Compass needle; N, North pole of magnet; *ns*, poles of needle. Rub pole of magnet a few times along needle in the direction of the arrow. Repeat on other side.

straight bar-magnet is laid away by itself alone it loses its magnetism. Bar-magnets should always be put away in pairs, with opposite poles adjoining, and connected by small pieces of soft iron laid



ns, ns, Poles of bar magnets; *a b*, keepers; *n' s'*, *n' s'*, induced poles of keepers.

across the poles as keepers. The keepers are magnetised by induction, and react upon the magnets and so preserve their strength. See sketch. A. DRYSDALE.

[96556.]—**Oil- and Gas-Engines.**—To "MONTY."—*Re* answer to "Isis," I am about making an oil-engine, and, according to my calculations, make capacity of motor cylinder to combustion-chamber at 2¾ to 1, equal 2¾ atmospheres, which at 14·7lb. equals 40½lb. pressure; not 65lb., as stated. Am I in error? 965.

[96562.]—**Lantern Screen.**—Best white, thick and strong linen—thickness gives opacity, strength prevents splitting. Corners strengthened with extra band of strong linen. Some made with eyelet holes at top and sides, other rings along the top and tape along the three other sides for opaque screens. Cover with paper, when dirty, repaper. A costly, but elastic filling is a prepared collodion:—Absolute ether 15oz., absolute alcohol 4oz., pyroxylin 1oz., paraffin wax 7gr. Hard paraffin wax first dissolved in ether, then add alcohol, lastly pyroxylin (soluble gun-cotton). Canvas stretched in frame and dried in hot-air chamber. Collodion rapidly applied to surface to be primed, several coats usually. Oil primings afterwards added in usual way. Collodion may be used itself as a priming thickened with dry pigment, such as Chinese white. REGENT'S PARK.

[96568.]—**Palms.**—Whilst thanking Messrs. Webster Michelson and Co. for their reply, let me assure them that the drawing-room is fully lighted by electricity. Therefore, the answer must be "J. D.'s" "air too dry," for which I thank him. As it is impossible to have the slightest damp in the drawing-room, it is obvious I must have them in the greenhouse. Surely there is a solution to what seems apparently a simple problem? L. R. C.

[96579.]—**Chemical Stylo. Paper.**—Bain, about 1851, used paper impregnated with cyanide of potassium, which gives a Prussian blue colour. REGENT'S PARK.

[96587.]—**Speed Indicator.**—To "W. J. G. F."—Many thanks for yours and "Regent's Park's" kind attention to my query; but in each case there is an important point omitted. In that of the speed indicator, you only state how it was driven—not the principle of the instrument itself, which I presume was that of a high-speed governor, but I wish to be sure. And your illustration of that of the plainimeter is exceedingly clear in all points save one—how is the wheel "attached" to the joint *j*?—what causes it to revolve so as show a definite relation (not ratio, presumably) to the area? SCORPIO.

[96596.]—**Waterproofing and Fireproofing.**—One out of many for fireproofing:—Sulphate ammonia 8lb., carbonate ammonia 2·5lb., boracic acid 3lb., borax (pure) 1·72lb., starch 2lb., water 100lb. Make hot solution of above and steep goods until thoroughly impregnated; afterwards drain, dry sufficiently to be ironed or pressed like ordinary starched goods. Waterproofing.—Linen calico: Use alumina acetate and soak. Used by Belgium coat department. Linen: Solution of alumina sulphate in 10 times its weight of water and soap bath. Or light-coloured resin 1oz., crystallised soda 1oz., water 10oz.; dissolve by boiling. Precipitate rosin soap with table-salt (½oz.), subsequently dissolved with 1oz. white curd soap in 30oz. hot water. Soak goods, or, with made-ups, brush solution and rinse off. Wools: White soap 4½oz., boil in hot water 2½gal.; separately dissolve 5½oz. alum in water 2½gal. Heat two solutions to 190° Fahr. Pass fabric through soap bath and then through alum, and finally dry in open air. REGENT'S PARK.

[96604.]—**Telescope.**—If J. Smith, p. 98, will refer to p. 561 he will find a similar query, strange to say, from J. Smith too—probably another person; but I have an idea that J. Smith is one of those questioners who do not take the trouble to see whether their questions are answered. Out of curiosity I have looked up the matter, and find that the first Mr. Smith was fully answered on p. 576. As to lenses for making telescopes, I think there is a little book published which gives instructions, but the telescope won't show mountains 70 miles off to a person standing on the sea level. T. O. JONES.

[96604.]—**Transformer.**—No; because, your dynamo being a continuous current machine, could not work a transformer. You might charge ten accumulator cells arranged five in parallel, and then the two parallel sets arranged in series, and this would enable you to light a number of 20v. lamps, according to the capacity of your accumulators. I may point out that you will have considerable difficulty in procuring 20-volt lamps that shall give 16-candle power. S. BOTTONE.

[96605.]—**Gas Pressure.**—This problem depends on "Boyle and Mariotte's Law," which states that the volume of any gas varies inversely as the pressure—i.e.—

$$(1)\quad V^1 P^1 = V_2 P_2$$

where V^1 and P^1 are the volume and pressure in one case, and V_2 and P_2 the volume and pressure of the same gas at any other time at the same temperature. In the case given the equation to use will be—

$$(2)\quad V_1 P_1 + V_2 P_2 = v p.$$

Let V_1 = volume of small cylinder = 5c.ft.
P_1 = pressure in small cylinder = 100lb. per square inch
V_2 = volume of air (if any) in large cylinder = 20 − 5 = 15c.ft.
P_2 = pressure of air in large cylinder = atmospheric pressure = 15lb. per square inch.
v = final volume of mixed gases = 20c.ft.
p is required

(I am taking it for granted that the larger cylinder will contain air. If it is a vacuum, use equation (1).) Applying equation (2)—

$$(5 \times 100) + (15 \times 15) = 20 \times x$$
$$500 + 225 = 20 \times x$$
$$x = \tfrac{725}{20} = 36\tfrac{1}{4}\text{lb. per square inch.}$$

I think the above should make the problem clear. J. BENNETT.

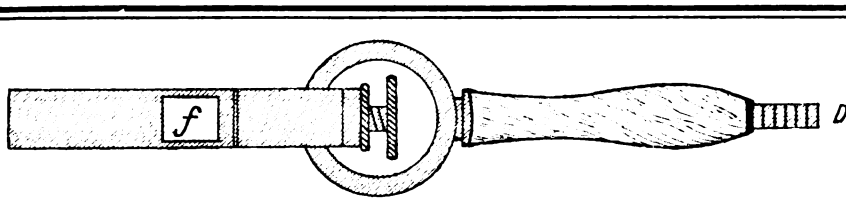
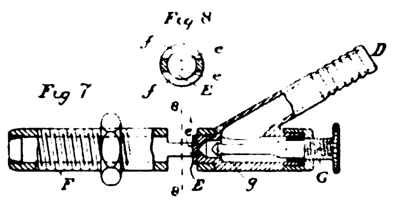


FIG. 1.

[96603.]—**Gas Blowpipe.**—A tool as illustration, Fig. 1. For details of construction, see Figs. 7 and 8. With a gas supply to it passed through a high-pressure foot-blower (such as are used for supplying "air" to gas blowpipes) would give the greatest heat possible from coal-gas. The blower would raise the gas to a pressure of about



300/10ths, so the orifices (*e*) from which it issues would need to be only minute ones. The air necessary to produce perfect combustion would be drawn in through the apertures (*f*) by the powerful inductive action of the gas.

GAS UNDER PRESSURE.

[96606.]—**Defective Battery.**—From your query I think you mean that you have connected a wire to zinc and another to porous, and a third wire to both zinc and porous at the same time. If that is so, then you will certainly feel no current, for it all takes the easiest path through the third wire direct. Connect one wire to zinc and another to terminal on porous, and put the ends on your tongue. You will feel it then if battery is charged properly. As far as I can make out, I take it to be a Leclanché battery. A. DRYSDALE.

[96607.]—**Mummy Wheat.**—It is an undoubted fact that some grains of corn—oats, I believe—that were taken from a mummy case germinated and ripened in England; but it was afterwards proved that the cases had been stored away for months in the Khedive's stables, and that the grain probably got in there. I have just spent a few months in Egypt superintending some work, and actually saw a case opened, and paid half a sovereign for a few ounces of wheat. As the grains seemed somewhat shrivelled, I soaked them in a glass of water, which afterwards appeared to have a faint blue colour. A few drops of ammonia solved the mystery, and proved that the ancients understood the virtues of sulphate of copper—or!! CLYTIE.

[96608.]—**Electric Clock.**—I think a good Daniell battery would be better than a Leclanché. It is, anyway, more constant, and does not require much attention when constantly employed. Zinc and copper sulphate are the only materials used up, and the products have a certain value. The Daniell can stand more hard work, I believe, than any other. Each cell gives about $1\frac{1}{12}$ volt approximately, so you need 6 cells = $6\frac{1}{2}$ volts. A. DRYSDALE.

[96608.]—**Electric Clock.**—I do not think you can beat Leclanché cells for this class of work. S. ELLIMAN.

[96611.]—**Voltmeter.**—To MR. BOTTONE.—About 10yds. No. 38 German silver wire, silk covered. But before starting work, you would do well to read the chapters on the construction of voltmeters in my "Electrical Instruments." S. BOTTONE.

[96614.]—**Charging Pocket Accumulator.**—The Siemens H dynamo is not adapted to charging accumulators. S. BOTTONE.

[96615.]—**Brown Boot-Polish.**—Phosphin is no doubt short for phosphine, a dye-stuff—an aniline yellow or orange, discovered by Nicholson, and made by Brooke, Simpson, and Spiller. Have you tried the well-known firm in the North—viz., Taylor, of Leeds, or at their branches? REGENT'S PARK.

[96615.]—**Brown Boot-Polish.**—I tried several of the beeswax and turpentine mixtures for my brown boots, but must say that, in my opinion, none of them proved satisfactory, owing to their causing the leather to harden and crack. If "Stella" will try the following recipe, which I obtained from the "E. M." a year or two ago, he will, I am sure, be pleased with the result, as I found it to keep the leather beautifully soft and supple. Mix together:—One pint of sour milk, 1oz. hydrochloric acid, ½oz. powdered alum, ½oz. powdered gum-arabic, scent with a few drops of oil of cloves. Phosphin, as mentioned by "Regent's Park," is, I believe, an aniline dye used by manufacturers for staining the leather a yellow tint. A. H. D. M.

[96615.]—**Brown Boot-Polish.**—I have the following recipe for a brown boot-polish, and perhaps it will be useful to your correspondents, though I have not tried it:—10oz. of good malt vinegar, 10oz. (fluid) of filtered water, 2oz. of good glue, 1dr. of soft soap, and 1dr. of isinglass. Colour with anatto or turmeric, or any of the aniline browns to the shade required. First mix the water with the vinegar, then dissolve the glue in the fluid by gently heating it; add the colouring matter and other ingredients, and boil from ten to fifteen minutes until all the ingredients are thoroughly dissolved and mixed together, then strain the mixture and put in a jar for use. To use this composition, lay it on with a clean sponge, and polish with a soft rag. If the mixture is too thick it may be thinned down with equal parts of vinegar and water; but, of course, it must be reboiled so as to get the vinegar and water to thoroughly intermix. In reply to a further question, I beg to say that "phosphin" is a mineral, and is used along with aniline brown stains to get the various shades in leather-staining. I might just say that it is very expensive, and very good stains can be got by using aniline stains alone, which can be got, I think, from some of the chemists in Manchester; if not, look through a Directory for manufacturers, and write to some of them, and you will then, no doubt, get what you require. If you require any particular shade, you had better send a sample of the colour you require, when you will be able to get it matched. W. H. B.

[96616.]—**Motor—Wire Table—Three-phase.**—To MR. BOTTONE.—(1) Wind the armature with about 2oz. No. 24 silk-covered wire. (2) You will find a table of copper wires, giving lengths, resistances, diameters, &c., in any electric-wire dealer's lists. I have given these so often in these pages, that it is not worth while taking up the space in repeating them. (3) A three-phase current is a rotary current produced by the combination of three alternating currents at different phases; the combined displacement between each set of phases being 120°. S. BOTTONE.

[96618.]—**Reducing Temperature.**—If you cannot have a small electric fan constantly moving, perhaps a limited quantity of freezing mixture, such as ammonium nitrate 1, water 1, sodium sulphate 3, dilute nitric acid 2. I could give you twenty-seven more, but think two may do. REGENT'S PARK.

[96619.]—**Electric Organ.**—The two organs could be played together in the way you suggest from one keyboard by electricity; but surely you are not thinking of wasting time and money on what would be a failure so far as the musical portion is concerned. In the first place, the reeds in the American organ and the pipes in the pipe organ would not keep in tune: when played together they are affected in different ways by the temperature—i.e., when the reeds are sharp the pipes sound flat, and vice versâ. A great many experiments have been made to try and get American organ or harmonium reeds to act in conjunction with pipes, but up to the present I do not believe any satisfactory result has been arrived at. If it could be done the use of 16ft. reeds on the pipe organ would be a great advantage, as the Bourdon pipes are frequently excluded from chamber organs, as they occupy so much room. With regard to adding pipes to the American organ, it would not do, for the above stated reasons, and also because the bellows of the American organ are exhaust bellows—i.e., they suck the wind down through the reeds, whereas in a pipe organ the wind is forced up through the pipes. With regard to articles on electric-organ construction, read Robertson's excellent articles which appeared in the "E. M.," and which are now published in book form. Take my advice, and if you have two good organs, let well alone; if you attempted what you propose, you may be certain it would be a dismal failure. If you wish to enlarge your pipe organ this could be done, and I shall be pleased to advise you in the matter. DIAPASON.

[96620.]—**Acids: Etching.**—Steel: Procure rubber stamp with required design made so that the letters and figure to be bitten by acid shall be depressed in stamp. Have plain border around design large enough to allow a little border of common putty to be laid around the edge of stamped design to receive acid. For ink, use resin, lard oil, turpentine, and lampblack. To ¼lb. of resin put one teaspoonful lard-oil, melt, stir in tablespoonful of lampblack, thoroughly mix, and add enough turpentine to make it of consistency of printers' ink when cold. Use this on the stamp in the same manner as when stamping with ink. When metal or plate is stamped, place a little border of common putty around and on the edge of the stamped ground. Then pour within the border enough acid mixture to cover the figure, and let it stand a few moments, according to the depth required, then pour the acid off. Rinse the surface with clean water, take off putty border, and clean off ink with turpentine. Use care not to spill acid over polished part of article. For acid mixture: Nitric acid 1, hydrochloric acid 1, water (by measure) 10. If the effervescence seems too active, add more water. Hot water may be used to rinse off, after pouring off acid. Brass: Paint or stamp sign with asphalt varnish, leaving parts to be etched unpainted; raise a border around outside of beeswax or asphalt, to hold the acid. Nitric acid 1, water 5. Pour acid on ¼in. deep. When cut deep enough pour acid off, clean by heating, wiping, and finally by turpentine. Nitric acid (sp.gr. 140) 16, water 160; potassium chlorate 6, water 100. Mix two solutions, &c. Try one or other of these on nickel, &c. REGENT'S PARK.

[96621.]—**Warts.**—Wash the parts affected in a blacksmith's cooling-trough, and let the water dry in the skin. This will remove the warts in about a week, without pain. AQUALOO.

[96621.]—**Warts.**—I used to be troubled with these. That which did me most good, and eventually removed them, was grinding the tops down with glass paper, followed by the daily application of a saturated solution of salammoniac in water. S. BOTTONE.

[96621.]—**Warts.**—Have cured myself of warts by continually applying common black ink. This should be applied by dipping pen into ink, and then pricking the warts. This treatment should be persisted in for some weeks, or until you will be able to pull it out by the roots. The ink will corrode warts or corns as well as steel pens. IVANHOE.

[96621.]—**Warts.**—Some time ago the *Medical Press* published that these could be easily removed by small doses of Epsom salts. "Several children treated with three-grain doses morning and evening were promptly cured. A case was cited of a woman whose face was disfigured by these excrescences, who was cured in a month by a drachm and a half taken daily. Another medical man reported a case of very large warts which disappeared in a fortnight from the daily administration of 10 grains of the salts." If the salts are thus useful, I should think the removal might be greatly accelerated by making a saturated solution of them, and wetting the warts with the finger. This would aid the internal action of the salts, which are very "lowering" when persistently taken. I have just got rid of four such disfigurements by the outward application of a cancer remedy. I therefore think the salts might act with similar effect. INCOG.

[96626.]—**Brass Coating for Iron Wire.**—If you dissolve good sheet brass in nitric acid until the acid is neutralised, and use this solution to make up a brassing bath, by the addition of strong liquor ammoniæ until the solution acquires a clear deep blue colour, and then add cyanide of potassium until the solution assumes the colour of old ale, you can easily get a good coating on iron wire either by the dynamo or batteries, using about 9 volts pressure. Brass anodes must be used in the bath. For full details as to strength of solutions and precautions to be observed, see Bonney's "Electroplater's Handbook," p. 187, *et seq.* S. BOTTONE.

[96627.]—**Foreign Currency.**—To "ALGOODS."—The Rio de Janeiro Exchange quotation is the value per milreis (1,000 reis), at which the Rio banks would, on that day, receive the greatly-depreciated Brazilian paper currency in payment of their sterling drafts, payable 90 days after presentation, on banks in London. Thus, if 90 days' sight exchange were quoted at 8d., you would have to give 30 milreis of Brazilian paper money for every sovereign payable in London. In Argentina the system is different, the quotation given being the *premium* on gold. Thus, for 100 pesos in gold you would have to pay in "national" paper money 100 plus the quoted premium. Of course, if you have gold to sell, or drafts payable in gold to receive, you are paid for it in paper money according to the quotation of the day. Sovereigns and Bank of England notes are freely accepted in both Brazil and Argentina at full value in currency. Note that civilised life in both countries costs quite double what it does in England. SOUTH AMERICAN.

IT is stated that a coalfield, comprising an area of about 45,000 acres, is being exploited in Cape Colony. It is calculated that one seam will yield 180,000,000 tons of coal of saleable quality.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Marlborough" has replied to 96373.

96248. Springs, p. 473.
96249. Wood Staining.—Photography, 473.
96257. Turning Ebonite, 473.
96265. Ink made of Banana Peel, 473.
96266. Transferring Collodion Positives on Copper Plates, 473.
99267. Cockney Accent, 473.
96272. Turning, 473.
96275. Textbook on Filing, 473.
96284. Burnishing-Ink, 473.

96387. Exhaust Silencer for Gasoline Carriage, p. 561.
96395. Motor Cycles, 561.
96396. Steam Turbines, 561.
96397. Portable Engine, 561.
98404. Mottled Colour on Bright Steel, 56'.
96410. Scale on Eyelids, 562.
96411. Dyspepsia, 562.
96413. Motor Cycles, 562.
96417. Photographing Spectra 562.
96419. Slip Reversing Gear, 562.
96420. Iodine, 562.
96421. Paper and Paper Bags, 562.

QUERIES.

[96628.]—**German Yeast.**—Can any reader of the ENGLISH MECHANIC inform me how to make German yeast?—CONSTANT READER, Wellington, N.Z.

[96629.]—**Linoleum Polish.**—I should be glad if any of your numerous readers can give me a recipe for making a linoleum polish or reviver. The best is of a creamy consistency.—CONSTANT READER, Wellington, N.Z.

[96630.]—**Fifty-volt Overtype.**—Will someone in this line help me in making an overtype dynamo, drum armature, 300 candle-power, 50 volts, and about 20 ampères, shunt wound, the size of F.M., gauge and weight of wire, the size of armature, gauge and weight of wire, and how many revs. per minute? Would it do for a small arc lamp as well as incandescent lamps?—the latter I want it for. Will someone kindly respond?—NEW ZEALAND.

[96631.]—**The Eight Queens Problem.**—What is this "problem," and is it possible to solve it? I find it stated as:—"The Eight Queens Problem is the problem of finding the different ways in which eight queens might be arranged on a chess-board so that no two should be in check of each other; in other words, the number of ways of arranging eight pieces so that no two shall be in the same row, column, or line parallel to the diagonal." The problem as stated is vague, because eight "queens," according to their powers in chess, would cover the whole board, but it appears that it is only "eight pieces" that is meant. Can any reader explain? It appears that it has engaged the attention of the most distinguished mathematicians, so there must be something in it.—Q. R.

[96632.]—**Motor Batteries.**—I thank Mr. Bottone for his information about the damping of sawdust. I find that chloride of zinc is difficult to get in large quantities. Will hydrochloric acid killed with zinc do as well? Will Mr. Bottone or any kind reader tell me how to make the battery from beginning to end, or in what back number I can find the information? What is the chemical in the inner cell composed of? Is the canvas in which the carbon and chemical are wrapped prepared in any special way? Must the zinc case be amalgamated with mercury? Why are there vent-holes left in the pitch?—SAWREY.

[96633.]—**Green Water.**—I have built a swimming-bath with bricks, and lined with Portland cement. The water is supplied from a well in chalk, and is pumped up with a windmill. The bath is covered over with glass. When first filled, the water is beautifully clear; but after a week it begins to get green and turbid, and eventually becomes quite thick with a vegetable growth. Can anyone tell me how to cure or prevent this?—QUEX.

[96634.]—**Injector.**—Can any of your numerous readers tell me why a small injector won't work when the water is hot in the tank? If the water is cold, the injector works all right.—R. GEDDES, Castle Douglas.

[96635.]—**Solder.**—Can any of my fellow readers inform me of a mixture that is more fusible than ordinary tinman's solder, but still stand the same breaking strain?—FUSABLE.

[96636.]—**Accumulator.**—Would any reader kindly give me a full and simple method of making up a small accumulator to give about 2½ ampère-hours? Also the method of punching plates, paste for both + and − plates, and how to prepare glass cells?—MOUSETRAP.

[96637.]—**Catarrh.**—Could any reader who has had experience with this complaint state a safe mode of treatment for curing or relieving catarrh of the stomach?—SUFFERER.

[96638.]—**Electric Lamplighter.**—Will Mr. Bottone or other reader kindly say if it is possible to make an instrument with platinum wire to light a spirit-lamp for burning about thirty minutes, when lighted, which would be required about once in the week? Please give particulars as to size of wire, &c.; also how many feet of No. 22 iron wire have the resistance of 1 ohm?—PERPLEXED.

[96639.]—**Motors and Castings.**—Will some reader kindly give me information on the following points? (1) How much work and skill and apparatus are required for making up ordinary advertised castings, &c., of small oil-motors, whether for launch or cycle, from drawings? (2) Is it difficult to attach motor to small phaeton or old tricycle? (3) What is the cheapest and most economical primary battery for small lighting installations?—R. S. EDWARDS.

[96640.]—**Silver-plating.**—Will Mr. Bottone please give me a recipe for making up a vat to silver-plate a frame that has been already copper-plated? I should prefer to use a vat separate from a battery, and not combined. Can he also say how I can renovate a sandbag that looks old and discoloured through wear.—REWOBOLE.

[96641.]—**Water Taps and Oil-Engine Valves.**—Will one of "ours" kindly tell how to regrind-in water taps that have worn badly, also valves for oil-engine, as I have had no experience in this work?—METAL TURNER.

[96642.]—**Irritation.**—I am suffering from a great irritation of the skin just round the anus, which at times is accompanied with a discharge of a clear colour, similar to that from a blister when snipped, and it causes great itching. The appearance is as though the part had been scalded. I have suffered more or less at that part for the last two years occasionally, but it now is much more frequent. Can any of our medical readers suggest a treatment? I have tried many ointments, some of which give temporary ease only. I am 69 years of age, and in otherwise perfect health.—J. HOPE.

[96643.]—**Relief Stamping.**—Would some reader kindly describe process of relief-stamping note-paper in colour, and kind of ink used? Have press and die.—ERIN.

[96644.]—**Marine Engineers.**—Kindly state if a stammer in my speech would prevent me from passing the Board of Trade examinations for a marine engineer? Do any of the Lines exclude one with a stammer from their service? What would be the best course to take if one was 20 years of age before starting to serve apprenticeship in the shops? Is it compulsory to serve five years in the shops first?—W. H.

[96645.]—**Arc Lamp.**—To MR. BOTTONE.—I want to make a hand-feed arc lamp for an enlarging camera I have. Will you kindly tell me how to go about it? The power at my disposal is an alternating current of 100 volts, and my carbons are ⅝in. bare diam. Should I have to put a choking-coil in? If so, what diam. and length should the wire be on coil?—CAMERA.

[96646.]—**Hernia.**—We are promised a reduction in the number of cases of rupture. Will someone competent to describe shortly the means employed kindly do so? There is, or used to be, a "hernia institute" that guaranteed cure of every case undertaken by means of hypodermic injection, and which permitted the patient to continue at his business during treatment. Has this system anything to do with the promise held out?—ERIC.

[96647.]—**Knife-Handle Cement.**—Will someone (not "Regent's Park") give a formula for cement for fixing hollow metal handles to blades of table-knives? The rosin compound softens in boiling water, and hard soldering with silver is, I am afraid, likely to draw the temper of the blades.—M. COLE, West Didsbury.

[96648.]—**Mercury Gauge.**—I have heard that there is a mercury gauge made on the siphon or some other principle to register steam-pressure up to, say, 150lb. per square inch. The gauge is about, say, 18in. long, and the divisions are equal. How is the above made? A sketch will oblige.—DUTCH PAUL.

[96649.]—**Battery for One Light.**—I shall be very grateful to anyone who would kindly tell me what kind of a battery is required for a small incandescent light. Whether wet or dry, what kind of plates, number of wire and exciting fluid, &c.?—IGNORAMUS.

[96650.]—**Trick Matches.**—Please tell me how to make the composition that is put on matches to make an explosion when the flame gets to it (trick matches)? I want them to sell at the fairs. People sell them here, but I cannot find out how to make them. Give the recipe in small proportions, and greatly oblige.—WILLIAM BRITTON, Boston, Mass.

[96651.]—**Transposition.**—Will any kind reader explain to me in a concise manner how to be sure of transposing a division sum—say one as follows: $\frac{A \times B \div C}{d + e}$? What I want is to transpose the sum so as to find out the values of A B C d e. If too long, kindly mention a book in which the matter is properly explained. The signs in the sum may be different.—N. I. X.

[96652.]—**Calcite.**—The mineral calcite, or Iceland spar, is merely calcium carbonate crystallised in the hexagonal form, and is found on Eskefjord, in Iceland. Is the mineral found at other places crystallised in the same form, or is the above mine the only one producing "Iceland spar"?—FLEUR-DE-LYS.

[96653.]—**Sailing Boat.**—Could any reader of "ours" oblige with the lines and dimensions of the skimming, dish-type of sailing boat so much in favour on the Upper Thames? They seem to be built carvel in all cases, and of mahogany, length about 25ft. There is also a slightly different type, with vertical sides instead of rounded. In either case the bow and stern rise clear of the water. The latter type is flat-bottomed, with a rising floor fore and aft. The mast is stepped right for'ard, but they sometimes carry a small jib on a short bowsprit. Both types have centre-boards, and carry very large rudders. I thought of building one of the latter type during the winter, if I could get the lines and dimensions.—W. J. SHAW.

[96654.]—**Turret Clocks.**—Will someone kindly inform me as to the best illustrated work upon turret clocks?—W. A. P.

[96655.]—**Silvering Polished Glass.**—Will any fellow-reader experienced in this work kindly give me a reliable recipe for precipitating a perfectly opaque coating of silver on any polished glass surface, so that the coating shall stand gentle polishing after precipitation? As little silver nitrate as possible to be employed in the process. An average working temperature of 60° Fahr. to be understood.—R. H.

[96656.]—**Bookbinding.**—Is bookbinding within the capability of an ordinary amateur as a hobby? I should like to know what tools are required, and how are the edges cut? I understand the way to sew the sheets, and the manner in which the tapes are inserted and fastened to the boards. I should like to be able to turn out really good work. The names of any books on the subject would be acceptable, and any hints welcomed by—AMATEUR BOOKBINDER.

[96657.]—**Laundries.**—What are the materials which are commonly used in laundries to assist in the bleaching and washing of the cotton and linen? Some laundries appear to use chemicals which eat holes in the fabric and cause rapid degeneration, whereas similar articles treated in the old-fashioned way in the family washtub do not give way in a similar manner.—T. J.

[96658.]—**Rheumatism.**—Some few months back I suffered with rheumatism in the knees, which yielded to a few doses of Salol and persistent friction with turpentine liniment. A week or two later, however, similar pains were felt in my hands, which are persistent in spite of liniment and friction, and in addition when the fingers are flexed two of them become fixed as with cramp, and when forcibly extended, again go back with a jerk and snap. I am 60 years of age, and have never known any serious illness save a serious attack of "grippe" some seven years since.—FINEM RESPICE.

[96659.]—**Joy's Valve-gear.**—I am building a launch with triple-expansion engines, 5in., 8in., and 13in., 8in. stroke, to run 350 revs. per minute, space being a consideration. I wish the valves on the side, and have stipulated for Joy's valve-gear. I am now told that whilst this runs very satisfactorily for a time, there are so many pins which, at a speed anything like above, soon wear loose and rattle. These pins I understand are not made adjustable, which, I fancy, would overcome to a great extent my objection; but, of course, one has to take these things as the patentee makes, or leave them alone. Have any of your readers experience of this valve gear in marine-work, or can they recommend any other form or make of valve-gear working on the sides of the engines?—F. C. B.

[96660.]—**Ringing Anvil.**—Will any reader kindly advise the best method of preventing the ringing noise of an anvil?—H. H. S.

[96661.]—**Regulating Capsules for Incubators.**—Will one of your readers oblige with information how to make above? I have tried thin hard sheet-brass without success. I am also uncertain what spirit is used. Have tried naphtha, ether, &c., but cannot get satisfactory results. I know the mechanical movements, but fail in the expanding capsule.—POULTRY BREEDER.

[96662.]—**Thunderstorm.**—Would any of "ours" kindly enlighten me on the subject of thunderstorms? I saw some time back in the "E. M." (I cannot say the number now, as I have not been able to find it), that if a person were wet through there would be no danger of being struck by lightning. I have seen repeatedly animals brought in killed by lightning; they have been out in the fields thoroughly soaked in rain. I remember two young horses being struck; they were both standing back to the storm in the open fields, and were struck from behind, bursting their entrails and forcing the contents between the flesh and hide down to the hock or knee. Have also seen cows and bullocks brought in after a storm that were picked up out of the fields with not a mark or burn of any description to show where or how they were struck; have seen the men unhide and cut these animals up, but there was nothing unusual to be seen, the only thing the bodies decompose very quickly. There was a man killed here yesterday (Sept. 6) sheltering under a large elm tree, the tree having large pieces of bark stripped off. This is the question: The animals were killed soaking wet, the man comparatively dry.—F. H. B., Stanstead Abbotts.

[96663.]—**Wimshurst.**—Will Mr. Bottone or others advise me on the following defects of 4-plate 20in. machine, 20 sectors on each plate, four salad-oil bottles as supports for prime conductors, bottles filled ⅓in. up with shot, and outside 2in. tinfoil? Prime conductors are 2in. brass tube plugged with wood, and upright conductors ⅝in. brass rod inclosed in brass tube. When working I only get about 3in. spark at discharging balls, and a powerful spark occurs at each end of the machine between the outside of jars and the neutralising rods, which are fixed in movable boards inside the case of machine, as in Grey's book. I think, also, the current escapes right through the glass tubes which cover the upright conductors. If I approach a brass rod, or my finger to the glass tubes, I get a discharge through the glass. The main balls on top of upright rods are solid, and 1in. diam., and the discharging balls are ¾in. and 2½in. respectively. The neutralising rods are connected by insulated copper wire. Do the bottom or outside of jars require to be insulated from the frame? Do the neutralising rods require insulating?—H. H.

[96664.]—**Sunken Ships.**—Will some reader tell me whether there are any important sunken vessels lying at a depth greater than 200ft., or, in other words, vessels which cannot be reached by ordinary diving apparatus?—INQUIRER.

[96665.]—**Coal and Electricity.**—At the present time I am driving my works by steam-power, and require 250I.H.P., and the requisite coal has to be carted four miles to the works, rising in transit nearly 700ft; consequently only small loads can be brought, which makes the cartage expensive. I have land at the station where the coals arrive, on which I could erect engine and boiler, &c., and think it might perhaps be economical to convert the coal into electricity there, and bring a cable to the works and drive by motors. I shall be greatly obliged if any of your electrical readers can advise if the scheme is feasible, and the probable cost of cable, dynamo, and seven motors? The cartage costs 3s. 4d. per ton.—H. JAY.

[96666.]—**To J. Dormer.**—Thanks for answer to Ferro. (96406, p. 583). Would you mind telling me what makes solution soak through the paper? I have only floated pieces about 6in. by 6in., but it soaks right through. Do you think a little more gelatine will do any good? Otherwise solution is very satisfactory.—W. J. A.

[96667.]—**Wheel-Cutting.**—Will some reader please give me instructions in the following? I want several small brass toothed wheels, after the style of clock-

wheels, but about ¼in. thick, and I want to cut them myself, if possible. This is my fix: If I go to a shop for cutters, I get one only of a certain pitch, whereas I have always understood that the tooth-shape of a driven wheel is different to that of a driver. How are they cut in actual practice? I have lathe, overhead, division-plate, &c.—AMATEUR.

[96668.]—**Mirror-Back Showcards.**—Can any one of "ours" tell me how the bronze powder is put on the glass to get this effect.—SIGN WRITER.

[96669.]—**Mercury's Mass.**—Could anyone oblige with the mass of Mercury? What is the figure generally assumed? Has anything in this direction been done recently?—GARSDALE.

[96670.]—**Spring Motors.**—Would any reader kindly give a description and sketch of a simple, strong, and cheap elastic or spring motor, suitable for driving experimental models, such as those used in children's automatic toys? I want to drive a small shaft for a short time at a high rate of speed.—PI.

‖[96671.]—**Solvent for Gum.**—Will any reader kindly let me know the best and cheapest solvents for "gum euphorbium."—AN OCCASIONAL READER.

[96672.]—**Mexican Furnace Chimney.**—I would like very much to know where I could get information about a furnace stack built in Monterey, Mexico, by Mr. William Drysdale, of Bonnybridge, Stirlingshire. A paragraph appeared about it in the *Falkirk Herald* for March (I forget which date exactly, but it was near the end), being copied from the *Mexico Monterey Daily Globe* of March 14. The chimney is stated to be the tallest and handsomest in the Mexican Republic. The height stated was 185ft. Where could I get more information about the chimney and its architect, Mr. William Drysdale, who is said to be an expert at this work, or where could I get a copy of the Mexican paper? Perhaps some Mexican reader may see this, and oblige—A. DRYSDALE.

[96673.]—**Aluminium.**—Will any kind reader tell me how to make use of a lot of lump aluminium? If I could, I should like to be able to turn it into very fine powder to use for painting with. I have about 3lb.—ALUM.

[96674.]—**To Mr. Bottone.**—Would Mr. Bottone please tell me how much wire, and what gauge, to put on a model standard type dynamo which I am making (I want it for incandescent lamps), and what would be the best speed for it to run at? The dimensions are: Magnets $2^8/_{16}$in. by 1¼in. by $4^3/_{16}$in. over all; armature, diam. 1¾in., length 2¾in.; Siemens H pattern. I should like to get 15 or 20 volts. What kind of armature would be best for charging accumulators?—L'ALLEGRO.

☛[96675.]—**Railway Lines.**—In laying down the metals for railways, a certain amount of "play" is allowed for expansion under hot sun. What is done in the case of the tram and other rails which are electrically welded, and are practically without a joint?—BUCKLE.

[96676.]—**Bookbinding.**—I have been binding three volumes of ENGLISH MECHANIC, but find great trouble in cutting edges clean; been using large carving-knife. A small sketch or explanation of any unexpensive device would be gladly received by—GLASGOW.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1692.—By H. CUDMORE.

Black. [6 pieces.

White. [7 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Sept.* 25.)

Solution of PROBLEM No. 1690.—By E. PRADIGNAT.

Key-move, P-B 4.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1690.—Correct solution has been received from E. Lobell, jun. ("A very nice mate"), W. Hamm (Wimbledon), E. C. Weatherley, G. W. Underhill (Weybridge), Geo. Christie, Whin Hurst, Richard Inwards, Hampstead Heathen, Quizco, J. E. Gore, Rev. Dr. Quilter ("Admirably constructed"), F. B. (Oldham), A. Tupman, who rhymes as follows:—

" A sentinel he stood throughout the strife,
Now on his move depends a monarch's life.
A pretty trick indeed, for White to force
A pawn past pawn, and win the game of course."

PROBLEM No. 1689.—Further correct solutions received from M. N. Munro, T. Cox.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 13, and unacknowledged elsewhere:—

W. J. G. F.—Martin Luther Rouse.—Meteor.—Ureka.—S. Elliman.—Clytie Dudley.—Monty.—H.—Pressure.—A Fellow of the Royal Astronomical Society.—Stud.—O. R. Walkey.—E. Wilson.—Chemical.—T. G. W.—Wm. F. Rigby.—Lanky.—Motor-mad.—A Beginner.—F. P.—Miliner.—Sala.—Member B. C. and A. Assn.—J. Harding.

J. P.—Better advertise in the Sydney papers, we suppose. Sell, G. Street, and Co., or any well-known London advertisement agent will do that for you. Quite outside the scope of our query column.

SMOKER.—We have, of course, tried the *Weekly Times and Echo* cigars, and our opinion is that they are, by comparison with others sold of the same size and quality, worth three times the price charged for them.

B. B.—A useful work is "Hot-Water Heating," by F. A. Fawkes, published by B. T. Batsford, High Holborn; there are several books on the subject. You will find an illustration of the method of fitting baths with hot and cold water in No. 1397, Oct. 23, 1891.

W. MURGATROYD.—The only way to obtain such a position is to apply to the owners of the vessels. The qualifications are the ability to keep accounts, and some knowledge of markets when it is necessary to buy provisions. They are positions not easily obtained.

STATURE.—You can have boots made with extra double-thick soles. You might increase your height a trifle by judicious exercise, but "elevators" are simply something to stand on.

LONGS.—For bamboo working see Vols. LV. and LVI. Full particulars are given therein.

D. EVANS.—Please see the back numbers. The questions have been answered many times.

ELECTRO.—Simply send a specimen, or tell the printers to put certain words in "Clarendon." They will understand. 2. Impossible to say: it varies with the reputation of the author and the demand for his works. Say 20 per cent.

H. H. S.—You can mount the anvil on rubber blocks; but query inserted for opinions of readers.

REU.—Probably the aniline black would answer, or the usual method—logwood first, and then a solution of sulphate of iron.

J. H. PRICE.—If not answered before it reaches the Unanswered list, it might be put in another form. It is, however, doubtful if there is a work that would be helpful. 2. The catalogue can, we presume, be obtained from Sir Howard Grubb's Works, Rathmines, Dublin.

CURVE.—A useful book is Molesworth's "Pocket-Book," published by E. and F. N. Spon, Ltd., 125, Strand, W.C. See Hints to Correspondents, No. 5. A civil engineer is a man who has been a student under a civil engineer, or who is a member of the Institute of Civil Engineers. There are, no doubt, some science classes in your town where you could obtain information and probably see the books. If you send to Messrs. Spon for a catalogue, you will find in their list a number of books which may suit you.

SEA VOYAGE.—The only way is to apply to the owners of the vessels, or to the captain or mate.

W. M. FOLLETT.—There are the articles which have appeared in the back numbers, and "Bicycles and Tricycles," by A. Sharp, B.Sc., published by Longmans, Green, and Co.

HIRSUTE.—Hair thins after illness, or during years of indigestion, or in old age, because of the diminution of nourishment to the roots. Curling-pins and tongs also help to destroy the hair and injure the growth. In some cases ordinary petroleum, rubbed well into the scalp daily, has been known to restore the growth of the hair; but in old age we do not think it will do much good. The professional "hair-restorer" is mostly an empiric, and the best proof of the futility of his pretensions is the baldness of so many royal, rich, and exalted people, who would pay anything for a really efficient hair-restorer, if it were possible to obtain it.

IN TYPE.—W. H. Bell.

IT is rumoured that either Seattle or San Francisco will, within the next few years, be made the terminus of a new Trans-Pacific steamship line to connect with the Trans-Siberian Railroad.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 22, 1899.

MOTOR CYCLES.—XVIII.

IT will not be long before the possessor of a motor tricycle will want to take a friend out with him on his machine. This can be done by attaching a "trailer" or small light carriage behind the machine or by means of a detachable fore-carriage converting the tricycle into a quadricycle. The first arrangement is unsatisfactory, inasmuch as conversation is practically impossible, and any odour from the motor becomes unpleasantly noticable to the passenger. The fore-carriage is distinctly better in every way, though it is more expensive and troublesome to construct. Fig. 107 shows a design which is as simple as any, and will be found both efficient and comfortable. The two side tubes A A′ are of 1¼in. by 18 B.W.G. weldless steel tubes. They are bolted at the rear ends to the same lugs, on the bridge-tube, to which the rear stays from saddle-clip, are fastened. Bolts of the same diameter but slightly longer will be used to hold them and the saddle-stays, to the bridge tube-lugs. These two main tubes are braced together at the front end by a cross tube, B, of the same diameter and gauge, and a bridge, C, holds them firmly to the down tube of the tricycle. This bridge can either be a malleable iron casting, or can be made up of lugs and two short tubes. I shall follow the latter method in the detail drawings.

The steering-gear is on the Ackermann principle, and will need to be carefully made. It will be readily understood that when turning a corner the two front wheels do not run round curves of equal radii. To make it safe to turn at anything over a mile or so per hour, it is imperative that the steering wheels should be each deflected to the proper angle so that they may roll around the curves and not scrape sideways. Whatever be the radius of the curve the machine is travelling around, the centre lines of the axles of all four wheels should meet at the centre of that radius. The links and levers, as shown in Fig. 107, while not theoretically correct in this respect, are as close an approximation as is necessary in practice. The dotted position of the front wheels in Fig. 107 corresponds to a curve of 8ft. radius, and the two centre lines D D′, if produced, would meet at a point on the centre line of back axle, also produced, 8ft. from the longitudinal centre line of the machine. I have worked out this steering gear full size, and will give all dimensions in my next when treating of the details of fore-carriage. The front axle, which is tubular, is attached to the machine by light elliptic springs. These should be bought, or can be ordered from any local carriage-smith, the needed particulars being 20in. centres, three plates 1¼in. wide. Distance between top and bottom bows 4in. when loaded with a man's weight. The front seat is to be padded and sprung, and will form the lid of a tool-box. The sides of tool-box and foot-plate and sides will be made of wood. I have made the seat, footboard, and its sides rather larger than usual for machines of this class. This I consider a necessity for comfort. During

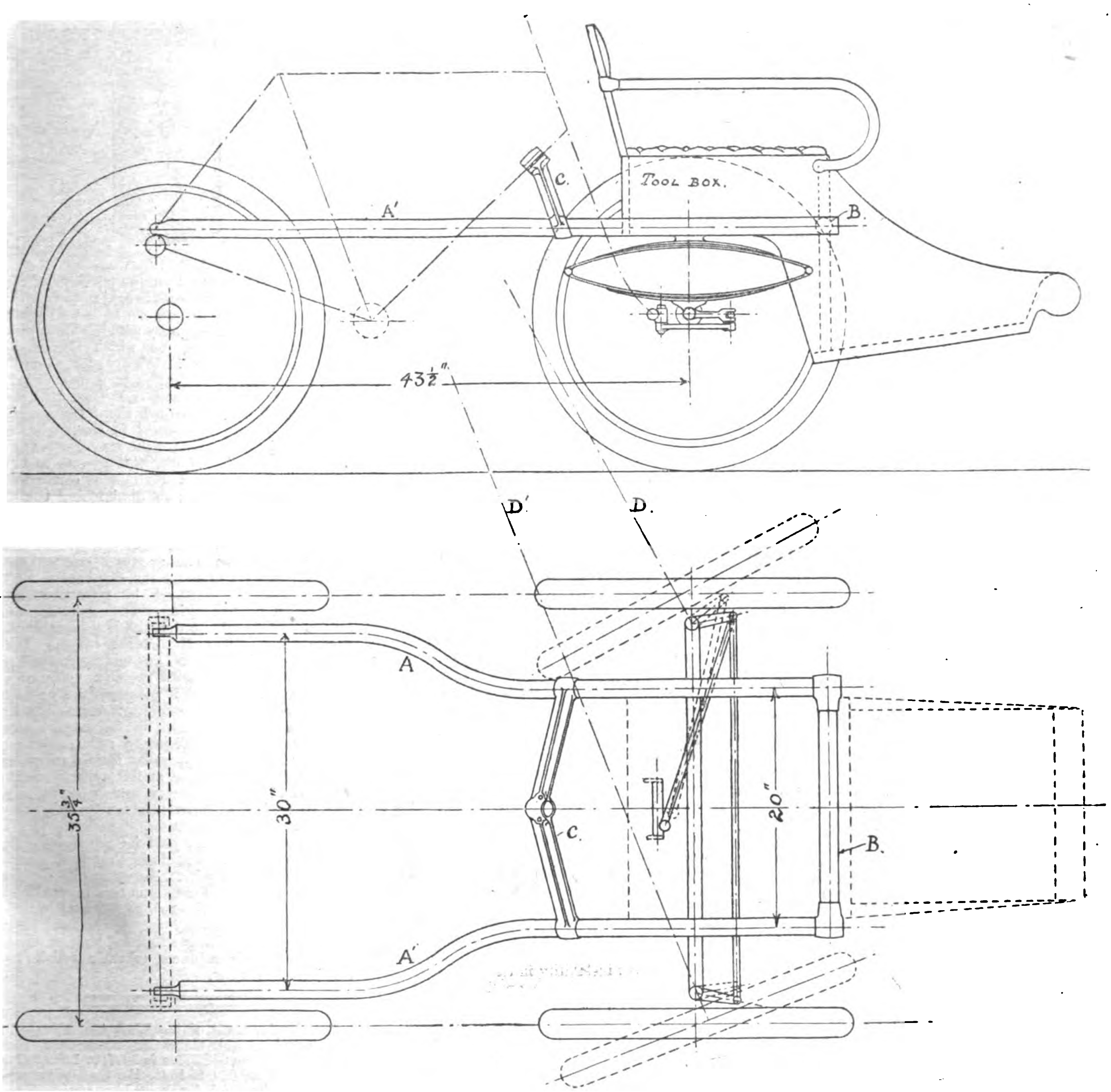
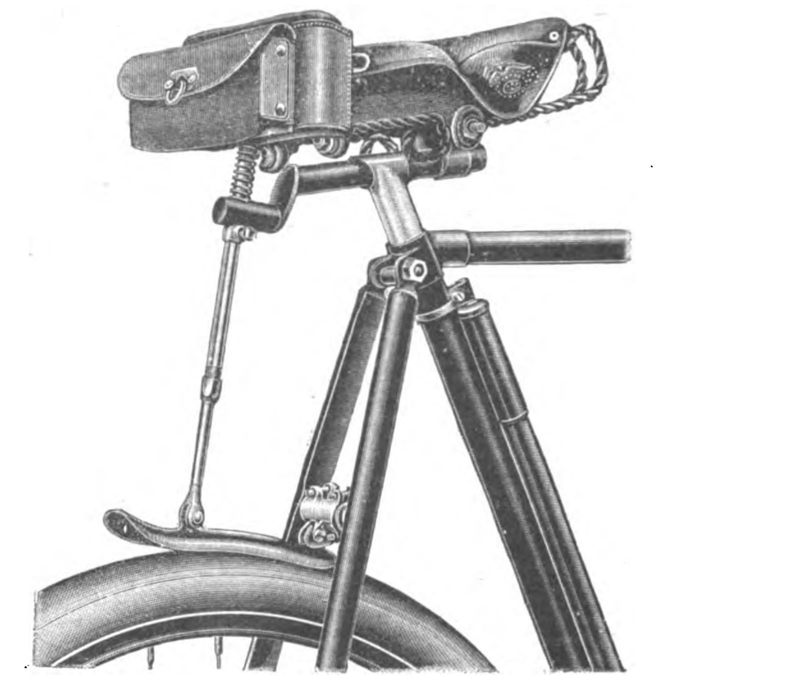


FIG. 107.



long drives a cramped position becomes very tiring. It will not be a difficult matter to arrange the tricycle front-wheel brake-lever to actuate a spoon brake on each back wheel, thus retaining two independent brakes on the machine when converted to a four-wheeler.

In order to avoid confusion, I have shown the existing tricycle-frame by centre lines only, using full lines for the new work. To insure plenty of power for hill-climbing, it will be advisable to somewhat lower the gear between motor and driving-axle, using for the driving-pinion 11 teeth instead of 13, and 102 teeth for the gear-wheel in place of 100, as originally intended. The gear of the tricycle being 7·69 revolutions of the motor to one of the axle, the new combination gives a ratio of 9·27 to 1, the distance between the centres of wheel and pinion remaining the same. An increase of power will result, though the speed of the machine will be reduced.

An extra supply of petrol can be carried, in a suitably-shaped vessel, slung under the tool-box in the space between the springs and in front of the fore-axle. A couple of good-sized foot-rests for the rear driver can be attached to the bridge C, and will be found more comfortable than keeping the feet on the pedals all the time.

COLE'S SAFETY SADDLE-BRAKE FOR BICYCLES.

THE inventor of this brake, a very old friend of "Ours," claims that it overcomes the chief danger to cyclists, as it is the only brake that renders it impossible to lose control over the machine under any conceivable circumstance. It is entirely distinctive, and is the simplest, the cheapest, the lightest, and the most efficient brake in existence.

The distinctive feature of this brake is the method of actuating the brake by utilising the weight of the rider's body through the medium of a rod or tube connecting a rest, or projection (which also forms the tool-pouch) at the rear of the saddle with a friction-plate or spoon, by which means an absolutely controlling brake is depressed into contact with the hind wheel. It dispenses with the use of a front brake, which is objectionable in any form (unless it be desired to retain the double security of a brake on each wheel). Its weight is less than that of the ordinary handle-bar brake. It is far more powerful than any brake in existence—so much so, that by its application the machine can be stopped, without danger, even on the steepest hill. It is not unsightly, like the usual front brake, nor an element of danger, as the handle has frequently proved, and it leaves the handle-bar unencumbered for other uses, and also facilitates the lamp being carried (as it ought to be) on the fixed socket instead of on the steering head. It utilises the tool-pouch among its component parts, thereby making it serve a double purpose, and reducing weight and encumbrance. Although so powerful, it is scarcely observable, and its appearance is extremely neat and unobtrusive on the machine. It is applied directly, and not by means of cranks, or levers, or cords, and with the whole weight of the body if desired. It does not throw mud or dust on the rider, as the front brake does. It does not injure the tire, as the ordinary plunger brake does, by pressing on a small portion of it. The pressure of this brake is extended over a large surface, and is found in practice not to cause the slightest injury—the wear being on the spoon and not on the tire. It can instantly be applied with the greatest facility, lightly or heavily, as desired by the rider simply moving or rolling his seat slightly backwards on the saddle. In so doing, he does not alter his position by any other motion—not requiring to use either his hands or his feet. He can, however, apply it by putting back one hand. The brake is instantly released on the rider resuming his normal position on the saddle, or removing the pressure of his hand. Being applied to the hind wheel, there is not the same strain to the frame of the machine by the sudden application of the brake as when applied to the front wheel, which throws all the strain on the front fork as the momentum of rider and machine is left unchecked behind it. This is a most important consideration in ladies' drop-frame bicycles. Nor is there, with this brake, any element of instability in its application, as is the case with any brake applied to the front wheel, which is, mechanically, an essentially bad arrangement. Consequently there is no danger of an upset by applying it suddenly, no matter how rapidly the machine may be running. It therefore removes all risk in getting on an unknown or dangerous hill, and so gives perfect confidence to the rider at all times. It affords perfect safety, inasmuch as it will instantly pull up the machine either in case of imminent collision or on any hill—even though the chain should break (as is liable to happen, particularly in strong back-pedalling) or come off when descending a hill, as sometimes occurs, or the tire should puncture (for if so, the spoon comes down on it when deflated), or the rider should lose the pedals—he still retains absolute control over the machine at all times, as he practically sits on the hind wheel, and so can stop under any circumstance without the slightest tendency to overthrow or disturb his equilibrium. Its cost is less than that of any other brake. There are also forms (provided for in the patents) in which it can be applied on either rim or hub; but this on the tire is found preferable, as it has none of the many objections which are inseparable from any form of rim-brake. It can be had of all agents, and of the manufacturer, W. E. Brough, Cycle Works, Basford, Notts.

A NEW EYEPIECE.

THE working microscopist sooner or later has in his battery of objectives lenses of both the achromatic and apochromatic type, and many would add at least one objective of the latter series to his equipment but for the heavy

additional cost involved in the purchase of compensating eyepieces to work in conjunction with it. These compensating eyepieces, as is well known, do not work advantageously with the lower power achromatic objectives, for which Huyghenian eyepieces are necessary. We are glad, therefore, to be able to call attention to a new eyepiece introduced by W. Watson and Sons, 313, High Holborn, W.C., and called the "Holoscopic" eyepiece, which is arranged to work with any form of objective. It is of the Huyghenian type, but the lenses are of different glasses to those hitherto employed, and a range of correction is obtained by increasing or diminishing the distance between the eye and field-lenses. The outer tube which fits into the microscope carries the field-lens at its lower end, and at the upper part receives the sliding tube on which is mounted the eye-lens and the diaphragm. This will be better understood by reference to the illustration accompanying this. A scale is engraved on this tube so that the best position may be registered. When the sliding tube is pushed home the eyepiece is an undercorrected one suitable for working with the achromatic objectives; when extended it possesses the so-called over-correction associated with the compensating eyepieces for working with apochromatic lenses.

Every item that efficiently reduces cost and the duplication of apparatus is important, and this eyepiece, combining, as it does, the working qualities of both eyepieces, and without sacrificing excellence of performance in either case, should receive appreciation. The price is very little in excess of that paid for the Huyghenian eyepieces alone. It is made in a range of powers, full particulars of which, together with detailed description, will be found in a new twenty-four-page supplemental list which Messrs. Watson have just issued for the coming season, and which contains many striking additions, both in microscopes and their adjuncts, to their well-known fully illustrated list.

The developments of the West Australian gold-fields are of a highly satisfactory nature, the export having risen from 674,933oz. in 1897, to 1,050,000oz., valued at £4,000,000, in 1898. For the eight months this year so far 993,123oz. have been exported.

The unsanitary condition of Naples is gradually being remedied. In the old quarters of the city ten miles of new streets have been made during the last ten years. The result of the new drainage arrangements has become very apparent, and deaths from infectious diseases are said to have greatly diminished.

Mechanism has been installed in one of the steeples of St. Patrick's Cathedral, New York City, for ringing the chime of bells. There are nineteen bells, which vary in weight from 300lb. to 7,000lb. The mechanism for striking, says the *Scientific American*, consists of horizontal air cylinders, with piston-rods attached to central studs projecting below the centres of the clappers. The piston is only used for a stroke one way, the weight of the clapper returning it. The bells are operated by a keyboard which is in electrical connection with magnets controlling the valves of the air cylinders.

THE BRITISH ASSOCIATION.

ADDRESS IN MATHEMATICS AND PHYSICS.

THE Address in Section A was delivered by Prof. J. H. Poynting, D.Sc., F.R.S., in the course of which he said:—While the investigation of Nature is ever increasing our knowledge, and while each new discovery is a positive addition never again to be lost, the range of the investigation and the nature of the knowledge gained form the theme of endless discussion. And in this discussion I believe that in some directions there has been real progress, and that physicists are tending towards a general agreement as to the nature of the laws in which they embody their discoveries, of the explanations which they seek to give, and of the hypotheses they make in their search for explanations. I propose to ask you to consider the terms of this agreement and the form in which, as it appears to me, they should be drawn up. The range of the physicist's study consists in the visible motions and other sensible changes of matter. The experiences with which he deals are the impressions on his senses, and his aim is to describe in the shortest possible way how his various senses have been, will be, or would be affected. His method consists in finding out all likenesses, in classing together all similar events, and so giving an account as concise as possible of the motions and changes observed. His success in the search for likenesses and his striving after consiseness of description lead him to imagine such a constitution of things that likenesses exist even where they elude his observation, and he is thus enabled to simplify his classification on the assumption that the constitution thus imagined is a reality. He is enabled to predict on the assumption that the likenesses of the future will be the likenesses of the past. His account of Nature, then, is, as it is often termed, a descriptive account. Were there no similarities in events, our account of them could not rise above a mere directory, with each individual event entered up separately with its address. But the similarities observed enable us to class large numbers of events together, to give general descriptions, and, indeed, to make instead of a directory a readable book of science, with laws as the headings of the chapters, which are, I believe, in all cases brief descriptions of observed similarities. If this is a true account of the nature of physical laws, they have, we must confess, greatly fallen off in dignity. No long time ago they were quite commonly described as the fixed laws of Nature, and were supposed sufficient in themselves to govern the universe. The old conception of laws as self-sufficing governors of Nature was, no doubt, a survival of a much older conception of the scope of physical science, a mode of regarding physical phenomena which had itself passed away. Man, knowing that his purpose and will were followed by motions and changes in the matter about him, thought of similar purpose and will behind all the motions and changes which he observed, however they occurred; and he believed, too, that it was necessary to think thus in giving any consistent account of his observations. Taking this anthropomorphic—or, shall we say, psychical—view, the laws he formulated were not merely descriptions of similarities of behaviour, but they were also expressions of fixed purpose and the resulting constancy of action. They were commands given to matter which it must obey.

ADDRESS IN CHEMISTRY.

The Address in Section B, Chemistry, was delivered by Dr. Horace T. Brown, F.R.S., who said:—The subject which I have chosen for my address is the fixation of carbon by plants—one which is the common meeting-ground of chemistry, physics, and biology. We have become so accustomed to the idea that the higher plants derive the whole of their carbon from atmospheric sources that we are apt to forget how very indirect is the nature of much of the experimental evidence on which this belief is founded. There can, of course, be no doubt that the primary source of the organic carbon of the soil, and of the plants growing on it, is the atmosphere; but of late years there has been such an accumulation of evidence tending to show that the higher plants are capable of being nourished by the direct application of a great variety of ready-formed organic compounds, that we are justified in demanding further proof that the stores of organic substances in the soil must necessarily be oxidised down to the lowest possible point before their carbon is once more in a fit state to be assimilated. It was the hope of gaining more direct evidence on this important question which led me some time ago to attack the problem experimentally, in conjunction with Mr. F. Escombe, the resources of the Jodrell Laboratory at Kew having been kindly put at our disposal by Sir W. Thistleton-Dyer and Dr. D. H. Scott. Up to the present time our experiments have not been carried far enough to enable us to give a positive answer to the main question; but they have already suggested a new method of attack which will enable us in the future to determine, with a fair amount of certainty, whether any particular plant, growing under perfectly natural conditions, derives any appreciable portion of its carbon from any other source than the gaseous carbon dioxide of the atmosphere. In the year 1884 Sachs found that the accumulation of freshly assimilated material in a leaf may, under favourable conditions, go on so rapidly as to give rise to a very appreciable increase of weight in the leaf lamina within the short space of a few hours. By observing at different times of the day the varying dry weight of equal areas of large leaves, Sachs obtained an approximate measure of the rate of the assimilatory process which he could express in terms of actual number of grammes of substance assimilated by a unit area of leaf in unit of time. In this manner he was able to show, for instance, that a sunflower leaf, while still attached to the plant, increases in weight when exposed to bright sunshine at the hourly rate of about one gramme per square mètre of leaf area. In the case of similar leaves detached from the plant, and of course under conditions in which the products of assimilation were entirely accumulated in the leaf, he found an increase in weight of rather more than 1½ gramme per square mètre per hour. It is evident that a far better plan of measuring the rate of assimilation under varying conditions would be the estimation of the actual amount of carbon dioxide entering a given area of the leaf in a certain time, and it was to the perfection of a method of this kind that Mr. Escombe and I first turned our attention.

All such experiments, of course, necessitate not only a determination of the carbon dioxide in the air which has passed over the leaf or plant, but also a simultaneous determination of the carbon dioxide in the ordinary air used. In our experiments the air was in all cases taken from a height of 4ft. 6in. from the ground, the amounts aspirated varying from 100 to 500 litres. The actual intake of carbon dioxide is determined by inclosing the entire leaf in specially-constructed, airtight, glazed cases, through which a sufficiently rapid air stream is passed. These cases are so arranged that the leaf can be inclosed while still attached to a plant which is growing out in the open under perfectly natural conditions, and some of them are sufficiently large to take the entire leaf of a sunflower. The carbon dioxide content of the air is determined both before and after its passage through the apparatus, and since the amount of air passed is known, we have all the data requisite for determining the actual amount retained by the leaf. An experiment generally lasts from five to six hours, and the carbon dioxide fixed in this time may amount to 150c.c. or more, the actual error of determination being very small indeed. In order to show the kind of results obtained in this manner I will give one or two examples. A leaf of the sunflower, having an area of 617·5sq.cm., was inclosed in its case whilst still attached to the plant, and was exposed to the strong diffuse light of a clouded sky for 5½ hours, air being passed over it at the rate of nearly 150 litres per hour. The content of the air in carbon dioxide as it entered the apparatus was 2·80 parts per 10,000, and this was reduced to 1·74 parts per 10,000 during its passage over the leaf. This corresponds to a total absorption of 139·95c.c. of carbon dioxide, or to an intake of 412c.c. per square metre per hour. If we assume that the average composition of the carbohydrates formed is that of a $C_6H_{12}O_6$ sugar, the above amount of carbon dioxide corresponds to the formation of 0·55 gram of carbohydrate per square mètre per hour. The penetration of the highly-diluted carbon dioxide of the atmosphere into the interior air spaces of the leaf on its way to the active centres of assimilation must, in the first instance, be a purely physical process, and no explanation of this can be accepted which does not conform to the physical properties of the gases involved. Since there is no mechanism in the leaf capable of producing an ebb and flow of gases within the air spaces of the mesophyll in any way comparable with the movements of the tidal air in the lungs of animals; and since also the arrangement of the stomatic openings is such as to effect a rapid equalisation of pressure within and without the leaf, we must search for the cause of the gaseous exchange, not in any mass movement, but in some form of diffusion. This may take place in the form of open diffusion through the minute stomatic apertures, which are in communication both with the outer air and the intercellular spaces, or the gaseous exchange may take place through the cuticle and epidermis by a process of gaseous osmosis, similar to that which Graham investigated in connection with certain colloid septa. For many years there has been much controversy as to which form of gaseous diffusion is the more active in producing the natural interchanges of gases in the leaf. In 1895 Mr. F. F. Blackman brought forward two remarkable papers which opened up an entirely new aspect of the subject. After showing the fallacy underlying certain experiments of Boussingault, which had been generally supposed to prove the osmotic theory of exchange, Mr. Blackman gave the results of his own experiments with a new and beautifully constructed apparatus, which enabled him to measure very minute quantities of carbon dioxide given off from small areas of the upper and under sides of a respiring leaf, and also to determine the relative intake of carbon dioxide by the two surfaces during assimilation in air artificially charged with that gas. The conclusions drawn are that respiratory egress, and assimilatory ingress of carbon dioxide, do not occur in the upper side of a leaf if this is devoid of stomatic openings, and that when these openings exist on both the upper and under sides the gaseous exchanges of both physiological processes are directly proportional to the number of stomata on equal areas; hence in all probability the exchanges take place only through the stomata. These observations of Mr. Blackman are of such far-reaching importance, and lead to such remarkable conclusions with regard to the rate of diffusion of atmospheric carbon dioxide, that we felt constrained to inquire into the matter further, and for this purpose we employed a modified form of the apparatus which we have used throughout our work on assimilation. Our results, on the whole, are decidedly confirmatory of Mr. Blackman's observations. The side of a leaf which is devoid of stomatic openings certainly neither allows any carbon dioxide to escape during respiration, nor does it permit the ingress of that gas when the conditions are favourable for assimilation. On the other hand, when stomata exist on both the upper and under sides of a leaf, gaseous exchanges take place through both surfaces, and, as a rule, in some sort of rough proportion to the distribution of the openings. There is, however, under strong illumination, a greater intake of carbon dioxide through the upper surface than would be expected from a mere consideration of the ratio of distribution of the stomata. Nevertheless, the general connection between gaseous exchange and distribution of stomata is so well brought out that we must regard it as highly probable that these minute openings are the true paths by which the carbon dioxide enters and leaves the leaf. One of the most interesting problems connected with plant assimilation relates to the efficiency of a green leaf as an absorber and transformer of the radiant energy incident upon it. It is already well known that the actual amount of energy stored up in the products of assimilation bears a very small proportion to the total amount reaching the leaf; in other words, the leaf, regarded from a thermo-dynamic point of view, is a machine with a very low "economic coefficient." We require, however, to know much more than this, and to ascertain, amongst other things, how the efficiency of the machine varies under different conditions of isolation, and in atmospheres containing varying amounts of carbon dioxide. The measure of the two principal forms of work done within the leaf, the vaporisation of the transpiration water on the one hand, and the reduction of carbon dioxide and water to the form of carbohydrates on the other, can be ascertained by modifying our experiments in such a manner as to allow the transpiration water to be determined, as well as the intake of carbon dioxide.

ADDRESS IN GEOLOGY.

The Address in Section C, Geology, was delivered by the president, Sir Archibald Geikie, F.R.S., on Saturday, having been postponed so that visitors from the Continent might be present. After reviewing the hypotheses that have been put forward in previous years, the president said:—Until, therefore, it can be shown that geologists and palæontologists have misinterpreted their records, they are surely well within their logical rights in claiming as much time for the history of this earth as the vast body of evidence accumulated by them demands. So far as I have been able to form an opinion, 100 millions of years would suffice for that portion of the history which is registered in the stratified rocks of the crust. But if the palæontologists find such a period too narrow for their requirements, I can see no reason on the geological side why they should not be at liberty to enlarge it as far as they may find to be needful for the evolution of organised existence on the globe. Referring then to the

Future Problems of Geology,

Sir A. Geikie said we may, therefore, well leave the dispute about the age of the earth to the decision of the future. In so doing, however, I should be glad if we could carry away from it something of greater service to science than the consciousness of having striven our best in a barren controversy, wherein concession has all to be on one side and the selection of arguments entirely on the other. During these years of prolonged debate I have often been painfully conscious that in this subject, as in so many others throughout the geological domain, the want of accurate numerical data is a serious hindrance to the progress of our science. The subject is too vast for adequate treatment here. But let me illustrate my meaning by selecting a few instances where the adoption of these more rigid methods of inquiry might powerfully assist us in dealing with the rates of geological processes and the value of geological time. Take, for example, the wide range of lines of investigation embraced under the head

of Denudation. A little consideration will show that in all branches of the investigation of denudation opportunities present themselves on every side of testing. By accurate instrumental observation and measurement, the rate at which some of the most universal processes in the geological régime of our globe are carried on. What we need is a carefully-organised series of observations carried out on a uniform plan, over a sufficient number of years, not for one river only, but for all the important rivers of a country, and indeed for all the greater rivers of each continent. The whole geological régime of each river should be thoroughly studied. Again, the action of glaciers has still less been subjected to prolonged and systematic observation. The few data already obtained are so vague that we may be said to be still entirely ignorant of the rate at which glaciers are wearing down their channels and contributing to the denudation of the land. The whole of this inquiry is eminently suitable for combined research. Nor is our information respecting the operations of the sea much more precise. The disintegration of the surface of the land by the combined agency of the subaërial forces of decay is a problem which has been much studied, but in regard to whose varying rates of advance not much has been definitely ascertained. The conditions under which subaërial disintegration is effected in arid climates and the rate of its advance are still less known, seeing that most of our information is derived from the chance observations of passing travellers. Closely linked with the question of denudation is that of the disposition of the material worn away from the surface of the land. We have yet to discover the different rates of deposit, under the varying conditions in which it is carried on in lakes, estuaries, and the sea. More momentous in their consequences are the disturbances which traverse mountain chains and find their most violent expression in shocks of earthquake. The effects of such shocks have been studied and recorded in many parts of the world, but their cause is still little understood. Are the disturbances due to a continuation of the same operation which at first gave birth to the mountains? Should they be regarded as symptoms of growth or of collapse? Are they accompanied with even the slightest amount of elevation or depression? We cannot tell. But these questions are probably susceptible of some more or less definite answer, and they might furnish us with suggestive information as to the rate at which upheaval or depression of the terrestrial crust is now going on. The vexed questions of the origin of raised beaches and sunk forests might in like manner be elucidated by well-devised measurements, for it is astonishing upon what loose and unreliable evidence the elevation or depression of coast-lines has often been asserted.

The president then mentioned the importance of the

Organisation of Research,

and said that the International Geological Congress, which brings together our associates from all parts of the globe, would confer a lasting benefit on the science if it could organise a system of combined observation in any single one of the departments of inquiry indicated, or in any other which might be selected. We need not at first be too ambitious. The simplest, easiest, and least costly series of observations might be chosen for a beginning. The work might be distributed among the different countries represented in the Congress. Each nation would be entirely free in its selection of subjects for investigation, and would have the stimulus of co-operation with other nations in its work. The congress will hold its triennial gathering next year in Paris, and if such an organisation of research as I have suggested could then be inaugurated, a great impetus would thereby be given to geological research, and France, again become the birthplace of another scientific movement, would acquire a fresh claim to the admiration and gratitude of geologists in every part of the globe.

ADDRESS IN ZOOLOGY.

The Address in Section D, Zoology, was delivered by Mr. Adam Sedgwick, F.R.S., who said in the course of his remarks, as everyone knows, there is a vast number of different kinds of organisms. Each kind constitutes a species, and consists of an assemblage of individuals which resemble one another more closely than they do other animals, which transmit their characteristics in reproduction and which habitually live and breed together. But the members of a species, though resembling one another more closely than they resemble the members of other species, are not absolutely alike. They present differences, differences which make themselves apparent even in members of the same family—i.e., in the offspring of the same parents. It is these differences to which we apply the term variation. The immense importance of the study of variations may be judged from the fact that, according to the generally-received evolution theory of Darwin, it is to them that the whole of the variety of living and extinct organisms is due. Without variation there could have been no progress, no evolution in the structure of organisms. If offspring had always exactly resembled their parents and presented no points of difference, each succeeding generation would have resembled those previously existing, and no change, whether backwards or forwards, could have occurred. This phenomenon of genetic variation forms the bedrock upon which all theories of evolution must rest, and it is only by a study of variations, of their nature and cause, that we can ever hope to obtain any real insight into the actual way in which evolution has taken place. Notwithstanding its importance, the subject is one which has scarcely received from zoologists the attention which it merits. According to the Darwinian theory of evolution, one of the most important factors in determining the modifications of organisms has been natural selection. Selection acts by preserving certain favourable variations, and allowing others less favourable to be killed off in the struggle for existence. It thus will come about that certain variations will be gradually eliminated. Meanwhile the variations of the selected organisms will themselves be submitted to selection, and certain of these will be in their turn eliminated. In this way a group of organisms becomes more and more closely adapted to its surroundings; and, unless new variations make their appearance as the old unfavourable ones are eliminated, the variability of the species will diminish as the result of selection. It would thus appear, and I think we are justified in holding this view, at any rate provisionally, that the result of continued selection will be to diminish the variability of a species, and, if carried far enough, to produce a race with so little variability, and so closely adapted to its surroundings, that the slightest alteration in the conditions of life will cause extinction. If selection tends to diminish the variability of a species, then it clearly follows that, as selection has been by hypothesis the most important means of modifying organisms, variation must have been much greater in past times than it is now. In fact, it must have been progressively greater the farther we go back from the present time. The argument which I have just laid before you points, if carried to its logical conclusion—and I see no reason why it should not be so carried—to the view that at the first origin of life upon the earth heredity was a much less important phenomenon than it is at present. Following out the same train of thought, we are inevitably driven to the conclusion that one of the most important results of the evolutionary change has been the gradual increase and perfection of heredity as a function of organisms and a gradual elimination of variability. This view, if it can be established, is of the utmost importance to our theoretical conception of evolution, because it enables us to bring our requirements as to time within the limits granted by the physicists. If variation was markedly greater in the early periods of the existence of living matter, it is clear that it would have been possible for evolutionary change to have been effected much more rapidly than at present—especially when we remember that the world was then comparatively unoccupied by organisms, and that, with the change of conditions consequent on the cooling and differentiation of the earth's surface, new places suitable for organic life were continually being formed.

ADDRESS IN GEOGRAPHY.

The Address in Section E, Geography, was delivered by Sir John Murray, F.R.S., and dealt mainly with the "Ocean Floor," which, he said, lies, for rather more than about a half, at a depth of 2,000 fathoms, or rather more. Depths exceeding 5,000 fathoms have been hitherto recorded only within the Aldrich Deep of the South Pacific, to the east of the Kermadees and Friendly Islands, where the greatest depth is 5,155 fathoms, or 530ft. more than five geographical miles, being about 2,000ft. more below the level of the sea than the summit of Mount Everest, in the Himalayas, is above it. Our knowledge of the temperature on the floor of the ocean is derived from observations in the layers of water immediately above the bottom by means of deep-sea thermometers, from the electric resistance of telegraph cables resting on the bed of the great ocean-basins, and from the temperature of large masses of mud and ooze brought up by the dredge from great depths. These observations are now sufficiently numerous to permit of some general statements as to the distribution of temperature over the bottom of the great oceans. All the temperatures recorded up to the present time in the sub-surface waters of the open ocean indicate that at a depth of about 100 fathoms seasonable variation of temperature disappears. Beyond that depth there is a constant, or nearly constant, temperature at any one place throughout the year. It is estimated that 92 per cent of the entire sea-floor has a temperature lower than 40° Fahr. This is in striking contrast to the temperature prevailing at the surface of the ocean, only 16 per cent. of which has a mean temperature under 40° Fahr. The temperature over nearly the whole of the floor of the Indian Ocean in deep water is under 35° Fahr. A similar temperature occurs over a large part of the South Atlantic and certain parts of the Pacific, but at the bottom of the North Atlantic basin and over a very large portion of the Pacific the temperature is higher than 35° Fahr. In depths beyond 2,000 fathoms the average temperature over the floor of the North Atlantic is about 2° Fahr. above the average temperature at the bottom of the Indian Ocean and South Atlantic, while the average temperature of the bed of the Pacific is intermediate between these. The deep sea is a region of darkness as well as of low temperature, for the direct rays of the sun are wholly absorbed in passing through the superficial layers of water. Plant-life is in consequence quite absent over 93 per cent. of the bottom of the ocean, or 66 per cent. of the whole surface of the lithosphere. The abundant deep-sea fauna, which covers the floor of the ocean, is therefore ultimately dependent for food upon organic matter assimilated by plants near its surface, in the shallower waters near the coast lines, and on the surface of the dry land itself. It thus happens that at the present time over nearly the whole floor of the ocean we have mingled in the deposits the remains of organisms which had lived under widely different physical conditions, since the remains of organisms which lived in Tropical sunlight, and in water at a temperature above 80° Fahr. all their lives now lie buried in the same deposit on the sea-floor together with the remains of other organisms which lived all their lives in darkness and at a temperature near to the freezing-point of fresh water. The marine deposits now forming over the floor of the ocean present many interesting peculiarities according to their geographical and bathymetrical position. On the continental shelf within the 100-fathom line sands and gravels predominate, while on the continental slopes beyond the 100-fathom line blue muds, green muds, and red muds, together with volcanic muds and coral muds prevail, the two latter kinds of deposits being, however, more characteristic of the shallow water around oceanic islands. The composition of all these terrigenous deposits depends on the structure of the adjoining land. In them the evidences of the mechanical action of tides, of currents, and of a great variety of physical conditions may almost everywhere be detected, and it is possible to recognise an accumulation of materials analogous to many of the marine stratified rocks of the continents, such as sandstones, quartzites, shales, marls, greensands, chalks, limestones, conglomerates, and volcanic grits. With increasing depth and distance from the continents the deposits gradually lose their terrigenous character, the particles derived directly from the emerged land decrease in size and in number, the evidences of mechanical action disappear, and the deposits pass slowly into what have been called pelagic deposits at an average distance of about 200 miles from continental coast lines. Our knowledge of the marine deposits is limited to the superficial layers; as a rule the sounding-tube does not penetrate more than 6in. or 8in., but in some positions the sounding tube and dredge have been known to sink fully 2ft. into the deposit. Sometimes a red clay is overlaid by a globigerina ooze, more frequently a red clay overlies a globigerina ooze, the transition between the two layers being either abrupt or gradual. In some positions it is possible to account for these layers by referring them to changes in the condition of the surface waters, but in other situations it seems necessary to call in elevations and subsidences of the sea-floor. There is a striking difference between the average chemical and mineralogical composition of terrigenous and pelagic deposits. It would be extremely interesting to have a detailed examination of one of those deep holes where a typical red clay is present, and even to bore some depth into such a deposit, if possible, for in these positions it is probable that not more than a few feet of deposit have accumulated since the close of the Tertiary period. One such area lies to the south-west of Australia, and its examination might possibly form part of the programme of the approaching Antarctic explorations. It has already been stated that plant-life is limited to the shallow waters, but fishes and members of all the invertebrate groups are distributed over the floor of the ocean at all depths. The majority of these deep-sea animals live by eating the mud, clay, or ooze, or by catching the minute particles of organic matter which fall from the surface. It is probably not far from the truth to say that three-fourths of the deposits now covering the floor of the ocean have passed through the alimentary canals of marine animals. These mud-eating species, many of which are of gigantic size when compared with their allies living in the shallow coastal waters, become in turn the prey of numerous rapacious animals armed with peculiar prehensile and tactile organs. Many deep-sea animals present archaic characters; still the deep sea cannot be said to contain more remnants of faunas which flourished in remote geological periods than the shallow and fresh waters of the continents. Indeed, king-crabs, lingulas, trigonias, Port Jackson sharks, *Ceratodus*, *Lepidosiren*, and *Protopterus* probably represent older faunas than anything to

be found in the deep sea. Sir Wyville Thomson was of opinion that, from the Silurian period to the present day, there had been as now a continuous deep ocean with a bottom temperature oscillating about the freezing-point of fresh water, and that there had always been an abyssal fauna. I incline to the view that in Palæozoic times the ocean basins were not so deep as they are now; that the ocean then had throughout a nearly uniform high temperature, and that life was either absent or represented only by bacteria and other low forms in great depths, as is now the case in the Black Sea, where life is practically absent beyond 100 fathoms, and where the deeper waters are saturated with sulphuretted hydrogen.

ADDRESS IN ECONOMIC SCIENCE AND STATISTICS.

The Address in Section F, Economic Science and Statistics, was delivered by Mr. Henry Higgs, who, in the course of his remarks said:—The prime concern of the economist and of the statistician is the condition of the people. Other matters which engage their attention—particular problems, questions of history, discussions of method, developments of theory—all derive their ultimate importance from their bearing upon the central subject. The statistician measures the changing phenomena of the production, distribution, and consumption of wealth, which to a large extent reflect and determine the material condition of the people. The economist analyses the motives of these phenomena, and endeavours to trace the connection between cause and effect.

Defects of Household Management.

The condition of the people has improved, and is improving, said Mr. Henry Higgs. Public hygiene has made great progress, and houses are better and more sanitary, though for this and other reasons rents have risen. Wages are higher. Commodities are cheaper. Co-operation and the better organisation of retail business giving no credit have saved some of the profits of middlemen for the benefit of the consumer, while authority fights without ceasing against frauds in weights and measures, and adulteration. Free libraries, museums, picture galleries, parks, public gardens, and promenades have multiplied, and it is almost sufficient to observe that no one seems to be too poor to command the use of a bicycle. But with all this progress it is to be feared that housekeeping is no better understood than it was two centuries ago—perhaps even not so well. If we were suddenly swallowed up by the ocean it appears probable that the foreign student would find it easier to describe from existing documents the life and home of the British craftsman in the Middle Ages than of his descendant of to-day. In part, no doubt, our fiscal system, with its few taxes upon articles of food, and its light pressure on the working classes, is responsible for this neglect. During the Napoleonic war Pitt sent for Arthur Young to ask him what were the ordinary and necessary expenses of a workman's family, and the question would again become one of practical politics if any large addition were required in the proceeds of indirect taxation. Taxation has the one advantage of providing us with statistics. But the details of consumption are still obscure. But when we travel abroad we are curious to notice, and do notice, without giving offence, the dress, the habits, and the food of peasants and workmen; and it is difficult to resist the conclusion that we are less observant at home because these common and trivial details appear to us unworthy of attention. In his "Principles of Economics" Prof. Marshall says:—"Perhaps £100,000,000 annually are spent even by the working classes, and £400,000,000 by the rest of the population of England in ways that do little or nothing towards making life nobler or truly happier." And, again, speaking before the Royal Statistical Society in 1893—"Something like the whole Imperial revenue, say 100 millions a year, might be saved if a sufficient number of able women went about the country and induced the other women to manage their households as they did themselves." These figures show, at any rate, the possibilities of greatness in the economic progress which may result from attention to the humblest details of domestic life.

Consumption of Coal.

After some remarks on the consumption of food, Mr. Higgs spoke about the coal and waste:—Mr. Sargant says, "It is impossible to say how much of the superiority of English health and longevity is owing to the use of open fireplaces; probably a considerable part is owing to it. It may be true that three-fourths of the heat of our fireplaces passes up the chimney and is lost to us; but we gain far more advantage by the fresh air constantly introduced into the room." At a former meeting of this Association Mr. Edward Atkinson exhibited a portable oven or cooking-stove, which was a marvel of simplicity and economy. He has described it at length in his "Science of Nutrition," 1892. He argues that the attempts to combine cooking with the warming of a room or house are absurdly wasteful; that almost the whole of the fuel used in cooking is wasted; and that nine-tenths of the time devoted to watching the process of cooking is wasted; and he estimates the waste of food from bad cooking in the United States at 1,000,000,000 dollars a year. I have not, however, heard of his oven being at all extensively used. Upon the thorny subject of dress it is perilous to venture; but it is impossible to be in the neighbourhood of a London park on a Sunday afternoon without feeling that the efforts of domestic servants to follow the rapidly changing vagaries of fashion are carried to a pernicious degree of waste. The blouse of the French workman and the bare head of the Parisian factory girl or flower girl are infinitely more pleasing than the soiled and frowsy woollens or the dowdy hats of their English fellows; nor does the difference of climate afford an adequate explanation of the difference of habit. We must perhaps admit a greater dislike in England to any external indication of a difference in wealth by a costume different in kind. M. Levollée, after referring to the low price of the ready-made suits which the English factories "fling by the million on the markets of the world, including their own," adds: "This extraordinary cheapness is, however, not always without inconvenience to the consumer. If the clothes he buys cost little, they are not lasting, and their renewal becomes in the long run very burdensome. This renewal is, too, the more frequent in that the wife of the English workman is in general far from skilful in sewing and mending. Whether she lacks inclination or the necessary training, or whether the fatigues of a too frequent maternity make her *rôle* as a housewife too difficult for her to support, the woman of the people is generally, on the other side of the Channel, a rather poor cook, an indifferent needlewoman, and a still more indifferent hand at repairs." Given an equal income, there is probably no doubt that a French working-class family will be better fed and better clad than a corresponding English family dealing in the same market, and will lay up a larger stock of the household goods, and especially linen, which are the pride of the French peasant. It is not suggested that every man should confine his expenditure to what is strictly necessary to maintain his social position. Le Play refers to tobacco as "the most economical of all recreations." How else, he asks, could the Hartz miner "give himself an agreeable sensation" a thousand times in a year at so low a cost as 10*f*.?

ADDRESS IN MECHANICAL SCIENCE.

The Address in Section G was delivered by Sir W. H. White, F.R.S., who spoke mainly about steam navigation at high speeds, saying that steamship design to be successful must always be based on experiment and experience as well as on scientific principles and processes. It involves problems of endless variety and great complexity. The services to be performed by steamships differ in character, and demand the production of many distinct types of ships and propelling apparatus. In all these types, however, there is one common requirement—the attainment of a specified speed. And in all types there has been a continuous demand for higher speed. Stated broadly, the task set before the naval architect in the design of any steamship is to fulfil certain conditions of speed in a ship which shall not merely carry fuel sufficient to traverse a specified distance at that speed, but which shall carry a specified load on a limited draught of water. Speed, load, power, and fuel supply are all related; the last two have to be determined in each case. In some instances other limiting conditions are imposed affecting length, breadth, or depth. In all cases there are three separate efficiencies to be considered; those of the ship, as influenced by her form; of the propelling apparatus, including the generation of steam in the boilers and its utilisation in the engines; and of the propellers. Besides these considerations, the designer has to take account of the materials and structural arrangements which will best secure the association of lightness with strength in the hull of the vessel. He must select those types of engines and boilers best adapted for the service proposed. Here the choice must be influenced by the length of the voyage, as well as the exposure it may involve to storm and stress. Obviously, the conditions to be fulfilled in an ocean-going passenger steamer of the highest speed and in a cross-Channel steamer designed to make short runs at high speed in comparatively sheltered waters must be radically different. And so must be the conditions in a swift sea-going cruiser of large size and great coal endurance from those best adapted for a torpedo-boat or destroyer. There is, in fact, no general rule applicable to all classes of steamships; each must be considered and dealt with independently, in the light of the latest experience and improvements. Speaking of the progress made in steam propulsion, Sir W. H. White said:—Speed has been increased from 8½ to 22½ knots; the time on the voyage has been reduced to about 38 per cent. of what it was in 1840. Ships have been more than trebled in length, about doubled in breadth, and increased tenfold in displacement. The number of passengers carried by a steamship has been increased from about 100 to nearly 2,000. The engine power has been made nearly 40 times as great. The ratio of horse-power to the weight driven has been increased fourfold. The rate of coal consumption (measured per horse-power per hour) is now only about one-third what it was in 1840. To drive 2,000 tons weight across the Atlantic at a speed of 8½ knots about 550 tons of coal were then burnt; now, to drive 20,000 tons across at 22 knots about 3,000 tons of coal are burnt. With the low pressure of steam and heavy slow-moving paddle-engines of 1840, each ton weight of machinery, boiler, &c., produced only about 2H.P. for continuous working at sea. With modern twin-screw engines and high steam pressure, each ton weight of propelling apparatus produces from 6H.P. to 7H.P. Had the old rate of coal consumption continued, instead of 3,000 tons of coal, 9,000 tons would have been required for a voyage at 22 knots. Had the engine been proportionately as heavy as those in use 60 years ago, they would have weighed about 14,000 tons. In other words, machinery, boilers, and coals would have exceeded in weight the total weight of the *Campania* as she floats to-day. There could not be a more striking illustration than this of the close relation between improvements in marine engineering and the development of steam navigation at high speeds. In many ways, and particularly in regard to machinery design, the construction of torpedo vessels has greatly influenced that of larger ships. One important consideration must not be overlooked. For short-distance steaming at high speeds economy in coal consumption is of little practical importance, but it is all-important to secure lightness of propelling apparatus in relation to power. For long-distance steaming, on the contrary, economy in coal-consumption is of primary importance; and savings in weight of propelling apparatus, even of considerable amount, may be undesirable if they involve increased coal consumption. Differences of opinion prevail as to the real economy of fuel obtainable with boilers and engines such as are fitted in torpedo vessels. Claims are made for some vessels which represent remarkable economy. Only enlarged experience can settle these questions. Endurance is also an important quality in sea-going ships of large size, not merely in structures, but in propelling apparatus. The extreme lightness essential in torpedo vessels obviously does not favour endurance if high powers are frequently or continuously required. Still, it cannot be denied that the results obtained in torpedo vessels show such a wide departure from those usual in sea-going ships as to suggest the possibility of some intermediate type of propelling apparatus applicable to large sea-going ships and securing sufficient durability and economy of fuel in association with further saving of weight. Referring to the

Possibilities of Increased Speed,

Sir W. H. White said it would be idle to attempt any prediction as to the characteristic features of ocean navigation 60 years hence. Radical changes may well be made within that period. Further reductions may be anticipated in the weight of propelling apparatus and fuel in proportion to the power developed; further savings in the weight of the hulls, arising from the use of stronger materials and improved structural arrangements, improvements in form, and enlargement in dimensions. If greater draughts of water can be made possible so much the better for carrying power and speed. For merchant vessels commercial considerations must govern the final decision; for warships the needs of naval warfare will prevail. It is certain that scientific methods of procedure and the use of model experiments on ships and propellers will become of increased importance. Already avenues for further progress are being opened. For example, the use of water-tube boilers in recent cruisers and battleships of the Royal Navy has resulted in saving one-third of the weight necessary with cylindrical boilers of the ordinary type to obtain the same power with natural draught in the stokeholds. Differences in opinion prevail, no doubt, as to the policy of adopting particular types of water-tube boilers; but the weight of opinion is distinctly in favour of some type of water-tube boiler in association with the high steam pressures now in use. Greater safety, quicker steam-raising, and other advantages, as well as economy of weight, can thus be secured. Some types of water-tube boilers would give greater saving in weight than the particular type used in the foregoing comparison with cylindrical boilers. Differences of opinion prevail also as to the upper limit of steam pressure which can with advantage be used, taking into account all the conditions in both engines and boilers. From the nature of the case increases in pressure beyond the 160lb. to 180lb. per square inch commonly reached with cylindrical boilers cannot have anything like the same effect upon economy of fuel as the corresponding increases have had, starting from a lower

pressure. Some authorities do not favour any excess above 250lb. per square inch on the boilers; others would go as high as 300lb., and some still higher.

ADDRESS IN ANTHROPOLOGY.

The Address in Section H, Anthropology, was delivered by Mr. C. H. Read, who spoke of the importance of preserving our "prehistoric antiquities." Many ancient remains, such as the barrows of the early Bronze Age, are altogether unrecognised as such, and in the process of cultivation have been ploughed down almost to the level of the surrounding surface, until at last the plough scatters the bones and other relics unnoted over the field, and one more document is gone that might have served in the task of reconstructing the history of early man in Britain. Such accidental and casual destruction is, however, probably unavoidable, and, being so, it is scarcely profitable to dwell upon it. We can, perhaps, with more advantage protest against wilful destruction, whether it be wanton mischief or misplaced archæological zeal. An enlightened public opinion is our only protection against the first of these, and will avail against the second also; but we are surely entitled to look for more active measures in preventing the destruction of archæological monuments in the name of archæology itself. It is a far more common occurrence than is generally realised for a tumulus to be opened by persons totally unqualified for the task either by experience or reading. The loss that science has suffered by this indiscriminate and ill-judged exploration is difficult to estimate. Experience teaches us that it is not to State control that we must look. We must look to private organisations, and preferably to those already in existence, for some effectual moral influence and control, and, in my judgment, the appeal could best be made to the local scientific societies. The plan I would propose is this. Each society should record on the large-scale ordnance map every tumulus or earthwork within the county, and at the same time keep a register of the sites with numbers referring to the map, and in this register should be noted the names of the owner and tenant of the property, as well as any details which would be of use in exploring the tumuli. I am well aware that a survey of this kind has been begun by the Society of Antiquaries of London, and is still in progress; but this is of a far more comprehensive character, and is, moreover, primarily intended for publication. The more limited survey I now advocate would in no way interfere with it; but, on the contrary, would provide material for the other larger scheme. Once the local society is in possession of the necessary information just referred to, it would be the duty of its executive to exercise a beneficent control over any operations affecting the tumuli, and it may safely be said that such control could in no way be brought to bear so easily and effectively as through a local society.

ADDRESS IN PHYSIOLOGY.

The Address in Section I was delivered by Mr. J. N. Langley, F.R.S., the subject being the relation of the motor nerves to the tissues of the body, which, as Lord Lister said, is one of "intense and universal interest." The president of the section (Mr. Langley), in the course of his remarks, said:—From the early part of this century one way of regarding the body has been to consider it as made up of tissues grouped together in varying number and amount. Each tissue has its characteristic features under the microscope, and the point I wish to lay stress on is that in any broad classification not more than two tissues are known to be supplied with approximate completeness with different nerve-fibres. The striated muscular tissue, which forms, amongst other parts of the body, the muscles of the limbs and trunk, receives in all regions nerve-fibres from the brain or spinal cord. And the unstriated muscular tissue, which forms, amongst other parts of the body, the contractile part of the alimentary canal, and of the blood-vessels, is in nearly, and possibly in all, regions similarly supplied. According to our present state of knowledge large portions of the organism live their own lives uninfluenced, except indirectly, by the storms and stresses of the central nervous system. No nervous impulse can pass to them to make them contract, or to make them secrete, or to quicken or slacken their inherent activity. The nervous system can only influence them through the medium of some other tissue by changing the quantity or quality of the surrounding fluid. Regarding, then, the body from the point of view of the control exercised by the nervous system on the other constituents, we have first to recognise that this control is in considerable part indirect only; that the several tissues are in varying degree under direct control, and that different parts of one tissue may be influenced by the nervous system to different extents. Even when nervous impulses can strikingly affect the vital activity of a tissue, their action is limited. They cannot modify the activity in all the various ways in which it is modified by the inherent nature of the tissue and the character of the surrounding fluid. Thus the sub-maxillary gland which pours saliva into the mouth is in life ceaselessly taking in oxygen and giving out carbonic acid; it does this without pouring forth any secretion. So far as we know no nervous impulse can hasten or retard this customary life of the gland by a direct action upon it without producing other changes. The essential effect of a nerve impulse appears to be to modify the amount of energy set free as work; usually it causes work to be done, as in the contraction of a muscle, or in the secretion of fluid by a gland; sometimes it diminishes the work done, as in the cessation of a heart-beat, or the decrease of contraction of a blood-vessel. Other changes often go on side by side with this setting free of energy as work; but there is no unimpeachable instance in which these other changes take place by themselves as the result of nervous excitation. The somatic or voluntary nervous system has in its essential features long been known; we may, therefore, pass on to the more obscure field of the arrangement of the involuntary nervous system which presents some peculiar characters. The most distinctive of these is that the nerves, after they leave the brain or spinal cord, do not run interruptedly to the periphery; they end in nerve-cells, and the nerve-cells send off the fibres which run to the periphery. Thus all nerve-impulses, which pass from the brain or spinal cord to unstriated muscle or glandular tissue, pass through an intermediate station on their way. In this, as in some other respects, the arrangement of the involuntary nervous system is more complex than that of the voluntary nervous system; in the latter the motor nerve-fibres run direct to the tissue, and have no nerve-cells on their course.

ADDRESS IN BOTANY.

The Address in Section K, Botany, was delivered by Sir George King, and was mainly devoted to the history of Indian botany, which was commenced by the Dutch in the "Hortus Malabarensis." After referring to the work done by Sir Joseph Hooker, Roxbrough, Wallich, and that "most remarkable man" William Griffith, the president pointed out that the bulk of the work of elaborating the materials sent from India must be done in a large Herbarium, such as did not exist in Asia. In the Kew Herbarium were to be found the types of an overwhelming proportion of the new species described for the first time in that monumental work, "The Flora of British India." "The preservation in good condition of a type specimen is, from the point of view of a systematic botanist, as important as is the preservation to the British merchant of the standard pound weight and the standard yard measure on which the operations of British commerce depend. 'Types' also stand to the systematic botanist much in the same relation as the national records do the national historian. The latter are guarded in the Record Office, I understand, with all the skill which the makers of fire-proof, damp-proof, and burglar-proof depositories can suggest. If, however, the type of a species happens to be deposited at Kew, what are the probabilities of its preservation? Such a type at Kew is incorporated in what is admitted to be in every sense the largest and, for its size, the most accurately named, the most easily consulted, and therefore the most valuable Herbarium in the world, the destruction of which would be a calamity commensurate in extent with that of the burning of the library at Alexandria. One might therefore reasonably expect that a people who rather resent being called a 'nation of shopkeepers' would feel pride in providing for this priceless national collection a home which, although perhaps somewhat inferior to that provided for the national historical records, might at least be safe from fire. This expectation is not fulfilled. The infinitely valuable Kew Herbarium and library have no safer home than an old dwelling-house on Kew-green, to which a cheap additional wing has been built. The floor, galleries, and open inner roof of this additional wing are constructed of pine coated with an inflammable varnish, and on the floor and galleries are arranged cabinets (also made of pine-wood), in which the specimens (which are mounted on paper) are lodged. On behalf of the Flora of India, I venture to express the hope that the provision of a proper home for its types may receive early and favourable consideration by the holders of the national purse-strings. But India is by no means the only portion of the Empire interested in this matter, and the safe custody of the Kew Herbarium is not merely a national, but a cosmopolitan responsibility."

ABSTRACTS OF REPORTS, PAPERS, &c.

Masses Smaller Than Atoms.

A paper giving an account of recent researches on the "Existence of Masses Smaller than Atoms" was read by Prof. J. J. Thomson, F.R.S., in which he pointed out that several lines of investigation lead to a determination of the ratio of the mass of an atom to the electric charge conveyed by it. These are (1) ordinary electrolysis; (2) experiments on the velocity of charged particles; (3) experiments on the velocity of cathode discharges. The result of these experiments indicates that the charge carried by an atom in cathode discharges and similar phenomena is apparently 1,000 times greater than in ordinary electrolysis. It follows either that the atoms become dissociated and only a portion of their mass carries the negative charges of cathode rays, or else that the atom can receive a greater charge than is assigned to it in explaining electrolytic phenomena; either the mass is smaller or the charge greater than in the case of electrolysis. The author described a method of discriminating between these two assumptions by determining separately the charge carried by a known number of atoms, in a case for which the charge per unit mass has the greater value. The method used consists in deflecting by a magnetic field the paths of particles which convey the negative charge from a flat plate to a close parallel one, under the action of ultra-violet light. A flat metal plate, negatively electrified, is brought near to a very large perforated metal plate through which ultra-violet radiation can pass, the whole apparatus being inclosed in gas at a pressure of about 1-100 millimètre of mercury. The radiation causes a discharge of electrified particles from the negative plate, which move in parallel straight lines to the perforated plate which receives their charge. If now a magnetic field be set up between the plates, its direction being parallel to the plane of the plates, the paths of the particles become curved—in fact, cycloids, and the particles may not reach the perforated plate if the latter is far enough away from the negative plate. There will therefore be a diminution in the rate of discharge, which is the phenomenon actually observed; its amount corresponds with theory if we assume the large value of the charge per unit mass. The magnitude of the phenomenon is the same in all gases and the same for ultra-violet and cathode rays. Similar results are obtained for observing the negative charges leaving an incandescent electric filament of carbon in an atmosphere of hydrogen in a magnetic field. The amount of charge carried by an atom depends on the gas and on the nature of the electrodes. It would appear from this, although he put the theory forward with diffidence, that electrification seems to consist in the removal from an atom of a small corpuscle, the latter consisting of a very small portion of the mass of the atom with a negative charge, while the remainder of the atom possesses a positive charge. This assumption favours Prout's hypothesis that the mass of an atom is not invariable, a supposition confirmed by the recent spectroscopic determinations of Lockyer and others. —M. Broca described some experiments confirming the conclusions of Prof. Thomson. He had obtained, in a Crookes vacuum-tube, with small platinum electrodes half a millimètre apart, an actual spark. The metal from the anode deposited on the walls of the tube and its path could be deflected by a magnetic field, as if it carried a positive charge. Spectroscopic analysis of the spark near the two electrodes confirmed Prof. Thomson's results.

Physical Conditions of the English Channel.

The recorder of Section D, Zoology, Mr. Garstang, presented the first report of the committee on the "Periodic Investigation of the Plankton and Physical Conditions of the English Channel during 1899." He said that the proposed investigation had been carried on by him at regular intervals during the year. Practically the whole of the grant had been devoted to the hire of a suitable steam-boat for the survey, and two further cruises would be necessary to complete the investigation. The observations of temperature and salinity and the collections of plankton obtained would furnish a complete year's record of the periodic changes in the physical character of the water, and in the quantity and character of the floating flora and fauna in the mouth of the English Channel. This standing record should be of the highest value in many branches of marine biological and hydrographic inquiry. Most of the apparatus used was the property of the Marine Biological Association, which had borne all the expense of the special nets and gear. The Royal Society Grant Committee had also lent apparatus. Mr. Garstang concluded by showing and explaining the special nets which he had devised for his investigation.—Prof. Ray Lankester, F.R.S., as president of the Marine Biological Association, congratulated Mr. Garstang on the results he had obtained. Baron Jules de Guerne, who has been conducting similar investigations from the yacht of the Prince of Monaco, commended the simplicity of Mr. Garstang's net. He explained that those used by himself had been far more elaborate, but had not given quite satisfactory results.

Electrolysis and Electro-Chemistry.

The report of the committee on electrolysis and electro-chemistry was presented by Mr. W. C. D. Whetham. It states that the conductivity of a number of salts in very dilute aqueous solution at

the freezing-point of water has been determined by Mr. Whetham, while Mr. Griffiths has concurrently made observations of the freezing-point for corresponding solutions. The observations of conductivity extend to solutions of sulphuric acid, potassium chloride, sodium chloride, barium chloride, copper sulphate, potassium permanganate, potassium bichromate, and potassium ferricyanide. The range of dilution is, speaking generally, from below the hundredth-thousand to about the twentieth part of a gram equivalent per thousand grams of solution. The water used was specially distilled three times, in the last instance from a platinum still, and collected in platinum vessels. Its specific resistance was rather smaller than that of the water obtained by Kohlrausch by distillation in vacuo. The results obtained this year, while confirming those described at the last meeting of the Association for solutions of moderate concentrations, show differences when great dilutions are reached, but the constancy of the present measurements shows that the water now used is good enough to enable trustworthy values to be obtained even at the lowest limits of dilution above mentioned.—Mr. E. H. Griffiths, F.R.S., stated that he had met with great difficulties in his experiments on freezing-points of solutions, though he believed he had now located the source of error in the results—namely, the absorption of gases by the solutions. He could measure easily a difference of temperature of five-millionths of a degree Centigrade.

Heat of Combination of Metals.

The report of the committee on the heat of combination of metals in the formation of alloys, was read by Prof. O. J. Lodge, F.R.S. The experiments have been carried out by Dr. A. Galt in order to determine whether the heat produced by the solution of an alloy of copper and zinc in nitric acid is the same as would be produced by the solution of the same amount of copper and zinc mixed, but not alloyed. The results show that the heat of combination of zinc and copper is negative when much zinc is present and becomes a negative maximum for 16 per cent. of copper. With greater percentages of copper the heat of combination becomes zero and then positive, reaching a maximum positive value for 38 per cent. of copper. It then sinks to zero, reaching that value for 90 per cent. of copper.—Mr. Vernon Harcourt, F.R.S., thought that great caution was necessary in making deductions from observations of this nature, because the products of decomposition of the acid used might be different according as the alloys or the mixed metals are used.

Stonehenge.

In Section H, Anthropology, Dr. Alfred Eddowes read a paper entitled "Stonehenge: Some New Observations and a Suggestion." Dr. Eddowes said he believed that the 30 large upright stones, with their intervals, indicated that the circle was divided into 60 equal parts; that the grooved stone (which was the best selected, worked, and preserved stone in the whole ruin, but had never hitherto received the attention it deserved) was used for supporting a pole in a definite and permanent manner; and that the signs of wear at the mouth of the groove, together with the two worn horizontal hollows or waists, and the dimples on the convex back of the stone, indicated not only where, but how, this pole was fixed. Such a pole would form the pointer of a sun-dial for daily observation, or, what was more important, an indicator of the time of year, by the length of its shadow. The levelled avenue (along which the sun's shadow would fall about 3p.m.) and the flat "slaughter-stone" with its arrow-head marking seemed to him to support his view.—Dr. Sebastian Evans thought that Dr. Eddowes had proved his point that Stonehenge had been used for the purposes of an observatory, and remarked that though there was a vast literature on the subject, yet the study of Stonehenge had hardly begun, for it had never been investigated as a part of a whole series of early stone monuments. Mr. Arthur Evans somewhat dissented from Dr. Eddowes's views. Observing that Stonehenge was on the site of remains of an early Bronze Age cemetery, he said it ought to be regarded not alone but in relation to a large series of other stone monuments, and he entered a protest against the attempt to introduce very precise and rigorous scientific ideas into what was, in his opinion, a rude monument.

Symbiosis.

In Section B, Chemistry, some interesting notes were read. Prof. Marshall Ward, F.R.S., first of all drew attention to various instances both in the vegetable and animal kingdom, where organisms existed together and performed functions helpful either to one or to all of the organisms concerned—functions, moreover, that were not performed in the absence of any of the contributory organisms. In some instances the organisms passed the whole of their existence together for their mutual advantage, as was the case with the alga and fungus constituting the dual organism of lichens. This he regarded as true symbiosis. In other cases the one organism appeared to prepare the way for the other, as for instance in the successive stages of the conversion of starch, first into sugar by a mould, and then into alcohol by yeast. For this sort of association he proposed the name metabiosis. But all stages of associations were to be found in nature up to the case where one organism injured the other. This state of affairs, which was exemplified by many parasites, had been termed antibiosis. In some circumstances, however, a condition of antibiosis might gradually become one of symbiosis. The aid rendered by one organism to another took various forms, such as the preparation of proper nutritive matter, the removal of injurious or noxious matter, or the formation of protective substance.—Sir Henry Roscoe, F.R.S., translated the "Note sur les Fermentations Symbiotiques Industrielles" presented by Dr. A. Calmette, director of the Pasteur Institute of Lille. In this paper particular attention was drawn to the conversion of starch into alcohol by means of the symbiotic existence of moulds with yeasts, and to its possible industrial application. Sir Henry remarked that this possibility had already been realised, for by the employment of pure cultivations of the two forms of organisms thousands of tons of starch were transformed into alcohol in France and Belgium. This state of things would revolutionise the industry of fermentation and distillation, inasmuch as under efficient scientific supervision the yield of spirit by the new process amounted to as much as 97½ per cent. of the theoretical yield. Moreover, the spirit was superior in quality to that produced in the ordinary way.—Prof. Armstrong, F.R.S., contributed a paper entitled "Symbiotic Fermentation: its Chemical Aspects." He advanced arguments in favour of the purely chemical character of symbiosis, and advocated in particular Baeyer's view that fermentative changes are due to the withdrawal of water and the subsequent addition of its elements in a different order, the function of enzymes being to bring the water to this particular condition of activity.

Coal in Kent.

A paper on "The South-Eastern Coalfield" was read by Prof. Boyd Dawkins, F.R.S., in the course of which he said:—The discovery was of great practical value, as it would probably result in the same development in Kent of industries and manufactures which had taken place where the coal had been worked, under the same conditions, under the cretaceous and jurassic rocks in France and Belgium. It was of equally great theoretical value, as it proved up to the hilt the truth of Godwin Austen's view, published in 1858, that the coal measures lie buried underneath the newer rocks in South-Eastern England. The first boring to be noticed was at Ropersole, a spot near the highway between Dover and Canterbury—eight miles from Dover, at 400ft. above O.D.—the surface being composed of upper chalk, with a thin stratum of clay-with-flints. It was begun at the close of 1897, and had at the present time pierced the strata to a depth of 1,773ft. 7in. In his opinion, the coal measures of Ropersole were a portion of the same series as those at Dover. Here, as at Dover, the question of seams of coal resolved itself probably into a question of sinking deeper. Here only two unimportant seams had been met with in a thickness of 197ft. There twelve seams were penetrated in a thickness of 1,054ft. 6in., the thickest 4ft. seam being at the bottom. The Ropersole boring established the fact that the Dover coal measures extended northwards for a distance of eight miles, and beyond in the direction of Canterbury. The coal measures set in in Kent at a sufficient distance to the north-east of Brabourne to allow of the presence of the carboniferous limestone and millstone grit. These probably dip at the same high angle as the Devonian below. Their south-western boundary could only be accurately defined by further borings, such as those which were now being carried on at Ottinge, about 2½ miles to the north-east of the scarp of the Downs, and six miles to the south-west of Ropersole. Their range to the north and the east still remained to be proved. They were, however, continued under the Channel, and had been proved by the boring at Calais in 1850, as well as those carried out in 1898 at Strouannes, near Wissant.—Some questions being asked, Mr. Etheridge replied that chemical analysis showed that the Dover coal was of the same quality as that found in the other fields; and Prof. Boyd Dawkins observed that there was good blazing coal, as well as steam coal and anthracite, found in South Wales exactly corresponding to that of Dover; that he had found no lignite in the Dover coal-measures, but some in the secondary rocks, the oolites, above; that no temperature observations were possible in the boring, and finally, in respect of the depths of the coal-measures, that he was of the opinion that the seams reached at Dover formed only the upper part of the measures, so thick at Westphalia, where they were 7,200ft. thick, and reached 7,600ft. at Liége.

Dover and Franco-Belgian Coalfields.

Mr. Etheridge said that the history of the stratified rocks of South-East Kent was now in a fair way of being fully determined. The Dover exploration was carried through the lower cretaceous, jurassic, and probably the upper series of the coal-measures, with, so far, eight seams of workable coal to the depth of 2,225ft. How many more seams there are was not certain, but over 100ft. of the coal-measures below the thick or 4ft. seam had been tested, and yet the coal-measure floor had not been penetrated. The discovery of these coal-measures proved completely Godwin Austen's view of forty years ago, that the coal-measures which form part of the line joining the coalfields of Westphalia, Belgium, and North France with those of Bristol, North Somerset, and South Wales lie buried beneath the newer rocks in South-East England. The future commercial value to Dover and its neighbourhood might be inferentially seen from the fact that in 1850 there were only two collieries in the Pas de Calais field, producing annually 19,000 tons, while in 1895 there were 17 collieries producing over 11,000,000 tons. Comparing by maps, plans, and statistics of borings the coalfields of Brabourne and Dover with those of Belgium and South Wales, Mr. Etheridge showed, first, that Prof. Prestwich's view was probably correct—namely, that the Dover field was one of a chain of isolated coal-basins that extended from Prussia to the South of Ireland, and passed under the Straits of Dover; then that the coal at Dover was workable at a depth comparing very favourably with (and, indeed, much less than) the depths worked in South Wales and Belgium.

Concealed Coalfields.

Mr. Walcot Gibson read a paper on some recent work among the Upper Carboniferous of North Staffordshire and its bearings on concealed coalfields. He observed that in his investigations he had met with workable seams of coal at reasonable depths beneath the red rocks surrounding the South Staffordshire coalfield; but there remained large areas lying between the known coalfields of Shropshire, North Staffordshire, and Nottinghamshire that had not at present been explored. Within the South Staffordshire area there were considerable areas of so-called permian rocks, which recent investigations had proved to be conformable to the upper coal measures and to contain a coal-measure flora. This determination would have important industrial bearings. The fact that the Newcastle limestone lay at the base of grey measures intercalated between an upper group of red strata (the Etruria marls) had enabled him to detect true coal measures in Keele-park, Shutlanehead, and to the west of Leycett. There was, moreover, little doubt that the coal measures of the Pottery coalfield lay not far from the surface under Little Madeley and Craddocks Moss. Evidence had been obtained that the strata on the north-west side of the North Staffordshire anticline did not uninterruptedly descend beneath the (so-called permian) red rocks to the west of Leycett, but rose locally westward under Hayes. The effect of this change of inclination was to bring to the surface strata which lay considerably below the unproductive red series, and to bring the principal coal and ironstones within reach further west than might have been expected. The conclusion he reached was that a thorough and complete examination of the exposed coalfields of the Midland counties and of the bordering New Red rocks would be of the highest importance in determining at what depth the productive measures lie beneath the great central tracts of the Midland counties. Prof. Lapworth congratulated Mr. Gibson on his very important work, and said that the conclusions he had reached from the practical observations made coincided with those that he himself had reached from theoretical deductions.

Solidification of Hydrogen.

A paper by Prof. Dewar, F.R.S., on "The Solidification of Hydrogen," in the absence of the author was read by Sir W. Crookes, F.R.S. Solid hydrogen presents the appearance of frozen water, and not, as has been anticipated by many, that of frozen mercury. The temperature of the solid is 16° absolute at 35 millimètres pressure, and it melts 16° or 17° absolute, the practical limit of temperature obtainable by its evaporation being 14° or 15° absolute.—Dr. Ludwig Mond, in proposing the vote of thanks, said it was gratifying to learn not only that Prof. Dewar had achieved this great result, but that he was still alive to tell the tale, for the danger incident to the experiments was considerable. Dr. Gladstone, F.R.S., in seconding the vote of thanks, remarked on this great triumph of Prof. Dewar, hydrogen being the last of the old gases that remained to be solidified. Sir W. Crookes, in acknowledging the vote of thanks, pointed out that the great danger in these experiments resulted from the leakage in of air, which made an explosive mixture with the hydrogen; furthermore, during the passage of the dry gas through the narrow tubes it became electrified, and in some instances sparking occurred with most violent detonation. Sir William also announced that Prof. Dewar had succeeded in liquefying helium by means of liquid hydrogen, an announcement that was received with acclamation. The hydrogen for these experiments was obtained by the action of pure sulphuric acid on pure zinc.

A Remarkable Sponge.

In the Section of Zoology, Mr. J. J. Lister read a

paper describing a new form of sponge, *Astrosclera Willeyana*, obtained by Dr. Willey at Lifu, in the Loyalty Islands. The features which render the sponge peculiar are a calcareous skeleton formed of polyhedral elements united together into a solid mass, which is penetrated by a system of canals containing the soft parts; the limitation of the canal system to the upper surface; the absence of large atrial spaces, and the minute size of the ciliated chambers (under 20-thousandths of a millimètre in diameter). In its larger characters the sponge presents considerable resemblance to the fossil *Pharetrones*, which are found in strata ranging from the Devonian to the Cretaceous. It differs from them, however, in the nature of skeletal elements. The sponge appears to form the type of a new family—the *Astroscleridæ*.—Prof. Sollas and Prof. Ray Lankester congratulated Mr. Lister on the work, whose results he had communicated, and Prof. Lankester stated that the discovery was one of the most remarkable of the year in biological science.

Origin of Flint.

The subject of the origin of flint was referred to by Prof. W. J. Sollas, F.R.S., who said that the first stage was the conversion of the calcareous remains of the organisms of the chalk into silica. The silicious foraminifera and coccoliths so produced were cemented by a deposition of silica into white flint, and this by a further deposit of silica became converted into black flint, just as snow might be transformed into compact ice. The source of the silica might be looked for in the remains of silicious organisms, such as sponge spicules, and Prof. Sollas said he was now able to bring positive proof of the original existence of abundant spicules in the chalk, which were now represented by hollow casts to the extent sometimes of 3 per cent. of the rock.

Permanence of Planetary Gases.

In a paper on the "Permanence of Certain Gases in the Atmospheres of Planets," Prof. G. H. Bryan, F.R.S., described an investigation of which the methods were indicated at the meeting of the Association in 1893, when he applied the kinetic theory of gases to explain the absence of an atmosphere from the moon's surface. In the present investigation similar methods were applied to the atmospheres of planets, account being taken of the axial rotations. A test of the permanence or otherwise of different gases in the atmospheres of different celestial bodies at different temperatures had been obtained, and a superior limit had been found for the rate at which any planet would lose any gas by the molecules flying off from its atmosphere. To interpret this limit in the simplest possible form he calculated the number of years which would have to elapse in various cases before the quantity of gas lost would be equivalent to that contained in a layer one centimètre thick covering the surface of the earth. In the case of terrestrial hydrogen the loss in question would occupy 84,000,000,000 years at temperature − 73°, 600,000 years at − 23°, and 222 years at 27° C. For helium on the earth's surface, the corresponding numbers were $3 \cdot 5 \times 10^{16}$ years at −73°, 3×10^{19}, or 30 trillion years at 27°, 84,000,000,000 years at 127°, 600,000 years at 227°, and 222 years at 327°. The removal of a layer of air one centimètre in thickness from the surface of the earth would only mean a lowering in the average barometric pressure of one-thirteen-thousand-six-hundredth of a millimètre, roughly. Suppose then that the afore-mentioned gases were present in the respective atmospheres in sufficient quantity to produce pressures comparable with one atmosphere, and assume that a fall of one millimètre in the average height of the barometer to be the least secular change that could be detected, the above-mentioned intervals of time would have to be multiplied by 13,600, roughly, in order to give the number of years in which the escape of the respective gases could be detected by a barometer. The only possible conclusions from these results were: (1) that helium could exist permanently in our atmosphere at ordinary temperatures; (2) that if helium once existed in appreciable quantities in the earth's atmosphere it must have escaped when the earth was far hotter than at present; (3) that hydrogen, on the other hand, might escape to an appreciable extent from the earth's atmosphere even at ordinary temperatures.

Luminous Rings in Lines of Magnetic Force.

A paper on the "Production in Purified Gases of Luminous Rings in Rotation about Lines of Magnetic Force," was read by Mr. C. E. S. Phillips, who described the apparatus used as consisting of an approximately spherical glass bulb, the ends of which were left open for the purpose of inserting two soft iron electrodes, half an inch in diameter, through air-tight flanges which themselves were cemented to the glass. The bulb was about 2½in. in diameter, and the electrodes were chosen of a sufficient length to enable them, while almost meeting at the centre of the bulb, to project outwards slightly beyond the rims of the flanges. A side tube was attached for the purpose of connecting the apparatus to a Sprengel air-pump and McLeod vacuum gauge. Two powerful electro-magnets were then adjusted, so as to strongly magnetise the electrodes when necessary. A low pressure having been produced in the bulb by the action of the air-pump, leading wires were attached to the iron electrodes to enable the discharge from the secondary of an induction coil to be passed through the rarefied gas. Under these conditions the effects produced in the usual glow-discharges by the magnetisation of the electrodes could be conveniently examined. It was seen that at a pressure represented by ·003mm. of mercury, and with the discharge just able to pass in the bulb (the magnets meanwhile remaining unexcited), on shutting off the current from the induction coil and completing the magnet circuit, a luminous ring appeared within the bulb in a plane at right angles to the lines of force and in rotation about the magnetic axis. The number of such rings could be varied by special devices, and their brightness largely depended upon the electrostatic condition of the outer surface of the glass bulb. The effect also depended upon the manner of stimulation of the rarefied gas within the bulb, and the shape of the magnetic field was of importance.—Prof. J. J. Thomson, F.R.S., stated that he had found the motion of positively-charged ions to be much smaller than that of negatively-charged ones—a fact which would account for the apparent preponderance of the negatively-charged ions in the tube.

Bacterial Treatment of Sewage.

Extracts from a report on the "Bacterial Treatment of Raw Sewage in Coke Beds" were read by Prof. Clowes—a method first experimentally carried out by the London County Council for treating the effluent from sewage dosed with "chemicals." Now coke of the size of walnuts is used, and beds from 4ft. to 13ft. deep have been tried. One treatment on the coke bed removes all the fæcal matter and 50 per cent. of the dissolved organic matter, whilst a second treatment removes a further 20 per cent. of the dissolved organic matter. The mode of procedure is to leave the sewage in contact with the coke for three hours, and then allow the coke to stand empty for seven hours for aëration. The effluent supports the life of fish, and neither it nor the coke becomes foul, although no bacterial improvement is brought about by the treatment—a factor that is advantageous for the final stages of purification. The efficiency of the filters falls off in time owing to clogging with the cellulose fibres derived from wood pavements, straw, &c., but much of this can be removed by a preliminary sedimentation and disposed of in a destructor. Fresh coke requires five or six weeks to get into working order; in dry weather, when the sewage is less dilute, the working is less satisfactory. Mr. W. Scott-Moncrieff followed with remarks on "The Place of Nitrates in the Biolysis of Sewage." He said there were three methods of recovering the nitrogen from sewage, the disposal of sewage directly on the land, the chemical precipitation of the sewage in the form of sludge, and the method described by Prof. Clowes. The bulk and dilution were the obstacles in the first method, whilst the second was not satisfactory. The third, however, properly conducted, was good; in fact, as the late Sir Edward Frankland remarked, it was a fermentative process like brewing, and, as the author said, the method of nature herself artificially aided. Sewage was a complex mixture, therefore different organisms had to work to break up the combinations. Hence the desirability of letting the process go on in stages.—Prof. Warington remarked that the process described by Prof. Clowes was really neither anaërobic nor aërobic, but partook of both characters. It seemed to him that neither had full play.—Mr. Dibdin pointed out that the bacterial treatment was a success, and could, by making a suitable bed, be made to yield an absolutely pure effluent, which was not always necessary. The important feature of Prof. Clowes's communication was the successful treatment of the sludge, which in London amounted to 40,000 tons a week, and cost a considerable sum to take out to sea. He remarked that the sewage of Leeds had been successfully treated on the coke-beds, although it contained a large proportion of chemical refuse.—Mr. Douglas Archibald doubted whether the bacterial treatment of sewage would be as efficient as the chemical treatment in destroying dangerous organisms.

Turbine Steam-Engines.

The Hon. C. Parsons, in referring to this subject, said that with turbine engines no lubricant whatever enters the steam part, so that the boilers become much less charged with oil than is the case with ordinary engines, and express water-tube boilers of the smaller tube type may be maintained in satisfactory working conditions for long periods; and, further, it is understood that the Board of Trade will be prepared to so modify their system of periodic inspection as to permit of such boilers being used for regular cross-Channel service. But perhaps the most important considerations are the increased comfort to passengers, owing to the absence of vibration and a remarkable smoothness of motion analogous to that of a sailing vessel, also the greater depth at which the propellers are placed below the surface of the water, reducing the liability to racing of the engines, which enables the speed of the ship to be maintained in heavy weather in a way that is totally impossible in the case of ordinary screw or paddle-vessels. If a service of 30-knot vessels were placed on the Newhaven and Dieppe line, it would become the fastest route from London to Paris; also, if the system were properly carried out as suggested, the time on the Dover and Calais route between London and Paris would be shortened by about half an hour. The draught of water with turbine engines does not necessarily exceed that of paddle-wheel vessels, and, as turbine engines are more readily and quickly manipulated than ordinary engines, and each side of the propelling machinery can be put ahead or astern independently, the manœuvring power is practically equal to that of paddle-wheel propelled vessels. The particulars of the proposed 30-knot turbine boats are as follows:—Length, 275ft.; beam, 30ft.; depth (moulded), 13ft. 1in. to main deck, 21ft. to awning deck; draught, 9ft. 3in. (about); displacement, 1,000 tons (about); speed, 30 knots; I.H.P., 18,000.

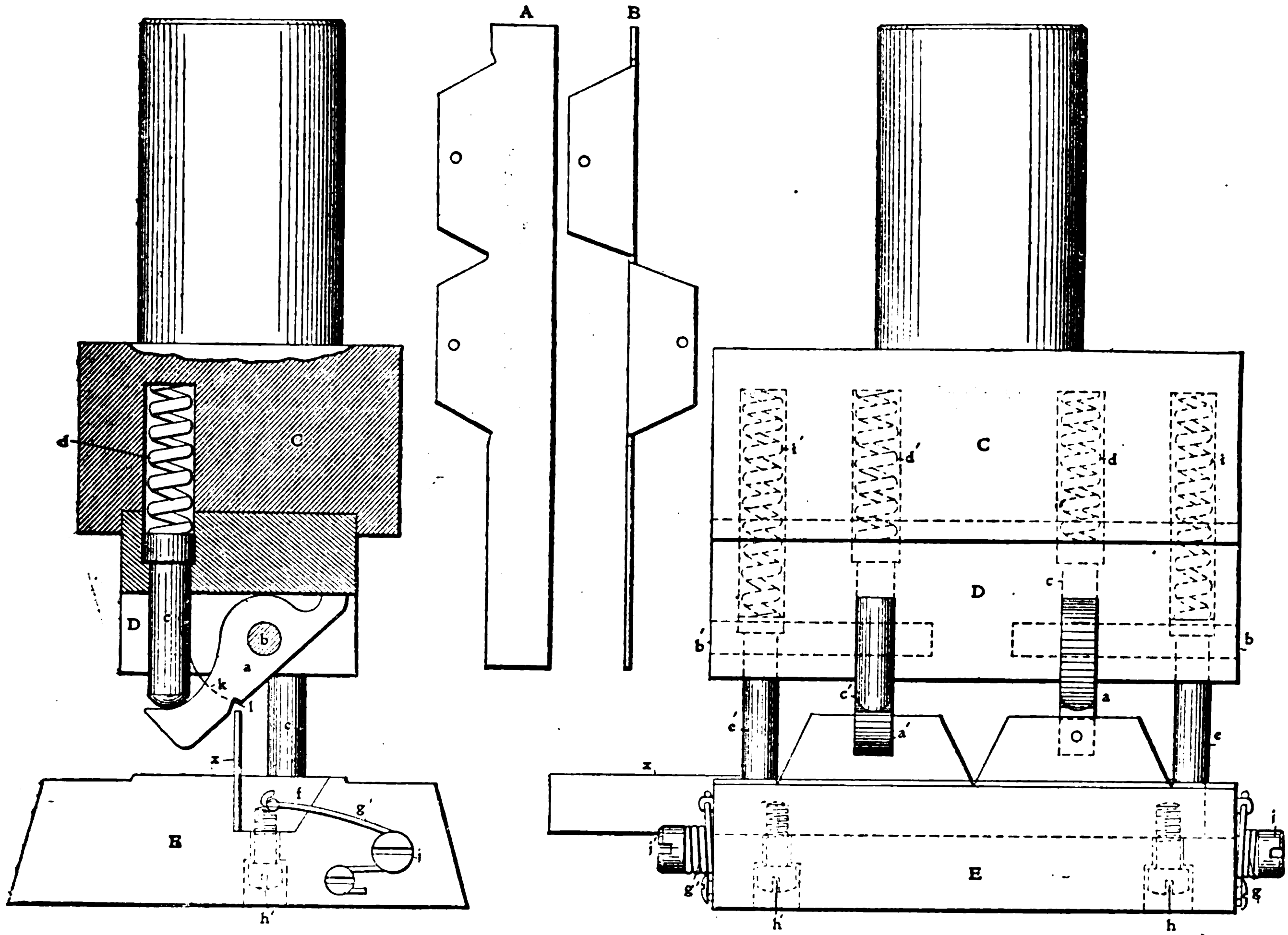
Vitality of Seeds.

It is well known that the vitality of seeds is not affected by low temperatures, but Sir W. Thiselton-Dyer described certain experiments that he had made in conjunction with Prof. Dewar to ascertain the influence of the temperature of liquid hydrogen on the germinating power of seeds. The result of the experiments went to show that life persists at a temperature so low that ordinary chemical action is practically stopped. Ordinary commercial samples of the seeds of barley, vegetable marrow, mustard, and pea were used. They were actually immersed in liquid hydrogen for more than six hours. The lowest temperature to which they were subjected was many degrees below the temperature of melting ice. The seeds, after being so immersed, showed no change visible to the naked eye. They came out of the ordeal as fresh and bright as they were before, and all germinated after they were planted.

Electro-motors on Board Ship.

A paper on "Electrical Machinery on Board Ship," by Mr. A. Siemens, was read, in which the author stated that direct driving was now generally preferred, and expressed an opinion that the type of generating plant now in use on board ship had reached a stage of development which would be improved, but not materially altered. To prevent the magnetic field of the dynamos affecting ships' compasses, "iron-clad" dynamos and double wires—one for the return current—were used. These conductors formed the most valuable part of the system of electrical installation for power purposes on a man-of-war. The superiority of the electric motor over small steam-engines or hydraulic distribution of power was dwelt on by the author. The two latter systems necessitated a network of piping all over the ship, which was difficult to arrange neatly, and gave endless trouble through leakage. The reason that the use of electric motors had not been more extended on board ship was due to the variation of the load that accompanied the working of most auxiliary machinery. In the case of the winch, for instance, it frequently happened that the strain on the cable increased sufficiently to stop the movement of the winch. This would cause the current through the electric motor to rise to an extent that might seriously injure the machine. It was impossible to overcome this by a fuse, as the interruption of the current would allow the strain to be taken off the winch, whereas in most nautical operations it was necessary to keep the strain on. To overcome this difficulty, shunt-wound motors might be used. These could be kept running continuously, the drums of the winches being operated through friction clutches, or special cut-outs could be applied in connection with series-wound motors. Through these cut-outs the current through the motors was not interrupted altogether, a by-pass taking a safe current. Examples of working a steering gear and rudder indicator were given. The suggestion that the main engines of a ship should be electrical motors was rejected as impracticable whether accumulators or steam driving, on the Heilmann principle, were adopted. A 6,000-ton ship propelled by 8,000I.H.P. would take 150 hours to cross the Atlantic, and that would be equal to 1,200,000H.P. hours. Fairly efficient accumulators gave ten watt hours per lb., so that a horse-power hour could be obtained for 75lb. of accumulators. The ship would therefore need 40,000 tons of accumulators.

More than half of the coke imported into California during 1898 came from Great Britain, while the remainder had its origin in Belgium, British Columbia, and Australia. The total amounted to 41,630 tons, which was an increase of 37 per cent. on the entries of 1887.



AN AUTOMATIC BENDING DIE.*

IT is very rare that we come across anything really new; so, although the combination here shown was new to me and to those around me, I do not claim that it will be new to all.

We have here shown a punch and die for bending the blank shown at A into the shape shown at B, making a "duck's-foot," such as is used in spacing the ventilating openings in armatures. In Fig. 1 is shown an end view (partly sectional) of the dies part way on the down stroke of the press, and with the "starters" just about to take hold of the blank. They consist of the tool-steel die E and punch D, which is screwed and dowelled from above (not shown) to the cast-iron holder C. The die E has a groove milled through it lengthwise, with one side perpendicular and the other side at an angle, as shown; to this is fitted the wedge f, leaving room at the perpendicular side for the blank x to be held tightly. Into the wedge f are driven the small pins to which the ends of the springs g' g are fastened, and then wound in turn round the screws $j j$, and the other ends secured by the small button-head screws as shown. The tendency of these springs should be to lift the wedge up, and away from the blank, thus releasing it after bending, and permitting a new one to be inserted. The motion of the wedge is limited by the screws h' h, which fit loosely in the die E, but are screwed home in the wedge.

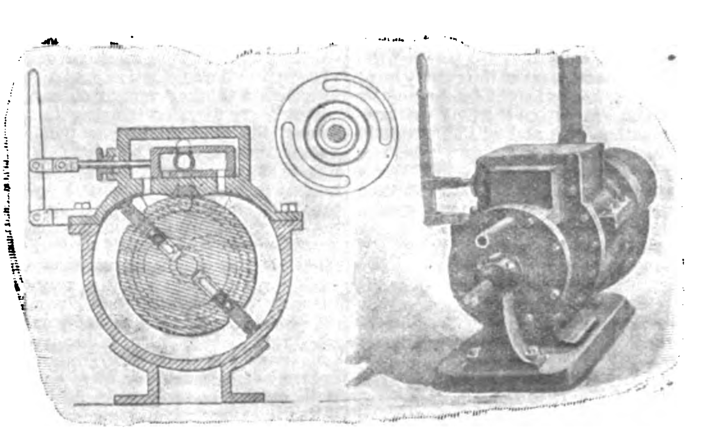
The blank is slid along between the wedge and die until it reaches a stop, not shown, which locates it in its proper position; as the press comes down, the buffers e e' press the wedge down into the die, and against the blank, thus securely holding it. The buffers should be long enough to do this before the starters a a' take hold; also, the buffer-springs i i' should be quite stiff. Referring to Fig. 1:—The starter a is pivoted on the pin b, which is on the opposite side of the centre line from which the bend is to be made.

The little arm at the upper end serves as a stop to bring the notch, shown at l, directly over the edge of the blank, and the projection at the lower end has a cam on its upper side upon which the plunger c works, actuated by the slight spring d, thus returning and retaining the starter in position shown after each stroke of the press. The top edge of the blank, catching in the notch of the starter during the down stroke, is carried over by it in the direction of the dotted line K, until it reaches the face of the punch D, which it then follows till the final bump flattens it out at right-angles with the part held in the die E. As the two "feet" of the blank are to be bent in opposite directions, the two starters, a and a', must work in opposite directions, the pins b' b and the plungers c' c must be on opposite sides of the centre line. All parts of this punch are hardened, and the starters have to work very very freely on the pins b' b and in the slots of the punch D, so that there will be no binding when under pressure. I made this die to bend the above blank in one operation, which before had always been handled twice in two sets of dies. It was very successful, bending thousands, to my knowledge, and I believe it still to be in active operation.

* By H. E. HARRIS, in the *American Machinist.*

AN IMPROVEMENT IN ROTARY ENGINES.

THE accompanying engravings represent a perspective view and cross-section of a rotary engine, together with a cut-off valve employed therein. The inventors are James T. Hay and Gilbert L. Depuy, of Garland, Texas. The engine comprises a cylinder with a fixed abutment in its upper portion. The piston is mounted concentrically within the cylinder, and in contact with the abutment. In the piston two piston-heads slide, having blocks mounted to rock on their outer ends, so as to accommodate themselves to the shape of the abutment. The piston-heads are pressed into contact with the cylinder by springs, resting on trunnion-bars, engaging cam grooves in the head of the cylinder. Above the cylinder is a steam-chest connected with the cylinder by ports on opposite sides of the abutment. In the steam-chest a sliding reversing-valve, controlled by a lever, is mounted.



The valve is provided with ports adapted to register with the cylinder-ports, only one port of the valve being in register with the corresponding cylinder at a time. The registering-ports serve as exhaust-ports; while the cut-off port serves as a steam-inlet. One side of the slide-valve opens at all times into an exhaust-pipe, so that the exhausted steam can readily escape. Into the steam-chest a channel opens, registering at intervals with the segmental slots of a rotary cut-off valve secured to the main shaft, and revolving in a casing of its own. The valve controls the opening of a steam-supply pipe directly opposite the steam-chest channel. When a piston-head reaches a lowermost position,

the steam is cut off, the corresponding slot in the cut-off valve being out of register with the steam-pipe. As the other piston-head passes the abutment and steam-inlet, the other slot in the cut-off valve begins to register with the steam-supply pipe, and a second impulse is given to the piston. In order to prevent leakage of steam, the inner faces of the cylinder-heads, the interior of the cut-off valve-casing, and the cut-off valve, are formed with grooves adapted to receive the water of condensation. As the grooves fill with water, they form a packing for preventing the escape of steam.—*Scientific American.*

A NEW ACETYLENE GAS GENERATOR.

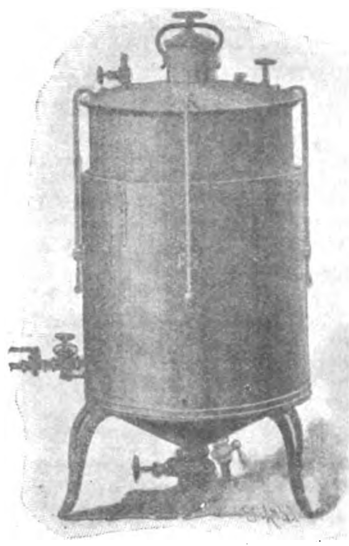
WE present herewith illustrations of a new acetylene gas generator, in which the production of gas is automatically regulated in accordance with the amount consumed by checking the water fed to the calcium carbide.

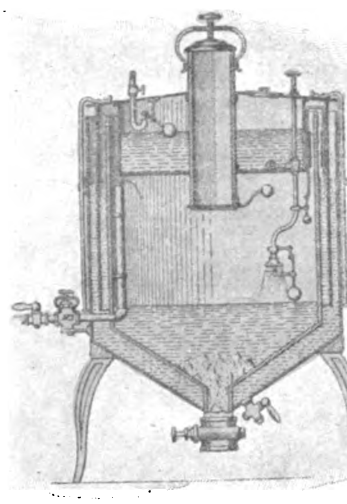
The apparatus comprises a generator surrounded by a jacket of water, a holder, the body portion of which occupies the space between the jacket and generator, a tank secured to the holder, and a carbide-receiver, which extends centrally through the holder and tank, and which is provided with a cover and with a weighted drop bottom. Into the tank extends a water-supply pipe, which is controlled by a float-valve. A water-distributing pipe runs downwardly from the tank, and is provided with a sprinkler which plays over the carbide, and which is provided with a float-valve. The water-distributing pipe is provided with two valves. Of these valves, one is controlled by a stem projecting above the holder, and is closed only when the machine is not in operation; the other valve is controlled by a weighted arm, and opened and closed by the rise and fall of the holder.

In operation, calcium carbide is fed through the receiver, and water is turned on at the supply-pipe so as to fill the tank to the height determined by the float-valve. The water from the tank will pass through the distributing-pipe and will be sprinkled over the carbide, thus generating gas, which is conveyed to the burners by a service-pipe. When the pressure of gas becomes excessive, the weighted arm controlling the valve in the distributing-pipe closes the valve under the action of the rising holder, and thus checks the water. When the pressure falls, the valve reopens automatically.

When the apparatus is to be cleaned, the lime is removed by opening a valve in the bottom of the generator. Water is then turned on at the supply-pipe, and is automatically shut off by the float-valve of the sprinkler when the desired level has been reached. After a time the water is drawn off. The operation is repeated until the generator is clean.

Further information regarding this apparatus can be obtained from Frank Zunino, 230, Washington-street, New York City.—*Scientific American.*





VOLTA AND THE ELECTRIC CURRENT.

THE Monday evening discourse before the British Association was delivered by Prof. J. A. Fleming, F.R.S., who took for his subject the "Centenary of the Electric Current." Copies of the lecture had been forwarded to Prof. Blaserna, as president of the congress of electricians assembled at Como, for presentation to the King and Queen of Italy. Telegraphic messages passed between Dover and Como, using the wireless telegraphy to cross the Channel, and also between the president of the British Association and Dr. Brouardel, President of the French Association assembled at Boulogne, the distance from the Connaught Hall, Dover, to Winnereux, near Boulogne, being 30 miles. In his discourse, Prof. Fleming said that the investigations of Alessandro Volta, born at Como in 1745, opened a new chapter in the history of electrical discovery by giving to the world the voltaic pile. To regard the modern uses of the electric current thus given to us by Volta was to realise the astounding results which a century had brought about. Some idea of those results might be found in the fact that in the year 1898 very little less than £85,000,000 was invested in Great Britain alone in electrical enterprise. Prof. Fleming having summarised Volta's researches, spoke of the wonderful researches of Hertz, which showed us that where alternating currents of very high frequency were set up in an open circuit the energy might be conveyed entirely away from the circuit into the surrounding space in the form of electric waves. At a certain intensity of strain the air insulation broke down, and the air became a conductor. This quality of passing quite suddenly from a non-conductive to a conductive state under the action of a critical electric pressure was a very peculiar and important characteristic of gaseous substances. It had been known for 20 years that tubes full of powdered metals were very curiously sensitive to electric sparks. The non-conducting mass at every spark became a conductor, but could be brought back to its original condition by a tap. Signor Marconi discovered that a long vertical wire attached to the sensitive powder-tube had the property of increasing enormously the distance at which it could feel the effect of the electric spark. These principles had received their most logical extension and completion in the evolution of the electro-magnetic wave telegraphy, developed by Signor Marconi on such a large scale within the last few years. The chief principle which underlay this industrial application of research was that the sensitive powder tube, when passing into the conductive condition, could be made to complete another voltaic circuit, and so operate any ordinary form of telegraphic instrument. Of course, the moment it was possible to close the voltaic battery, by merely making an electric spark at a distant place, innumerable applications immediately suggested themselves, one of the latest being the steering of self-moving torpedoes. Turning to the transference of electrical energy by wave motion, Prof. Fleming said that Hertz had proved that electrical energy could leave a rod in which a very rapid oscillatory current was set up and could travel with the speed of light outwards in all directions. Where was it after it had left the radiator and before it had arrived at the receiver? The answer was that it existed as free radiant or wave energy in the ether. Both optical and electrical phenomena had compelled the assumption of an imponderable material which could be the vehicle for energy in certain forms. After referring to Clerk Maxwell's researches, Prof. Fleming concluded by observing that from the starting point of Volta's discoveries a century's development had brought us to this point—that the actions we call an electric current, if alternated rapidly enough in direction, would end by producing a ray of light. We were, however, as yet in the region of conjecture, when we attempted to formulate a specification of the exact nature of the motional and configurational changes which must be at the root of observed effects. To devise a theory of the ether, such that from the simplest possible assumptions could be deduced the facts of electricity, magnetism, and optics, might be said to be the aim of physical inquiry at the present time.

SCIENTIFIC NEWS.

ON the proposition of Lord Lister, F.R.S., seconded by Sir A. Geikie, F.R.S., Sir William Turner, F.R.S., was unanimously appointed President-elect for the next meeting of the British Association for the Advancement of Science, which will be held in Bradford, commencing on Wednesday, Sept. 5. Lord Lister, in making the proposition, said that Sir William Turner was perhaps the foremost human anatomist in the British Islands, and was also a great anthropologist. On his shoulders had largely rested for many years the task of guiding the great medical school at Edinburgh, and he also occupied a most honourable position as President of the General Medical Council. Sir William, also, had long taken an active part in the work of the Association, and he was in all ways a man eminently deserving of the great honour of the Presidency of the British Association. Sir J. Evans proposed that there should be asked to serve as vice-presidents, The Earl of Scarborough (Lord-Lieutenant of the West Riding), the Duke of Devonshire, the Marquis of Ripon, the Bishop of Ripon, Lord Masham, the Mayor of Bradford, the Hon. H. E. Butler, Sir A. Binnie, Prof. Rücker, and Prof. Thorpe. The last meeting of the British Association during the nineteenth century will therefore be held in Bradford in 1900. Glasgow is the place of meeting for 1901.

An important discussion took place during the meeting of the British Association in connection with a paper by Prof. Clarke, of Washington, D.C., on a "Proposed International Committee on Atomic Weights," which Prof. Tilden, who read it, followed by a paper of his own, expressing the opinion that the only chance of obtaining uniformity was to submit the subject to discussion at the British Association, the Chemical Society, and foreign scientific societies, and finally to the international meeting of chemists which it is proposed to hold in Paris next year.

In a communication to the Paris Academy of Sciences by Prof. James Dewar, it is stated that a tube containing liquid hydrogen surrounded by another vacuum tube containing liquid hydrogen shows the gas as a solid, the upper surface being a solid froth. The lowest temperature is stated to be about minus 259° C. For a full comprehension of these remarkable experiments the papers must be consulted; but if there is any knowledge in the grave Faraday, Andrews, and others must be pleased at the results which their successors have attained.

The International Geographical Conference (the seventh) will be commenced on Sept. 27 at at Berlin, and will continue until Oct. 4. A large attendance is expected, and the following papers, amongst others, are already announced:—"The German Deep Sea Expedition," by Dr. Chun; "The Results of an Expedition in East Greenland," by Prince Albert of Monaco; "The Geographical Distribution of the Tea Plant," by Mr. John M'Ewan; "The Plains of Ancient America, especially Mexico," by Mrs. Zelia; "The Oceanographical Results of the *Fram* Expedition," by Dr. Nansen; "The Antarctic Expedition," by Sir Clements Markham; "The German South Polar Expedition," by Dr. Erich von Drygalski; "The Distribution of Deep Sea Deposits," by Sir John Murray; "The Geographical Cycle," by Prof. W. M. Davis; "Some Particulars of the First and Second Cataracts of the Nile," by Dr. de Claparede; "Discoveries in England in Remote Ages," by Prof. Sieglin; "International Ballooning," by Prof. Hergesell; "Scientific Ballooning by the German Balloon Society," by Prof. Assmann; "A Project for a North Polar Expedition," by Mr. Arthur C. Jackson.

Dr. R. H. Traquair, F.R.S., will deliver a course of free lectures (12) at the Museum of Practical Geology, Jermyn-street, S.W., on the Pleistocene Mammalia, commencing on Monday Oct. 2 (5 p m.), and continuing on the following Wednesdays and Fridays.

The Harveian Oration will this year be delivered by Dr. G. Vivian Poore before the Royal College of Physicians on Wednesday, Oct. 18.

The Friday evening lecture at the meeting of the British Association was delivered by Prof. Charles Richet, whose subject was "La Vibration Nerveuse," that is, the rate of transmission of nerve impulses, which he said could not be

repeated more than ten or twelve times a second. Prof. Richet states that if one tried to think of a set of words in succession he could never pass that speed, and could not receive a more rapid succession of sensations on the same organ. This period, then, might be called the psychological "unit of time." If the rapidity were greater, sound, electricity, and light would be perceived as independent undulations, not continuous sensations; were it slower, one would see the motion of the hour hand of a watch and the growth of a tree.

M. Scheurer-Kestner, whose untimely death is announced from Paris, was born at Mulhouse in 1833. His name has been prominently before the world of late years in connection with the "affaire," and his death is "untimely" in the fact that he could not have known of the pardon. M. Scheurer was a distinguished chemist (on the commercial side), and was one of the most brilliant pupils of Prof. Wurtz. Marrying Mlle. Kestner, he added her name to his own, and embarking in various industrial enterprises which his knowledge of chemistry enabled him to carry on at great profit, he early in life made a fortune, and, entering the political world, became one of the vice-presidents of the Senate of France.

The death is announced of Karl Störk, of Vienna, in his 67th year. He was well known as a laryngoscopist and a writer on medical subjects; but, in addition, he was the inventor of many useful instruments and mechanical accessories.

At the meeting of the British Association Mr. A. L. Rotch, of the Blue Hill Observatory, Massachusetts, stated that the first crossing of the English Channel in a balloon was accomplished by an American, Dr. Jeffries, and M. Blanchard, a professional French aëronaut, in 1785.

A preliminary report on the erosion of the coasts of the United Kingdom was presented to the British Association by Mr. Whitaker, F.R.S., which shows that systematic observations have been made in a tentative way, and that replies to a circular sent out by the council of the Association to coastguard stations had been received from over 400 stations.

At the conclusion of Sir A. Geikie's address in Geology at the British Association meeting, M. Gosselet, the president of the Geological Society of France, in proposing a vote of thanks, said that the hearts of all geologists went out to Sir Archibald Geikie for the great services he had rendered to geological science. Geologists were especially indebted to England for the excellent mapping of the geology of the British Isles, which splendid work served as a model to all other countries. Lord Lister, in seconding the vote, said the president's address was at once worthy of that meeting, of their French and Belgian visitors, of science, and of Sir Archibald Geikie himself. Though Sir Archibald did not quite agree with Lord Kelvin's position, he had nevertheless paid a warm tribute of gratitude to physicists, and admitted that Lord Kelvin had done very valuable work in bringing the subject of the age of the earth within more definite limits.

The *Athenæum* says:—We learn that the Russian Government propose to adopt the Gregorian Calendar at the beginning of next century —i.e., on January 1, 1901. According to this, they will still make next year a leap year in accordance with the old Julian reckoning, but will afterwards fall into line with other Christian nations by making their dates correspond with what they would have been had the Gregorian rule of dropping a leap year at the end of each century (except each fourth century) been observed since A.D. 325. Let us hope that before another century is completed the more simple and accurate rule will be substituted of dropping a leap year at the end of each period of 128 years without exception, so that the next dropped after 1900 will be 2028.

Wireless telegraphy formed an important attraction to the visitors to the meeting of the British Association, and, as it happened, they had the advantage of hearing or seeing that it could do very well even in a thunderstorm. Some preliminary tests were made before the meeting by Prof. Fleming, and the "show" tests for the benefit of the members of the Association were satisfactory.

Meantime some interesting experiments with wireless telephony have been carried out by Sir W. H. Preece, F.R.S., and it remains to be seen whether they will not be more useful than those made with wireless telegraphy. At present there is no doubt that the latter is, or can be made, a very serviceable servant for many purposes. The distances over which it can be used are in the experimental stage.

The proposed Antarctic expeditions formed a prominent subject in the Geographical section at the meeting of the British Association; but nothing more than has been previously discussed was brought forward. Admiral Makaroff, however, in describing his voyage in the *Yermak*, said that explorers should no longer be deterred by the ice, but should compel the ice to bend to their will. His ice-breaker made splendid practice on the ice in the Polar regions last August; but it is considered that she ought to be slightly improved as regards strength. It would seem from the failure to reach the mouths of the Siberian rivers this year that an "ice-breaker" must always pilot the cargo vessels.

The *Oceanic*, the largest steamer in the world, has made a most successful voyage to New York, and now it is reported that Cramps, of Philadelphia, have prepared a design for a steamer for the American line, which is to be 710ft. long, and which, if constructed, will be the longest vessel in the world. The average speed of the *Oceanic* is reported to have been over 19½ knots, but bad weather was met with on some days.

The ice-breaker for Lake Baikal has been re-erected and successfully launched into the lake. The dimensions are 290ft. by 50ft., and the draught of water under ordinary working conditions is 18ft. 6in. The vessel is of 4,200 tons displacement. The principle of watertight subdivision has been carried very far, so that the vessel must be pierced in several compartments before she is in danger of sinking, and, in addition to the usual watertight bulkheads, an inner bottom is fitted on somewhat the same system as that which obtains in ships of war. The cars are run over a hinged gangway on to the railway deck, where they are securely fixed in position by means of special appliances. There are three sets of triple-expansion engines, working at a pressure of 160lb. Two sets drive twin propellers, fitted, as usual, at the stern, and the third a propeller at the bow of the vessel. The last is for the purpose of disturbing the water under the ice, so as to assist the heavy steel stem to break up the solid field ice, that it may be pushed aside by the advancing vessel. This is the first occasion on which so large a vessel has been built, shipped on an ocean-going steamer, transferred to railway waggons, and finally re-erected.

News has reached Rome from the Polar expedition which is being "personally conducted" by the Duke of the Abruzzi. The duke and Captain Cagni made accurate observations, which enabled them to fix the geographical position of Cape Flora at ten miles further east than its position on the charts. When the provisions had been disembarked the *Stella Polare* pushed northwards on July 26, and attempted to pass through the "British Strait," but found the ice too thick. Then an attempt was made to round Alexandra Land, but without success, on account of the enormous masses of ice. A second effort was made to penetrate the "British Strait," and by dint of breaking the fresh ice with the prow of the vessel, and by steaming slowly through the narrow channels of open water between the icebergs the *Stella Polare* managed to pass into the open sea. There she met the whaler *Capella*, with the Wellman expedition on board. The *Capella* brought final letters and news of the expedition up to August 6, when the two vessels parted company. The temperature at that date was about 32° Fahr., and as the sea was still fairly open, it is expected that the Duke of the Abruzzi and his companions will be able to winter at 81° of north latitude, or even further north if a sufficiently sheltered spot can be found.

It would be interesting to learn how much of truth there is in the following paragraph from a London morning paper: "When the Princess of Wales is back in England she intends to interest doctors in the curative virtues of electric light. Her Royal Highness, with the King of Greece and several of the Russian princes now in Denmark, paid a visit some days ago to Prof. Finsen's electric-light institute in Copenhagen for the cure of disease, and spent some time in witnessing the effects of the treatment on lupus. This method has given such striking results in lupus, that in a few years there will be no patient suffering from the disease in all Denmark."

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

CLOUD PHOTOGRAPHY—JOSHUA AND THE SUN STANDING STILL—THE CHALDEAN DAY (?)—LEGAL REMEDY—LIQUID AIR—ASTRONOMICAL SIGNS—AN OPTICAL IMPOSSIBILITY—MUMMY WHEAT—THE ETHER—THE ORBIT OF POLARIS AND ITS APPROACH TO THE EARTH—METEOROLOGY AND WEATHER PREDICTION—DEATH BY LIGHTNING—MASS OF MERCURY.

[42838.]—As mentioned in your "Scientific News," on p. 86, *Knowledge* for September contains a remarkable series of photographs of clouds, taken by MM. E. M. Antionadi, F.R.A.S., and G. Mathieu, accompanied by a paper descriptive of the method by which these most valuable pictures were obtained. Personally, I have studied this work with great interest, inasmuch as my own efforts (and accidental results) at cloud photography have been by no means a conspicuous success; the actinic activity of the blue sky seriously interfering with the contrast between it and the clouds, which is so apparent visually. The authors of the paper before me surmount this difficulty by the use of coloured screens before the lens of the camera; such screens being of a yellow or yellowish tint, produced either by (*a*) actually yellow glass, (*b*) yellow gelatine, or (*c*) a solution of bichromate of potash contained in a cell with rigorously parallel sides. The contrast is intensified by use of isochromatic plates. They have even succeeded in photographing a rainbow. The value of their results is incontestable alike to the meteorologist and the physicist. M. Léon Teisserenc de Bort, at his private observatory at Trappes, has already succeeded in measuring the height of clouds above the earth's surface by it. He employs two photographic theodolites of the type adopted by our own Government in India, separated by a distance of 4,324ft. (say, 0 82 mile). They are united by a telephone, so that any given conspicuous cloud may thus be simultaneously photographed. In this way, as I have just said, the height of clouds above the earth's surface have been measured with great accuracy. I need say no more, but would refer everyone interested in the subject to the paper itself.

If "Wilmay" (letter 42797, p. 92) will refer back to Vols. XXXVI. and XXXVII. of the ENGLISH MECHANIC, he will find the question of the standing still of the sun and moon thoroughly threshed out in a most numerous series of letters and replies. I may perhaps quote from one of my own communications on the subject in the former volume, in which, speaking of its interpretation, I said, "Jahn among the Roman Catholics and the late Dean Milman among English Churchmen: the former regarding it as a sublime poetical trope, and the latter speaking of it, *totidem verbis*, as 'pure poetry.'" As a statement of physical fact, it is precisely on a par with the occurrences alleged to have taken place in Psalm cxiv. 3 and 4.

"Silverplume" (letter 42799, p. 92) really does Mr. Hardy too much honour by noticing his wild nonsense about the Chaldean day at all. The earth rotates on her axis in 24 hours, and "the evening and the morning" are, and always were, one (as we read they were the "first") day. I should be curious to know in what work or works Mr. H. found the remarkable statements on which he founds his calculations.

It seems to me that letter 42806, p. 93, is written throughout on the assumption that an action must, *ex necessitate*, be brought in the High Court of Justice; but I would remind "Hear Both Sides" that the defrauded purchaser has his remedy, if he chooses to seek it, in the County-court, a certainly less costly mode of proceeding.

Does "G. A. H." (letter 42809, p. 94) believe in perpetual motion? Or did he ever hear of the Irish sailor whose blanket covered his feet but did not quite come up to his chest, and who cut a piece off the bottom of it and sewed it on the top?

The symbols for the Zodiacal signs now in use, as also those employed for the planets (concerning which Mr. Lambert puts query 96600 on p. 98), had their origin with the Mediæval astrologers and alchemists. But ☉ and ☽ for the sun and moon date from the Egyptians.

There is some remarkable mistake in query 96601 on p. 98. It is utterly impossible for any one at or near the sea-level to see hills 60 or 70 miles distant.

Mr. Dormer (query 96607, p. 98) may take it that De Candolle's pronouncement as to the allegation concerning the alleged germination of mummy wheat is strictly correct.

"Curious" (query 96609, p. 98) will find a great deal that will well repay perusal in that admirable little book "Light, Visible and Invisible," by Silvanus Thompson, published by Macmillans.

The announcement which you reproduce in the fourth paragraph of your "Scientific News," on p. 113, is, as it stands, not too intelligible; but it has since been supplemented by a more detailed account, whence it would appear that what Prof. Campbell really has observed by the familiar spectroscopic method is a variable approach of Polaris to our Solar System with a velocity of eight kilomètres (4·97 miles) per second. In two days this will increase to fourteen kilomètres (8·7 miles), and in the next two days again decrease to eight kilomètres. Hence α Ursæ Minoris must be revolving round a dark and invisible body, or rather the two must be revolving round their common centre of gravity in an orbit about the size of that of our own moon, once in four days. From measures made at the Lick Observatory in 1896, the rate of approach of the Pole-star to the earth was calculated to be twenty kilomètres (12·42 miles) per second, and this Prof. Campbell attributes to the presence of a second dark body, and further believes that Polaris itself and its primary, or attendant, are approaching the earth at the rate of eleven and a half kilomètres (7·15 miles) per second. All this must be only provisionally accepted; but the skill of the well-known observer at Lick must render any results at which he may have arrived worthy of consideration.

"M. E. V." (letter 42812, p. 114) does well in calling attention to the curiously local character of the weather. No one would ever listen for an instant to the sunspot-and-weather humbugs, or to the so-called astro-meteorologists, were it not that this enables them to point to *some* spot on the habitable globe at, or in, which a particular prediction of theirs has been more or less verified.

May not the explanation of the difficulty felt by "F. C. B." (query 96662, p. 121) be found in the fact that the electrical discharge passed through the warm fluid blood in both cases, and not through the hides of the cattle or the clothes of the man?

In reply to "Garsdale" (query 96669, p. 122), the most recent determination of the mass of Mercury would make it about 1-21st that of the Earth.

A Fellow of the Royal Astronomical Society.

CRATER NEAR LIMOCHARIS.

[42839.]—IN Elger's book on the moon I observe that he shows a small crater pretty close to Limocharis on the N.W., and he also in the text describes it as being in that position. On, however, examining the same region, as shown on some photographic lantern slides ("Lick Obs.") I do not find any small crater on the N.W. of Limocharis, but just such a one as Elger describes, W., or rather south of W., in a position where Elger shows no crater. Is it an error of Elger's to show a crater to the N.W., or are there two craters, and has the more southerly one been omitted? I shall be much obliged if "F.R.A.S." or anyone else will inform me. **R. P.**

THE TRIPLE SYSTEM OF POLARIS—CAPELLA—STAR MAGNITUDES.

[42840.]—IN the issue of the ENGLISH MECHANIC for this week (Sept. 15) I notice a paragraph announcing that Prof. Campbell has made a dis-discovery regarding Polaris. It says (p. 113): "Simultaneously, they revolve together around a third body, as the stars and moon revolve around the sun." Should this read: "As the earth and moon revolve around the sun," or "As the planets and moon revolve around the sun"?

Again, it says: "This is the most interesting discovery, surpassing even that of Capella." As I only took up Astronomy a short time ago, I do not know what this discovery regarding Capella is. Can any reader of the "E. M." inform me, or tell me where I can obtain the information?

To "F.R.A.S.," or any other reader of the "E. M." who can tell me: What is the greatest magnitude star I shall be able to see with my telescope, a refractor of 2·85in. clear aperture, with powers of 60 to 240? Also, can you give me examples (names or numbers of stars) from the first magnitude down to the faintest I shall be able to see?

Earlsfield, S.W. **Silverplume.**

RIGEL.

[42841.]—WITH reference to letter No. 42752, p. 64, I find on looking through my notebooks extending over the last 25 years, and using a fine 5in. Wray refractor and a 10·5 Calver reflector, that whenever I have noted the colour of Rigel I have always put it down as having distinctly a *yellow* tint—even in the clear skies of Malta and Crete. In my opinion, there is no comparison between Rigel and Vega. Vega must come first, inferior to none, not even to Sirius, in its intense electric colour.

I think that each of the giant stars has a beauty and colouring peculiarly its own, and I never see any one of them exactly like any other.

"*Yellow-white*" is just about a fair description of the colour of β Orionis.

T. H. Foulkes, M.A.,
Chaplain to H.M. Forces.

British Camp, Kandia, Crete, Sept. 7.

TELESCOPES: TO E. P. CLARK.

[42842.]—THE information solicited by your correspondent in 42784 is, so far as his lenses are concerned, very easily supplied, provided he finds the lenses properly made and properly mounted. If not correct already in these respects, no useful information could be given without knowing accurately the refractive and dispersive powers of all the three lenses, a matter not easily ascertained by an amateur devoid of suitable apparatus and some skill in using it. Mr. Clark is correct in supposing his telescope to be one of Mr. Rogers's construction—generally now known as the "dialyte." If, as very possibly is the case, the three lenses are properly made and properly placed in respect to each other, or, in the latter circumstance, even approximately so, the adjustments necessary for perfect vision need not be very difficult. I fear, however, he has placed the "corrector" lenses with their flatter sides the wrong way. As usually computed, the two flat sides require to be *outwards*, the convex part of the corrector being next the object-glass, the concave flint lens behind it. But as the arrangement, however, admits of considerable variety, and as I know nothing about the glass of his lenses, I should not be held to fix the above relative positions definitely.

This device, which was considered a very hopeful one before optical flint-glass became cheapened (or even possible in large discs), is not now much used, although some excellent dialyte telescopes by Plössl, of Vienna, are to be found in some of the Continental observatories.

The colour correction admits of easy and perfect adjustment; but except for the very centre of the field of view the correction for spherical aberration requires, besides shift of relative position, a rather delicate proportioning of the curves. I computed a case lately, but am not content with the marginal correction it is likely to give. A Mr. Ingall, of London, is, I believe, quite an authority on these telescopes, and he would, I am sure, be glad to give your correspondent every assistance in his power. With a rigid and well-made tube and good fittings the dialyte can be made to give very good results; but although Mr. Ingall has done well, it is a telescope still worse (although cheaper) than the ordinary achromatic for an amateur to make successfully. It would be well also for your correspondent to consult Mr. Rogers's original paper on the instrument in the "Mem. Ast. Soc. of London," Vol. III. p. 229, 1828. This can be seen in a public library.

Next, concerning Mr. Clark's queries about his old Gregorians, the replies may be given somewhat as follows;—First, in cleaning the tarnished metallic specula, I prefer dilute ammonia to long wiping with alcohol, although I generally finish with the latter. The ammonia solution I find most suitable may be made by adding 5 minims of strong *liquor ammoniæ*, such as photographers use, to 1oz of pure water—preferably distilled. Moisten with this solution a piece of cotton-wool, or clean, soft cotton well washed (preferably an old and much-worn piece), and daub it gently all over the surface of the speculum, or if very bad staining seems to require a little friction, any rubbing done must be very gentle, and must be *uniform over the entire surface*, whether it needs it or not. *No local friction* must be used. If not badly stained, only very gentle wiping is required; but in all cases it is best to allow the surface to remain wet with the solution for a few minutes, not more than five, or if a very bad case, say ten. Prolonged action of the ammonia tends to make the surface crystalline—this must be avoided. Finally, wash well, and apply a little absolute alcohol in the same manner, wiping the surface dry while the spirit evaporates; *do not permit it to dry spontaneously*, and *do not use "methylated spirits"*; also, in no case use saliva, or even breath, on the metal, as the breath contains volatile fatty acids, which tend to tarnish metal.

Secondly, regarding the adjustment of the specula, it may almost be assumed that the large speculum requires no shifting of its supports, which, indeed, seldom permit of any such adjustment. Remove the eyepiece, and look at the small speculum through the hole in the large one, keeping the eye some distance behind it, so that the circular obstruction of the small speculum seems centrally situated in the bright hole, the telescope meanwhile being pointed to a part of the sky near the horizon. Keeping the eye in this axial position, see whether the bright circle of a size a little less than the small speculum be placed concentrically with it. If the bright circle (which is an image of the large speculum) appears to lie off to one side of the small speculum, screw *inwards* that one of the three bearing screws at the back of the small speculum which seems the *nearest* one to where the bright circle has become eccentric—repeat the process until bright circle and dark rim become concentric.

In the centre of the above bright circle will be seen a small dark circle, which is an image of the hole in the large speculum. If all be right, this circular spot ought to have a narrow annulus of equal width all round it, which is an image of the small speculum itself; but if this narrow annulus be eccentric, either the large speculum is out of square with the tube, or the small speculum is out of the tube axis. The latter adjustment can easily be made with inside calipers, if necessary, but the former requires some filing of the large speculum supports, which should not be necessary if correctly made at first.

These directions seem rather complicated to read, but a few minutes' practice of them will soon enable your correspondent to adjust his specula.

ERRATUM.—In letter 42816, on Reducing Light, middle column, p. 115, line 20 from foot, omit "to."

H.

TELESCOPES, ETC.

[42843.]—MANY thanks to Mr. Ellison for his kind notice of my letter (No. 42622). I am sure that if he will give a detailed description of how to build his stand, many readers besides myself will be grateful. I expect an 8½ reflector, altazimuth mounting by Linscott, to arrive before long, and shall certainly make attempt at mounting it equatorially on Mr. Ellison's plan.

"What has the Equator to do with it?" Don't "speak disrespectfully of the Equator," please. *Experto crede*, he can make his power felt. The heat in this place during about nine months of the year is like that of a well-warmed greenhouse, and makes manual labour very exhausting. Again, I have to send hundreds of miles for the simplest tools. However, I shall have a try. There are compensations out here: a horizon clear in all directions, and magnificent definition night after night for many months in the year.

According to Chambers, Vol. II. p. 285 (4th edition), Dawes used a stop of perforated cardboard for bright objects, but it is not stated whether he did so in observing the sun.

I see that my complaint against the telescope vendor has attracted some attention. Mr. Caplatzi is not the dealer in question; nor would anyone, I fancy, suppose that he was. I do not in the least doubt his statements. There are trustworthy dealers, no doubt, and there are dishonourable buyers. He accepts my principle that instruments should be examined by a third party, and I suggested no detailed plan. Mr. Ellison's letter shows that one gentleman, at any rate, is willing to give his services. Friendly co-operation among the readers of "Ours" will do much.

Mr. C. is mistaken if he supposes that I object to a fair price for a fair article. I do not; nor do I imagine that the difference between buying and selling prices represents clear profit. I do not accuse the shoptician whom I have criticised of dishonesty; but I think I have fair grounds of complaint when, after I have paid him his own price for an instrument, I am bothered with a finder that will not find, screws that screw badly, and eyepieces that have to be changed. I think I may fairly charge the individual in question with stupidity, carelessness, and blindness to his own interests as well as to mine. **Pauper et Exul.**

GREGORIANS—γ¹ ANDROMEDÆ AND "H."

[42844.]—"ELL HAY" distinctly tells us now that "as to testing (his) small speculum, (he does) not pretend to ability to do so." Now, to those fully acquainted with optical work, is it not a well-known fact that the testing of a mirror is a much *easier* process than the making of the same? Indeed, have we not been regaled in "Ours" with lengthy instructions for *testing* by some whose actual work could only pretend, as we know, to a very subordinate place? In view, however, of this relative difficulty in these branches of art, we find immediately on the back of above avowal of inability, the apparently irreconcilable statement, "I have nowhere acknowledged want of either theoretical

training or practical experience in telescope-making." In reply, one might point to the numerous obtuse questions and out-of-place remarks made on the Gregorian by your correspondent, all of which, while quite in keeping with the expressions of one inquiring into things he knows little or nothing about, are strangely at variance with those of an expert in the art, either from the aspect of "theoretical training or practical experience": to claim the possession of these qualifications now, most surely tends to cast either a doubt of sincerity of purpose over the whole tenor of his letters, or to cause us to suppose that his own appraisement may be at fault while his sincerity is intact. In either case, letter 42783 does not improve matters, unless we are to suppose that the whole question of Newtonian alteration into a Gregorian, with the "discoveries" made during the process, was meant for a joke;—if so, while regretting I took so much trouble to supply the information asked, I agree to take it as such.

Unfortunately for the "joke" theory, his remarks about the Gregorian eyepiece in 42579 do not tally with his reintroduction of the same in 42783, in which he now says, "To ask the opinion of others about an eyepiece is not to profess ignorance." In the first place, "Ell Hay" *has never yet asked* the opinions of *any one* of us on said eyepiece; in the second place, we find him saying (in 42579), "Progress in the alteration is checked, because I have found it involves getting new eyepieces." Now, does anyone, at least one so well instructed as your correspondent, use the present perfect part of the English verb ("I have found") when he means other than that the event is but recent—in fact, when the words "I have just found" would be equally suitable? Note the *simultaneous* "discovery" *re* the stand.

It would appear that he questions very much my remarks about a given injury to the figure of a speculum being more injurious to the final reflected image, in his case ten times (leaving out the eyepiece action), when that speculum is used as a Gregorian, than when used as a Newtonian. One would have thought the "theoretical training" mentioned would have made it evident that the elongation of focus by the small speculum, and the increase of primary divergence from supposed error, are on the same scale.

As to "Ell Hay's" objection to my use of the phrase "he knows" in connection with my inability to act upon his invitation to inspect his work, the desire to preserve my incognito fully explains.

"Expense" is again commented upon in 42783—we all know that scientists as well as others try to shirk it, but no one expects to have the question of "expense" brought in, while deciding comparative merits from a purely scientific point of view, which, indeed, was the only aspect in which I attempted to consider the comparative merits of Newtonians and Gregorians.

The "mere theorist" assertions of the writer of 42783, in trying to belittle the opinions of the famous authorities I gave in 42757, as favouring direct-vision telescopes, have probably been already sufficiently met in (42814).

Again, we are asked to accept the notion that "the common judgment of astronomers (is) in favour of the Newtonian form," which, in view of what I quoted from some of the foremost astronomers seems a strange statement to make. In one respect, perhaps, "Ell Hay" is right, however, for with recent *amateur* astronomers, saving the mark (telescopists would seem a more appropriate word in the vast majority of such cases), and these amateurs of *our own country* almost entirely, the Newtonian has had its innings for a few years, the reasons for which I thought I gave, but with astronomers of the true kidney "Ell Hay" must know this is not the case in any marked degree; for, on the contrary, whatever reflectors have been added to large public observatories of late years, either in this country or America, have nearly all had perforated specula for use as Cassegrainians or Gregorians, although, as already stated by me in 42757, *very large reflectors*, in which the requirements as to distinctness are not severe, these giants being mainly needed for such purposes as the observation of nebulæ and comets, or for spectrum work, will probably, for a time at least, be possible only as Newtonians. Indeed, I began this series of letters with a statement of this very fact concerning concerning "observatory" reflectors, when I said in 40968 speaking of compound reflectors: "On a scale of no mean dimensions, they have been recently constructed for the use of some of our foremost amateur and professional astronomers."

Respecting the γ^2 Andromedæ controversy, as to whether one, two, or no green discs at all, are visible when this star is resolved, I shall again ask him to bear in mind that as my letter of Feb. 17 merely introduced the size of a hypothetical green disc *to compute from*, and made no mention whatever of one or more green discs being *at all visible*, and as I could scarcely be led to conceive that anyone could possibly take that ridiculously nonsensical meaning out of my words, I was at no trouble to periphrase, in order to prevent that absurdity. Even after an attempt of mine to re-explain the whole affair in 42757 (which see), I find "Ell Hay" saying in 42783 that my explanation of the matter is "neither ingenious nor ingenuous,"—a remark in which *I quite agree with him*, for, as a simple and uncontroverted scientific fact, the above two adjectives are both equally and totally inapplicable to it. But if "Ell Hay" be found differing so markedly from what I thought was the only possible conception, it is for me pleasant to find our most competent and obliging contributor, my elder brother "F.R.A.S.," remarking in 42065, on this very letter with which "Ell Hay" finds such fault, and saying, "(he) knows most thoroughly what he is writing about," and this certificate, which I prize not a little, surely outweighs the remarks of the man who has had the aforesaid "theoretical training and practical experience."

Then we find the writer of 42783 saying γ^2 Andromedæ "*is not sea-green*," and that, in consequence of this, my computations founded on that colour are all wrong. Might I refer him to "Webb" who calls the companion we are discussing "sea-green" as plainly as he can; while others, Smyth for example, use the term "emerald-green." We all know how largely provisional and conventional colour names are, especially the names of the compound or hyphenated colours; but let your negatory critic consult a colour scale in a mineralogical treatise, say Dana's, and he will find "emerald-green" at the blue end of the green scale and "pistachio-green" at its yellow end. It is also common knowledge that the most prized form of emerald, also sometimes called the beryl, is in lapidaries' terms known as "*aquamarine*," a name which so well informed a man as your correspondent must know to mean simply "sea-water," so that those writers who use the term emerald-green for the colour of γ^2 Andromedæ, only differ in mere phrase from those who use the words "sea-green."

But as a matter of fact, the above colour name never once occurred to me when looking up my spectrum map for the particular λ to be used in computing the hypothetical disc, of the colour of the spectrum place mean between those of the two components. I took the place by measurement, and only afterwards affixed the colour name to popularise the information regarding the spectrum place employed, being pleased, however, when I found that colour agreed with the *observed* one as given by "Webb," &c. I never trust my own estimation of colour, as several of your readers already know. Finally, let it be understood I criticise only statements, *never the writers of them*, and in this case I must thank "Ell Hay" for his flattering references to me in the opening and closing paragraphs of 42783. H.

REDUCING LIGHT OF TELESCOPE.

[42845.]—None of the plans suggested is really the best. What is wanted is a plan which causes no interference with definition—nearly all these suggestions do. In the case of the sun we don't want to absorb the heat, which most of the plans mean, but to throw it away. In the plans where coloured glasses, fluid-cell, &c., are suggested, there is the evil effect on definition through these surfaces not being perfect planes nor perfectly parallel to each other. The one and only correct plan is a first-surface reflecting prism of about 16°—a diagonal. The plane surface of it must, of course, be perfect. The parallelism of the back and front surfaces is of no consequence. Here there is no interference of any kind, and the light and heat are passed out into the air, and not into the eye-tubes or eyepiece. It is good for either refractor or reflector, and reduces the light and heat more and better than any other plan.

With the Newtonian the means for reducing light and heat are the best of all, and a larger aperture can be used than with any other instrument, for an unsilvered plane can be used instead of the silvered one. Again, an unsilvered mirror can be used, thus reducing light and heat to almost nothing, and this without interference of any kind—either colour, refraction, or distortion. I have tried perforated screens, but did not like them at all.

I have made several telescopes with the above provisions to get rid of light and heat, and with double-concave mirrors. One was a 30in. mirror. Thus most of the heat and light passed out at the low end of tube—about 2½ per cent. only sent to the plane, which reduces it again, and then again at the prism, so that little reaches the eyepiece.

G. Calver.

REDUCING THE INTENSITY OF LIGHT—MICRATOMIC ETHER.

[42846.]—In view of some of "H.'s" remarks (letter 42816), I should like to offer a few of my own, especially with reference to my previous letter (42729) on this subject (in which, by the way, occurs an obvious misprint in the punctuation). Having read of the experiences of others with perforated screens, I determined to make a trial myself. When I turned my telescope on the sun, there was, unfortunately, no spot visible, so I was compelled to focus on the limb. This was not easy, as, of course, the latter was "boiling"; still, try how I would, the limb always appeared surrounded with several concentric rings of light. As this is not the case when the plain aperture is used, I naturally concluded that a perforated screen did not improve the definition.

I did not, however, in my letter proceed to "confidently condemn their use," but confined myself to stating my experience and asking for an explanation. I may add that the optical parts of my refractor are by the late Andrew Ross, and, needless to say, are of a high degree of excellence.

With regard to the second heading of this letter, Mr. Howse (letter 42825) seems to have the haziest notions as to what I actually did say in my previous letter (42787) on this subject. It happens so often, when abstruse questions of this nature are discussed, that scientific terms with very definite meanings are freely used with other than their proper senses, and the discussion degenerates into mere logomachy.

The "complete explanation" which the crude hypothesis of "micratomic ether" is supposed to afford of the cause of gravitation is, I am afraid, only likely to raise a smile. I must confess I cannot understand what Mr. Howse means when he says "Let me ask him ("J. M. W.") what properties water has in common with a mixture of oxygen and hydrogen which it does not share with other elements and compounds." Will he kindly explain?

Light is certainly one of the forms of radiant energy, in which the latter becomes manifest to us through the medium of our senses. (How light is demonstrated to be energy by means of the photometer is a mystery.) It is, however, transmitted to us neither through a void nor through the agency of matter, but through the ether which pervades the visible universe.

Will Mr. Howse kindly explain what bearing his remarks on the nature of magnetism and electricity have on the question?

If he supposes magnetism itself to be a form of energy he is certainly mistaken. Magnetism is probably due to a stress set up in the ether; energy is consumed in creating the stress, and that energy can be recovered when the system returns to its original configuration. It would be almost as incorrect to say that the force which a compressed spring can exert was also a form of energy.

I can discover nothing in my previous letter which could possibly be construed into the extraordinary statement:—"He ('J. M. W.') tries to point out that it is against the laws of nature for an element to combine with itself . . . ." What I did say was that it seemed unlikely that we should ever succeed in splitting up the elements into anything still more elementary.

In the hands of Mr. Howse the hypothesis of micratomic ether seems to be nothing more than an allotropic form of the "Protyle Theory." It would be futile to enter into the merits and demerits of this latter hypothesis in this paper.

We are unfortunately left in ignorance as to the wonderful way "Lucretian's" hypothesis is going to explain the periodic law. When we are more enlightened on this point, it will then be time to offer criticism.

Does Mr. Howse seriously think that the difference between native gold from Australia and California is either "atomic or molecular"? If so, a course of elementary chemistry would be beneficial. While Australian gold contains about 99 per cent. gold, and a mere trace of silver, that from California contains about 90 per cent. gold and 10 per cent silver. Specimens of pure gold prepared from any source whatever are all absolutely identical.

Trin. Coll. Oxon. J. M. W.

OVERHEATING OF GAS-ENGINE.

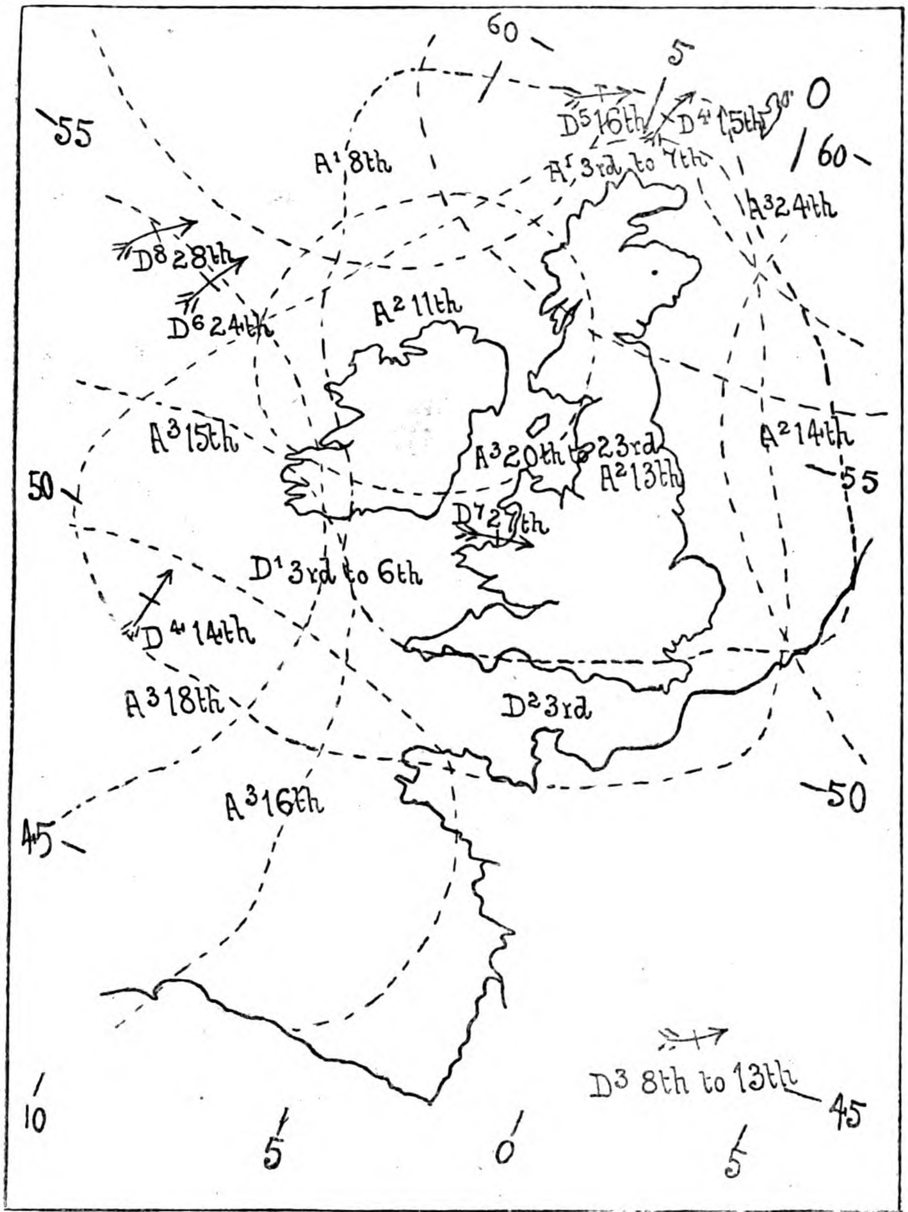
[42847.]—Having had trouble with a 2H.P. gas-engine from the above cause, I tried a number of experiments to see if I could remedy same. After several trials I attached a bend to length of pipe (same size as circulating to the end of the return pipe where it enters the tank). This piece extending to a depth of 12in. in the water, acting, to my idea, like a siphon. This altered matters greatly, as I can now run the engine for a stretch of six hours, and the jacket barely getting warm. Before altering a two-hours run almost carbonised the oil, and sometimes engine slowing down considerably, and missing fire. I write this in the hope of any contributor experiencing the same difficulty giving it a trial, when I am sure they would be well repaid for the trouble taken.

Enfield. Sebberger.

STEREOSCOPES.

[42848.]—If "R. S. D." (letter 42836) wants to see stereoscopic views without a stereoscope, he had better get "Impressions of America," by the Rev. T. C. Porter, where he will find a long explanation, taking up four pages, with three diagrams. I would gladly send a *résumé*, if not a full account.

C. E. R. Brocklebank.



THE WEATHER OF THE BRITISH ISLES IN AUGUST—THE LATE PROLONGED DROUGHT—TEMPERATURE.

[42849.]—THE following tabulated statement shows, as usual, the weather changes over the British Isles, with "effect" in relation to "cause."

Date.	Cause.	Effect.
August 1 to 6	High pressure to N.; shallow depressions to the South-westward.	Hot weather; fair as a whole, but close air; local thunderstorms.
to 14	Arctic anti-cyclone, giving place to Atlantic high-pressure system. Low pressure over the Iberian peninsula.	Fine and warm, with easterly breezes.
15 & 16	Depression to Northward; high pressure to South.	Squalls from westward in the South, with fine weather; rain and thunder in the North.
17 to 23	Atlantic anti-cyclone covering our islands; low pressure to East and South.	Generally fine, warm weather. Very fine and hot in the South and East.
24	Low pressure to W.; "straight isobars" throughout.	Hazy in the North, rainy in the West.
25 & 26	Anti-cyclonic conditions.	Fair throughout.
27 to 31	Low pressure on N.W., spreading inwards over the whole of our islands.	Unsettled and showery generally; break in the drought.

For explanation of the chart, readers are referred to page 492 of the last volume.

It may be interesting to note that August completes the *fourth* consecutive month with a rainfall *below* the average, and the *second* with a rainfall of *less than half* the average in the South-east of England.

The actual figures for East Surrey are:—

Month.	Average Rainfall.	Actual Rainfall, 1899.
	in.	in.
May ..	2·01	1·35
June ..	2·02	1·02
July ..	2·47	·61
Aug. ..	2·37	·32
	Aver. total 8·87	Actual total 3·30

8·87in.
3·30in.

Total deficit in four months 5·57in.

The temperature, on the contrary, has been *above* the average throughout the entire period of eight months—January to August—the figures being:—

Month.	Average Temperature.	Actual Mean Temperature in 1899.
Jan.	38°·5	43°·0
Feb.	39·5	44·5
Mar.	41·7	45·5
April	47·2	48·5
May	53·1	54·0
June	59·4	62·0
July	62·4	67·5
Aug.	61·6	68·6

Meteor.

THE DELUGE.

[42850.]—IN your issue of Aug. 25, Mr. E. L. Garbett, in letter 42720, quotes Rev. S. G. Wilson, M.A., as saying: "In 1883 the *Levant Herald* published a detailed account of an alleged discovery of the Ark on Mount Ararat. . . It would be interesting to know what it is that has apparently deceived these worthy . . . chroniclers."

The bare facts of the case are as follows:—There is, and was in 1883, a morning daily paper published at Auckland, New Zealand, called the *New Zealand Herald.* Every Saturday there was a special column or so contributed by a writer signing himself "Calamo Currente." In 1883 (or perhaps 1884) April 1 fell on a Saturday (or possibly Sunday). On that Saturday "Calamo Currente," instead of his usual running criticism of the topics of the week, filled his column with what purported to be an extract from the *Levant Herald*, giving a detailed account of the discovery of the Ark on Mount Ararat.

This "extract" from the *Levant Herald* was copied into nearly every newspaper in England and America, and even found its way into Continental papers. Six months or so later "Calamo Currente," much surprised at and somewhat apologetic for the extent to which his April-fool joke had spread, explained that he had invented the "detailed account of the discovery of the Ark on Mount Ararat," and that the *Levant Herald* (so far as he knew) had no existence outside of his imagination.

I was in Auckland at the time, and write from recollection; but Mr. Garbett can verify the details by referring to the files of the *New Zealand Herald.*

A. J. Bliss.

THE COMET AND THE DELUGE.

[42851.]—MANY of your readers ere this must have been weary of the above heading. Mr. Garbett calls Lyell and Darwin "supreme asses"! but is unable to foresee that this stigma can be very appropriately adapted to himself. The former he terms "Breakneck Lyell," with inane mockery of the circumstance of his lamented death. These scientists arrived incontestably at their conclusions from a study of palpable facts, and yet Mr. E. L. Garbett denounces their writings as "absurd." He can accept and revel in the belief of the Mosaical legend, in accordance with the scope of his own limited understanding.

This legend was written by men of crass ignorance, under the then prevalent idea of a flat earth, vaulted over, or covered by a firmanent. All this will not bear the test of the slightest scientific investigation, which informs us that the earth could never have been flooded so as to involve the annihilation of all living things. If more than five hundred skilled maritime shipwrights had been occupied for many years with the impossible task of collecting all the scant supply of timber available in the locality, they could not have built a vessel sufficiently large to contain and accommodate the living animals therein to be reserved for the continuance of their kind, together with an army of men that would be required to collect their food and attend to their needs. A floor space of more than eight acres would be inadequate for this purpose, with a structure strong enough to withstand the furious currents and hurricanes consequent upon such a world of rushing water. For such reasons the Ark with its conditions is a mere fable, and could not have been a reality.

Immense quantities of submarine shells and fossils are to be found in many localities on the tops of mountains, proving that these were upheavals from the bottom of the ocean, and not the result of a forty days' apocryphal flood. These self-evident relics must have been a puzzle to the ignorant men of the period, and may have given rise to the legend of a universal Deluge.

F. H. Wenham.

[42852.]—I HAVE to thank Mr. Garbett for the valuable information which he gives me concerning the progress of cometary astronomy. I did not know it before. Probably more was known about comets 5,000 years ago than now.

Possibly ink was one of the fluids which overwhelmed the earth at the time of the Deluge. It seems to be now connected with it. I hope "Nouri" will give us some more information about the Ark. Perhaps what he took for the signature of Ham will, on closer inspection, be found to be surmounted with a shamrock, with the name "Matterson, Limerick" below.

W. H. S. Monck.

A CHEAP ANEMOMETER.

[42853.]—THERE are doubtless many readers of the "E. M." who take a great interest in meteorology, and would like to possess a full set of recording instruments, but are, like myself, deterred by the expense. Many thousand amateur observers have to content themselves with the thermometer, barometer, and the rain-gauge; but the study of the most interesting phenomenon of all—the wind, is

practically beyond their reach. Even at the stores the cheapest anemometer is listed at £3 5s.—a price prohibitive to all save the wealthy. Having long desired to possess one of these instruments, I have set to work and constructed a very satisfactory substitute for exactly eighteenpence! Of course, it has no claim to scientific accuracy, and cannot be compared to the standard instrument; but it is capable of affording the owner considerable information as to the rate of the wind from day to day. First of all construct a "windmill," such as can be seen in many country gardens to scare the birds away, mounted on a pivot, and provided with a vane to keep the "mill" always facing the wind. Mine is constructed wholly of wood, having four arms, about 18in. diameter, the arms being slightly twisted so as to insure the wheel always turning in the same direction. This is mounted by a wood screw into the end of a stick 18in. long by ⅝in. thick, a washer intervening. At the other end a fan-shaped piece of thin wood is fixed vertically to form the vane. The centre of gravity is then found, a hole bored at this spot, and the whole fixed by a long screw or nail to some elevated support so as to move freely with the wind. The recording part of the apparatus consists of one of those cheap (but good) American cyclometers, which is firmly fixed close to the revolving windmill. A small screw is fixed into one of the arms so that its head engages with the star-wheel of the cyclometer. A drop of oil on the pivots and the machine is ready for use. The cyclometer should be read at the same hour every day, say 9 a.m.; but, of course, it may be read at shorter intervals—in fact, the more often the better. The result, of course, is in miles, which can be reduced to revolutions by multiplying by the appropriate factor (732 for my particular instrument), but I do not consider that necessary. As an example, I may mention that for the 24 hours ending 9 a.m. this morning my instrument registered 172 miles; to-day, with a fresher wind, it has already got to 133 miles in only seven hours.

Reymond.

AHAZ'S DIAL.

[42854.]—THE return of the shadow on the sundial of Ahaz may, or may not, have been caused by a parhelia or mock suns, as Mr. Garbett explains (letter 42822), most likely not. It was most probably caused by a movement of the earth. Joshua's miracle of stopping the sun and moon was not the actual stopping of the sun and moon, but a movement of the earth, causing the sun and moon to remain in view longer than usual.

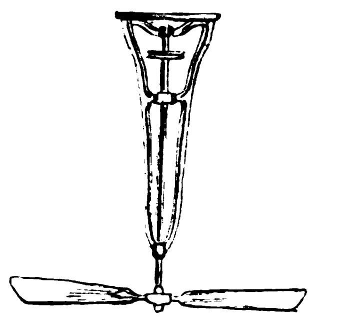
If this is so, let us consider would it not be possible to better our condition in relation to the sun? Why can't we go round the sun in the same manner that the moon goes round the earth? Let the land side be day, and the oceans night. In this condition war would be unnecessary—the same with money, and time would fall into disuse. There would be no more poverty. "Behold, the days come, saith the Lord, that the plowman shall overtake the reaper, and the treader of grapes him that soweth seed, and the mountains shall drop sweet wine, and all the hills shall melt."—Amos ix. 13.

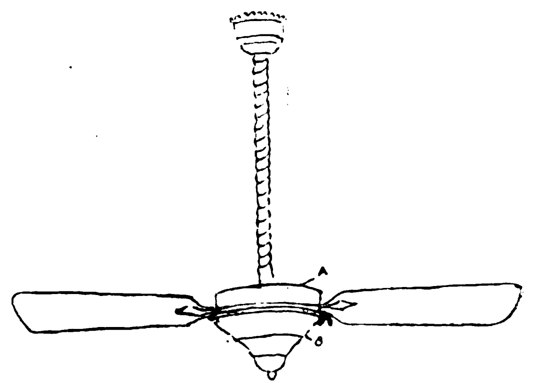
Little Bookham.

[42855.]—IT does not seem as if any of your correspondents are aware of what has been written about this matter a good many years ago, and it would be well, before filling your columns with what is at the best but irrelevant matter, that they should make themselves acquainted with the papers on the subject which appeared in *L'Astronomie*, Vol. V., for the year 1885. These papers consisted of (1) a communication by Flammarion, describing how, by means of a simple alteration of the inclination of the face of an ordinary dial, the shadow could be made to go backwards to the extent required. This could be done all the year round except at the two Equinoxes. So perfect is the method that Flammarion gives an engraving at the beginning of his paper of a dial he has had erected in the grounds of his observatory at Juvisy, to enable him to do this at pleasure. The face of the dial is first of all placed at the same inclination as the latitude of the place, and by means of a slotted quadrant at the sole and a pinching screw, that inclination can be altered 5° or 10°, or any other number required, the round rod which casts the shadow being placed exactly in the centre of the dial and perpendicular to its face.

The second paper (2) is a mathematical dissertation on the accuracy of the subject by Colonel Guillemin, of the Swiss army, who communicated the fact first to Flammarion. There seems to be no occasion for entering into a discussion as to whether or not the prophet knew that the shadow could be made to go back by natural means. Those who wish to enter into that question had better read Flammarion's paper, and a reply to it from the theological side given in a following number in the same volume by a French Catholic priest.

At a meeting of the Royal Scottish Society of Arts about four years ago, Mr. W. B. Blaikie, F.R.S.E., when exhibiting an improved astrolabe





constructed by him, which he termed "Cosmos," showed in my presence the retrogradation of the shadow upon that instrument by means of the light of a candle.

A few months ago "H." promised to give a description of the means used for ascertaining the truth of "flats." Perhaps he will now be so good as to fulfil that promise.

Procella.

[42856.]—AMONG the questions raised by Isaiah's miracle there is the connection between *ten* degrees and the *fifteen* years that Hezekiah's life was lengthened. We must remember the distance of each of the mock suns from the true sun is always 22½° of our measure. It depends on the refractive power of ice, and cannot vary. Forty of their degrees, therefore, went to a quadrant, and 80 to an average day of twelve hours. Now, Scripture defines the regular lifetime of Postdiluvians as 120 years. In Genesis vi. 3, we read that the Lord said, "My spirit shall not strive with man for ever. In their going astray they are flesh: yet shall his days be 120 years." Now, as "ten degrees" of Ahaz's dial was an eighth of an average day, so would 15 years be an eighth of 120.

Thus we see that Psalm xc. has no reference to average life. It was written by Moses (who himself lived to be 120) to deplore the shortness of his people's lives in the Wilderness. King David, who died at 70, was really only middle-aged (the middle between 21 and 120), and all who fail to reach 120 die prematurely. Jehoida the priest, in the reign of Joash, lived to be 130.—2 Chron. xxiv. 15. Anna the prophetess lived 91 years after her marriage.—Luke ii. 37.

E. L. Garbett.

ELECTRIC FANS IN AMERICA.

[42857.]—THOSE of your readers who have not visited the United States of America would hardly realise the extent to which electricity is being used in that country for ventilating and cooling purposes during the hot summer months, and it may be of interest to some of them to have a short description of the apparatus used for these purposes.

The fans of which I shall give a brief description are those used for keeping in motion the air in rooms, offices, &c., not so much for the purpose of ventilation as to create a cooling breeze, for in many offices and stores the heated state of the atmosphere makes some means of creating an artificial draught almost a necessity.

The first kind of fan used for this purpose consisted of a vertical shaft carried on brackets attached to the ceiling, and carrying on its lower end two or more wings, or blades, made of wood, and set at a slight angle, somewhat after the style of the sails of a wind engine, churning the air horizontally, and at the same time, owing to the set of the blades, giving it a downward motion. The driving power was communicated by means of a belt and pulleys from shafting. But as this necessitated the use of some engine or motor to run it, besides the use of shafting in places where it was often inconvenient and unsightly, it became evident that if a fan could be designed which would contain its own motor, and do away with shafting and belts, there would be a great demand.

About twelve or fifteen years ago the founder of a firm now engaged in turning out thousands of electric fans a year designed one of this class, consisting of an electric motor suspended from the ceiling, and carrying the blades on a shaft, very much after the fashion of the belt-driven fans, with this exception: that, instead of having a pulley on the top end of the shaft, it had an electric motor.

It will not be necessary to follow the development of this fan from its crude form to its present state; but a description of the fan as it is now made may be of interest, especially as the description will apply with some variation to many other makes of fans in use in America.

The motor consists of a ring armature, revolving outside the field-magnet cores, which are built up of laminated discs. The armature is carried vertically on a spider which carries the wooden blades, which have a sweep of about 5ft., and make about 150 revolutions per minute. The commutator is of a very peculiar construction, and consists of a fibre disc carrying 24 flat strips of brass, which are riveted on, leaving a space of about $\frac{1}{16}$in. between each. Copper brushes press against the flat surface presented by these bars or sections, and carry the current to the armature.

The armature and commutator run on a stationary vertical shaft, which is attached to a brass bracket carrying the field-magnets. This method of using a ring armature with internal fields allows a very low speed without sacrificing the efficiency of the motor, and also keeps the size of the motor within reasonable limits.

The whole is suspended from the ceiling by means of an iron pipe covered with ornamental polished brass or nickled casing, and the motor is hidden by brass or plated covers, A B, which allow a great variety of ornamentation and give a highly-finished appearance.

Instead of being suspended from the ceiling, these fans are sometimes mounted on columns or floor stands, and are much used for driving away flies and mosquitoes in restaurants and other places where these pests are apt to congregate, serving this useful purpose in addition to creating a cooling breeze.

Another kind of motor used on suspended fans, is that of the iron-clad type. In this a drum armature is used, and the casting forming the field magnetic circuit completely incloses the armature and commutator. This design makes a very compact and efficient motor, and is sometimes seen in this country applied to fans of the propeller class and small motors.

Perhaps the most common type of fan now used in America is that known as the propeller, consisting of a motor with a drum armature running horizontally, and carrying four or more blades at the end of the shafts.

All the better class of fans of this description are of the iron-clad design, and generally have carbon, instead of copper brushes.

The great objection to these fans is, that they create too much draught in front of them; but do not circulate the air round the room, while, on the other hand, the fans suspended from the ceiling keep up a steady circulation of the air, without creating unpleasant draught.

It is not probable that the demand for electric fans, for cooling purposes in this country, will ever approach that of America; but there are many places, as the late hot weather has forcibly reminded me, when their use would be an agreeable luxury, if not an absolute necessity, and the spread of facilities for obtaining current should cause electric fans to come into more general use here.

Space will not permit me to give more than the above brief outline of the application of electricity in this direction in America, or to touch upon the subject of its application to exhaust fans, for ventilating large buildings and factories; but the subject is an interesting one, and might well engage the attention of your readers, even in this country, where the extremes of heat are not so severely felt as they are across the Atlantic.

James O. G. Gibbons.

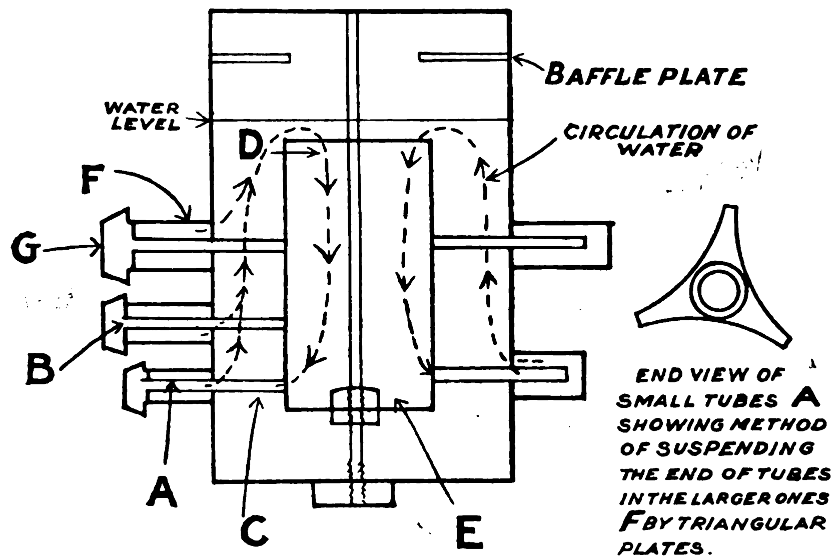
UP "DEVONIAN," G.W.R.

[42858.]—ON p. 64, "Scorpio" says that Warren made up six minutes on booked time in the 17 miles between Didcot and Reading, which does not correspond to the times I gave: Didcot Station being passed at 2h. 46m. 28s., and Reading at 3h. 7m. 0s., which gives the time between these two stations as 20m. 32s.—i.e., 32s. over the 20m. allowed. Again, the Reading to London journey took half a minute over booked time, which proves that Warren eased down after Didcot, being 3½ early at that place.

Ealing. O. R. Walkey.

STEAM-BOILER FOR MOTOR-CARS.

[42859.]—I THINK the neat design shown on page 90 (42792), Sept. 8, might be improved by the



following:—By having internal tubes, A (see sketch), to run into fire-tubes, F; the end B being, of course, open and supported in F, as shown in end view, by a triangular washer arrangement. The end C of the tube to be screwed into a cylinder, D, which is suspended, as shown, in boiler, and fastened in same at end E by two nuts, one each side of the stay. The end E of cylinder is perforated with holes, and end D is about 1in. below water-level of boiler. This arrangement, with small internal circulating tubes in larger ones, is adopted in one class of water-tube boiler with considerable success, it being found that the boilers will withstand considerable forcing. The circulation in this case would, of course, proceed from D through small tubes, A, into larger ones, F, and so up to the water-level and down again into D. These tubes F and A might, I think, with great advantage be bent down slightly at the free ends, which would help the steam as formed to escape to the steam space. The cylinder D cannot get short of water by water-level getting below the top of D because of the holes at E. The idea of the cylinder D is to keep the circulating currents separate, and so improve the circulation. In this case the boiler, if strongly made, should be able to withstand a lot of rough work, which the design (42792), though very neat, would not, the steam being formed in the tubes and driving the water out, and there, as the pressure varied, coming out with a rush, besides getting quickly burnt out if much forced. The feed-water should enter at lower end of D. The ends G of tubes F should have a screwed cap.

Ogap.

[42860.]—WILL Mr. Allison (42792) please say what length ⅜in. brass tubes are in sketch of motor-car boiler, and about what size should I have to make for an engine with a pair of cylinders 2in. bore, 4in. stroke? Also, would Mr. Allison give sketch and dimensions for an oil-burner for same, to burn benzoline or paraffin? Would a sheet-iron casing lined with asbestos do in place of fireclay cylinder?

J. Wells.

[42861.]—I AM only too glad to give friend "Water-Tube" (42830) any information in my power. In the first place, the boiler is vertical, which would be implied from the statement in my description to take steam from the top plates. The boiler should not be filled with water more than two-thirds up; otherwise it is very apt to prime, and it is very necessary that no oil should be put into the cylinder, as very nearly all the steam is condensed and used over and over again. Coal cannot be used in road locomotives, nor must any steam be visible. Coke or charcoal would do; but, standing, would blow off at a terrific rate, as all tubular boilers are wont to do, as they make steam so very rapidly. Oil-burners are not expensive. Write to Mr. Hicks, tool-merchant, of Chelmsford, who will supply you with a suitable one. Paraffin is only about 7d. per gallon. I may state that a boiler of the dimensions of the drawing supplies a cylinder of 2¼in. diam. with a stroke of 5in., good enough for any motor tricycle. I have made many such boilers in my time, and with the exception they prime somewhat if care is not taken, they answer admirably, and there is very little fear of their bursting. The only chance is that the bolt might possibly break, that being the weakest point; but, however, 100lb. would be the extreme wanted. You should, however, test up to 150lb. cold water. Any other information I can give I should only be too happy to.

R. Allison.

MOTOR CYCLES.

[42862.]—As the person responsible for the design of the Components Dion Motor as fitted to tricycles by the Ariel Cycle Company, the Swift Cycle Company, and others, referred to by your correspondent "Monty" in a recent issue, I desire to compliment him on the great grasp of the details of the motor and the tricycle, as shown by his able, and, on the whole, very fair letter. There are one or two points, however, in which he requires correction.

I do not think that the motor placed in front of the back axle was ever tried by some French makers years ago and given up, and I would be glad to be furnished by your correspondent with the facts on which he bases this assertion; nor can I admit his contention, "the reason being not far to see." All the reasons given by your correspondent are fallacious: the side bearings are not cut down in the least, but are all, without exception, longer and larger in diameter than any of the French motors hung on to the tricycle behind the main axle. This cutting down is far from being a disadvantage, because the side bearings being much closer together, the bending strain on the crank-shaft is much less. As regards an accident to the valve-rod foot, this can be taken out without disturbing anything at all, beyond unscrewing the valve-rod guide-bush out of the crank-case; this bush, I may explain, is larger in diameter than the valve-rod foot. Again, your correspondent is entirely mistaken in supposing that the valve-rod foot had anything to do with the stoppage of Mr. Stocks in his twenty-four hours' ride. The reason was an unseen flaw in the inlet-valve stem. Unfortunately, the rider had no spare parts with him.

I cannot admit that "A two-speed gear is necessary for anyone riding in hilly country," and I ask this question from your correspondent's letter to be read with this extract from the same: "People do not want to be summoned for furious driving every time they use machines." The motor under discussion geared six to one with the tricycle is capable, has, and does drive a tricycle up any hill the gradient of which does not exceed one in six (there are not many such to be found), and on the level will give a speed of about 22 miles an hour, and proportionately faster downhill. I admit that it seems well-nigh impossible to fit a two-speed gear to this motor; but in view of the foregoing incontestable facts, I have no desire so to do, and I would like to have your correspondent tell me, presuming for the moment that he will accept them as true and reliable, whether in his opinion and under such conditions the extra work and complication of a two-speed gear is worthy of consideration.

I agree with "Monty" that, theoretically, a clutch between the motor and the tricycle which would allow of the motor to run loose when tricycle is being ridden in traffic, is an advantage; *but* I do not see my way to design it, and even did I, would not recommend it: in all probability it would give considerable trouble.

I am pleased to note your correspondent is satisfied with the workmanship and general appearance of the motors and tricycles. I think that many cycle-makers are at the moment much too slow in seizing upon the opportunity they have of fitting reliable motors to tricycles of their own manufacture. Perhaps they will waken up soon. Your readers can accept my assurance that from my own knowledge every part of the motor and motor-cycles referred to were made in England with British capital and British labour. **Charles Sangster.**

Cycle Components Manfg. Co.,
Componentsville, Birmingham.

THE FUTURE OF AERIAL LOCOMOTION.

[42863.]—REPLYING to J. Sutcliffe, letter 42803, the reason that small birds, such as sparrows, tomtits, linnets, &c., beat the wings vigorously for a second or two preparatory to folding them close to the body, is, as before described, that, compared with the weight of the body, the wing area or supporting surface is small, thus necessitating their number of strokes to be beaten with greater frequency than those birds with ample wing area. The folding enables the wings to evade the air resistance, the weight of the body contributes to increasing acceleration, and the impetus gained impels the bird either horizontally or at any degree of obliquity upward or downward, the last greatly facilitated by the tail, the operation being repeated alternately as long as the flight continues. When, however, the bird desires to fly upward from the ground to a roof, it gives a vigorous leap upward; the body is inclined, and it strikes the air as a kite. The wings are inclined at the angle required by means of the universal joint at the shoulder (which enables the wings to incline themselves at any degree of obliquity). Furthermore, Dr. Pettigrew states his opinion that in each beat of the wing a current of air is drawn after it (which may be verified by experiment), and the results of such swift operations of the small wings necessitate the folding close to the body to avoid the air currents thus set up. It is for this reason that I have stated that it matters not whether the air is calm, gusty, or what; the bird, when once in the air, has the aërial currents entirely under control. If we take an ordinary common carrier-pigeon and hold it suspended upside-down in the hand, and suddenly let go, it will be found that it regains its equilibrium quicker than the eye can catch the return of its equipoise. Or, if we hurl it away from the body in a huddled heap, whilst you are watching it, it has regained its stability by a few vigorous flaps with its plastic wings, and appears to have merely flown aloft under ordinary circumstances. These experiments, with many other interesting ones, I have made with a pair of pet homing carrier-pigeons;—all of which tend to favour the opinion that with properly-made artificial wings and a thorough knowledge of bird mechanism, individual flight is really within human bounds to accomplish.

Now Mr. Challis will, I feel sure, pardon me for again correcting him on a few somewhat untenable opinions respecting my system. In the first place, in letter 42751, he ventures an opinion that a flying craft on my principle would only go with the wind or dead against it, and the wind would act on the rudder when "tacking" at cross angles against it, and blow it from its course. I assure Mr. Challis, in all friendly spirit, that this is a fallacy as absurd as it is irrational, which may be conclusively demonstrated thus: The bird in motion has two forces to propel it through the air, and not one, as he states—viz., gravitation. The downward pull of gravity is one certainly, yet equally positively is the great *propelling* force of the wings when beaten to be taken into consideration, and if he will only construct an artificial wing as explained in my previous letter (42704), he will find how true are these remarks. Thus, when cross-currents retard the velocity of the bird's progress, this enormous momentum residing within the bird, materially assisting gravitation, literally *forges* the bird through the atmosphere. Now, if a small bird gains stability aloft, it is within reason that a large apparatus much heavier in bulk and weight must of necessity retain its stability with increased momentum under these conditions.

I note with extreme surprise that Mr. Challis in his first letter discredits the paddle principle as a misconception, and in letter 42751 contradicts this statement by saying "the double-acting paddle we must have." I have no hesitation in saying that the paddle principle is a modification of the bird impelling its path obliquely upwards by its screw-wings and concave supporting surfaces. In short, the screw for elevation and propulsion in conjunction with curved surfaces reproduces faithfully every movement of the flying animal.

It may, no doubt, interest J. Sutcliffe (letter 42803) to know that, regarding the question of the elastic requirements of artificial wings and aërial screws, I made two wings of similar dimensions, one being more elastic and flexible than the other. I found that the more plastic screw, whilst forming a powerful propeller, broke when beaten vertically with great force after awhile; but the other stood the ordeal splendidly, showing that, although the wing must contain a certain degree of flexibility, rigidity at the inner half must be to a certain extent maintained to enable the wing to "wedge" itself forward; at the same time it is equally imperative that it should yield to evade the air in the beats or strokes.

Respecting his other query: Large birds of prey, such as hawks, vultures, eagles, and condors, have large, broad, ample surface wings, the beats given being slow and stately. Such birds fly higher, and sustain the longest flights. The condor of the

Andes will soar to an altitude of five miles, as is well known. I quite indorse this contributor's opinion as to limitation of the diameter of the screw propeller.

Letter 42802 is very interesting, as, indeed, have been all letters recently inserted in the English Mechanic on this subject. At the same time, I would like to mention that this writer's views are a trifle romantic when it is mentioned that future flying craft will be specially made for sea and land service. In my opinion, considering they will be made all on one system (the screw), it is immaterial whether the projected cruise aloft will be above the sea or land, so long as due precautions are taken to prevent a sudden breakdown of machinery and retard a sudden fall, independent of the suspensory helices, which could only be insured by curved supports.

In reply to letter 42804, respecting the valvular or Venetian-blind principle, I may point out this system is neither original nor practicable, and is at variance with natural laws or types. It is immaterial, in my judgment, whether or not the feathers open in the up-stroke and close in the down-stroke, so long as the wing is plastic and yields (as before described in letter 42704), and evades the resistance of the air. It is not my contention, however, that the feathers do not, for assuredly they do. Mr. G. Dixon terms the feathers "pinion feathers." They are, it may doubtless interest him to know, called "primary," feathers, others being classed as "tertiary," "secondary," "coverts," "sub-coverts." I assure him that it matters not that the feather is broad and narrow respectively on each side, and neither does it insure wholly flight. Flight is attained by impulsion caused by the anterior or front margin of the wing being thicker and graduating compared to the posterior margin or rear half. A writer in October last published sketches of a similar conception, which, however, whilst decidedly advanced, yet contained inherent defects, in that safety was considered insured by concavity of surface only, instead of reversing planes, plasticity, &c.

In conclusion, whatever system is advocated—paddles, artificial wings, aëroplanes, &c.—all are modifications of the one true principle which evolution would conclusively show—to wit, aërial screws plus curved supporting surfaces. **E. Wilson.**

[42864.]—I have been looking up numbers of "E. M." as far back as 1869, and it seems to me the power required in a flying machine is nearly lost sight of. F. H. Wenham, in his splendid letter (42737) does not make it clear to my understanding when he says 3H.P. per 100th raised.

Can any reader give any information on this point? I have two machines in model which I can guarantee will fly, but am short of suitable power. Please see my address in "Wanted" Column.

Ureka.

WATER SUPPLY OF GLASGOW.

[42865.]—In your issue of Sept. 8, 1899, on. p. 87, appears a paragraph relating to the above, being a notice of an article on the subject by Mr. Benjamin Taylor in the *Engineering Magazine* for September. There can be no doubt, from the figures published, that the inhabitants of the Scotch Metropolis enjoy a supply per head considerably larger than that provided for the Londoners, and that their water-rate, is moreover, only about 37 per cent. of what we pay in London. But it is very questionable whether the water obtained from Loch Katrine can be described as the "purest in the world." Two quotations from a very interesting volume, "Shadwell's London Water Supply," should be noticed. On p. 62 we have, "Glasgow, which has a very large and cheap supply; but then Glasgow does not filter its water, and *the typhoid death rate is double that of London.*" (The italics are mine.) Again, on the next page, in a statement as to purity, we have given us in the form of a table—

Comparative Analysis in Parts per 100,000.

—	London. Organic Carbon.	London. Organic Nitrogen.	Birmingham. Organic Carbon.	Birmingham. Organic Nitrogen.	Glasgow. Organic Carbon.	Glasgow. Organic Nitrogen.
June ..	·107	·014	·260	·050	·126	·011
July ..	·091	·012	·180	·050	·128	·011
Aug. ..	·084	·012	·120	·050	·175	·011

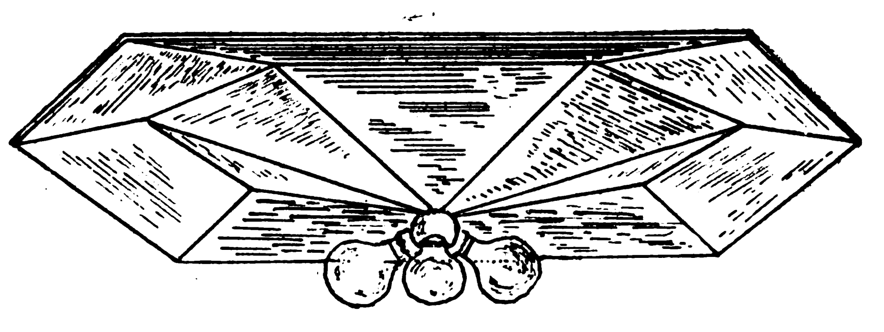
An examination of "The Purification of Public Water Supplies," by John W. Hill, which was reviewed in *The Engineer*, Aug. 25, 1899 (page 187), would probably throw further light on this matter. In this work we find the statement that filtration in London "probably averages less than 1·5dol." (per million gallons). The conclusions which the author draws from a comparison of the typhoid rates of large towns in his own country (United States of America) and in Europe, are totally adverse to neglect of filtration, and this, in spite of the fact that, as far as filtration is concerned, America stands at the bottom of the list.

Lawrence B. Tappenden.

Strathmore, Chiswick, W. Sept. 13.

A RAY DIFFUSER.

[42866.]—I inclose a block of a ray diffuser for electric-lighting, designed to disperse the light, making it particularly suitable for street-lighting, as it prevents dark spaces between the lamps. It is



glazed with silvered fluted glass in sections, so is inexpensive to maintain, and does not tarnish like silvered copper, or become non-radiant like enamelled iron. I thought it might interest some of your readers. The illustration represents the diffuser canted to show the underside.

161, Albion-road, N. **A. Clarke.**

LATHE MATTERS, OVERHEADS, &c.

[42867.]—By the merest chance I have had sent to me a few numbers of the "E. M.," for I am sorry to say I have left off taking it regularly; and also that I have parted with my many back volumes: hence I cannot refer you to the volume containing an article and diagram of an overhead motion now some years old, for which I at once threw away my overhead motion in the old and usual system, and after years of experience have never regretted it. I feel somewhat ashamed at not having written you before on this subject; but, *of course*, have lots of excuses ready.

Now this overhead (42519), which "South Australian" has just *devised*, seems to be identical with the one illustrated by you, and from which I took mine, and I thank God for it; for as a friend to whom I showed it, and who at once imitated it for his own lathe, said, "It is like the Waverley pen—a boon and a blessing."

As the description given by "South Australian" may not be sufficiently explicit for all amateurs to work from, I try to suggest that you will refer to the number of "E. M." and diagram for the benefit of your many readers who desire to use an "overhead," if they could only rig up an inexpensive and effective one. *Now this is both.* As a clue, I believe the volume was in the "'80's," and the diagram (most simple) and description was by a writer with a Polish name, beginning, as far as I can remember, with a P——. The only alteration I found advisable was to make the frame travelling on the supporting bar capable of being "locked" at any desirable point, as otherwise it had a tendency to "run" in the direction the cord was being driven;—it was then, and remains, *a perfect* overhead motion. My pulleys are all of hard wood, and after years of wear are as good as the day they were made. My "gut" is simply a piece of logline with a long splice; and if this is well made will last for years, for the tension being so constant and regular, there is, in a sense, no strain or wear. Of course, any suitable piece of cord or rope will answer the purpose, and is always ready to be set to work in any position by the simple employment of leading pulleys on the drill motion on slide-rest—i.e., parallel to lathe centres, at right angles, or vertical, and any intermediate position. The degree of tension is always regular, and can be increased at will by the weight for the purpose. I have never found it necessary to alter this weight. I have not found it necessary to have "all the pulleys constructed as snatch-blocks," for the cord can be unshipped and hung up in a moment, and the lathe driving-cord put on. Nor is it necessary all or any of the pulleys on the overhead should "swivel." The cord will be led by leading pulleys on drill motion at any angle; but the frame carrying the two pulleys, which are movable along the bar, is made to "swing" at right angles to lathe, about which there is no difficulty if "the supporting-bar" is round (mine is a piece of 1in. gaspiping, light, and quite stiff enough, with wooden knobs at ends as a finish), after the manner of a curtain-pole. The whole thing is most satisfactory, works easily, is always ready, and can be driven at any speed. Mine is usually driven from 1,500 to 2,000 revs. per minute, and will do the most perfect work on any material. I do not have main cord pass "through sheave in weight," but round a pulley on the supporting bar, which is pulled taut by small chain over fixed pulley at right-hand end of lathe, to which weight is attached. After years of work, I have not found anything wanting in this arrangement; therefore I call it perfect.

One other point in lathe matters deserves consideration—viz., the driving, or, say, treadling arrangement. Where the lathe is driven by power even, the workman might be allowed to sit at his work, especially in work where there is much manipulation of the slide-rest, as is the case in all ornamental work. Now, amateur turning is very laborious with the old treadle, and it is not always convenient or pleasant to have someone else to treadle, and I think it is much on account of this hard labour that many give up turning. It becomes almost an impossibility in the warm weather at home, and nearly always so in Tropical countries, when it is often as much as one can do to lie down comfortably to avoid the feeling of "can'tstand-upatittishness," without toiling at a treadle whilst standing on one leg! This is easily avoided by the use of the velocipede-seat and treadles, as in the American lathes sold by Churchill (Brown and Sharp's, I think), with which turning becomes a pleasure instead of a toil. Moreover, a temporary seat at the back of the lathe enables an assistant to treadle without being in the way of the turner, when it is necessary on special occasions, which I find are very rare with an amateur. I am in a good climate, but my workshop is for weeks 84°; yet, although in my 69th year, I can, and do, work at my lathe eight or ten hours a day without fatigue. Now this I certainly could not do without a velocipede seat and my overhead motion, to which I owe great pleasure and amusement. My lathe is a sort of *multum in parvo*, with which I can do almost anything in the way of ordinary turning and screw-cutting on a 4½in. lathe—circular-saw work, fret-sawing, milling, ornamental work, with overhead motion and eccentric chuck (which latter I made myself), emery grinding, and, indeed, anything that could be expected from a lathe. I have a micrometer screw working in large cog-wheel on spindle by which I can divide to almost any number up to 4,200, and move my work round slowly or to any portion of a revolution whilst my drill motion is doing its work. My "jims" are always open for anyone to inspect, and I take the greatest pleasure in imparting such knowledge as I may possess from experience. I should have sent you specimens of work and drawings of my "jims" long ago but for the consideration of time and distance.

S. B. Newton, A.M.I.C.E.

Bhowalie, Kumaon, N.W.P. India.

DEAD-CENTRE LATHE—WORK TRAVELLING OUT OF CENTRE.

[42868.]—I have made a small dead-centre lathe. With this I had fondly expected to be able to turn up the thumb heads of binding and levelling screws, resistance plugs, and the other small brass articles which the electrical amateur is always using. I find, however, that things do not work quite so smoothly as I anticipated, and as I have no doubt there are still a great many amateurs who use a dead-centre lathe, I trust I shall receive a few hints as to how to get over the difficulties which have presented themselves to me. So far, I have only worked on brass, using ⅜ and ⅝ wire. The flywheel of lathe weighs about 35lb., and the power is taken off a small band-wheel 7in. diameter, fixed on the crank. The wheel on mandrel is 2in. diameter; poppets are hard wood faced with ¼ iron, and firmly fixed by means of bolts and fly-nuts; mandrels ½ steel, and points of centres exactly opposite each other. I give these details to show there is no vibration or wobbling of parts.

Now, my difficulty is this. After most carefully finding centre of a piece of brass wire, and drilling deep holes in same, I find that after applying the turning-tool for about a minute or so, one or both the centre-holes appear to travel towards one of the sides, and the work, instead of being round, soon presents an egg-shaped section. What is the cause of this, and the remedy?

I have used the lathe very successfully as a drilling machine. I have a mandrel with a hole at one end instead of a point. I take a twist-drill of desired size, attach a carrier to it, and rest the end in the hole of mandrel mentioned above. Then I rest the work (it must be something moderately flat) against the tail-stock, and press it against the point of the drill. Of course, it is all guesswork as to whether the drill is exactly perpendicular to the work, although it is not difficult to get it fairly so by running the eye along the drill and getting it into line with something straight, such as the slot of the lathe-bed. I find it very difficult, however, to fix very small objects in position against the tail-stock. They twist about in all directions, unless securely held by the fingers. I suppose that when dead-centre lathes were more popular, there were many little contrivances used which have now gone out of fashion. Perhaps some of your readers can offer a short description of some of them.

I should also like to know what is the most suitable sized tool for small brass articles, from ¼ to ⅛ diameter? So far as I have been able to find, a large-sized awl well hardened appears to cut much better than the tools described as "turning tools."

Dead Centre.

SIR MICHAEL FOSTER'S ADDRESS.

[42869.]—In letter 42815, p. 115, the printer omits at the end my reason for saying "Christians ought to have" anticipated Darwin's famous book. What I said was, that they should have seen the true or Biblically revealed "origin of species," which was never by "natural selection," which only preserves a species when it has appeared, but cannot originate anything. The very title of Darwin's book was ridiculous. The first man, the first ox, or the first of any new species, originated as Christ did, by birth from a virgin. A most important step in biology has been made since Darwin's time, though totally ignored by Sir M. Foster in p. 106; namely, the discovery that among the lowest animals are some that are now individually born sometimes of virgins. What was supposed an *unparalleled miracle* in Mary's case, is now seen to be still natural among the lowest creatures, making it far more credible.

Again, Sir Michael Foster totally omits an astronomical fact only discovered in this century, and the latter half—namely, that in all probability the *sun is younger than the earth.* It is connected with the relative densities of the planets, which were supposed half a century ago to be partly denser than the earth. It is now certain that the earth is the densest of them all, which makes her very probably the oldest. This entirely reverses a point in which science was popularly supposed to clash with the Bible. The earth is also the largest of all bodies that can be proved to be partly solid. All the larger are apparently fluid alone. The sudden appearance of a star in the Andromeda nebula in 1884, and its evident cooling down till invisible half a year later, was also most providential in illustrating the book of Genesis.

Sept. 15. **E. L. Garbett.**

THE NUMBER 666, AND INTEREST.

[42870.]—With regard to "Glatton's" first question on p. 116, I cannot find in any margin to Daniel viii. the word *prosperity.* So I cannot tell what word he means. In a concordance to the LXX. no such noun as 'εὐπορία appears, but only the verb εὐπορέω, and this only twice. I should not be running this to death if a single bishop, or priest, or deacon in the last *fifty-five years* (to say nothing of the S.P.C.K.) had taken the slightest notice of Taylor's discovery. It is only their studied silence thereon that drives me to smell brimstone.

Mr. Monck, on p. 117, seems rather to attack H. George, who takes but one of the Earth-Beast's two horns for attack, the use of land as capital, and not of movables. I call anything "*capital*" that is used *against* labour, not in partnership with labour, as Joseph's Pharaoh used it. What is used *with* labour ceases to be capital at once.

Demetrius artfully addressed workmen as if the εὐπορία were theirs as well as his. But that is the constant trick of capitalist speakers everywhere. Certainly neither in the parable of Talents nor of Pounds were the servants capitalists for a moment. The master tried how they would add to the value "by *trading*"—that is, by working at their trade, but certainly not by hiring wagelings to fleece them of profits. If one had said, "Lord, thou gavest me five talents. Behold, I went and hired poorer men, and of their industry have gained five more," he certainly would not have entered "the joy of thy Lord," but have been imprisoned as a thief till restoring his victims their profits to the uttermost farthing.

The crime of capitalism doubtless was practised abundantly long ere Franklin lived; but I doubt if anyone before him taught that borrowing at 6 per cent. per annum (or any lesser rate) was obtaining "all the advantage that there is in possessing money." He was not believed in his economic doctrines *because* of the electric discovery, nor was the latter regarded as a miracle; but neither does the prophecy imply this connection. It simply says that wonders, even to the extent of "making fire descend from heaven to the earth in the sight of men," will be done by a teacher of this heresy.

From 1700, half a century before this sign, till Ruskin's time, I know of no teacher hinting at the difference between capitalism and the honest use of wealth. I have seen an old book on the "Right Use of Ritches," but that was dated before 1700. As soon as ever the lord bishops gave consent to the damnable crime of a National Debt, our Church at once, as Ruskin says, "both renounced the Biblical Jehovah, and flung his Bible in his face." Till then, from the Reformation, Protestantism had been the truer Christianity; but thenceforth, till 1872, I regard Popery as the truer and less idolatrous. Its idolatry was what the Koran attacks as *associating* other objects of worship with Allah; but ours was rejecting him and *substituting* another god, which is far worse. But at length our god of εὐπορία came in 1872 to be adopted by Pius IX. when he had ceased to be a king and become a prisoner. Popes now define the crime of usury as getting 3 per cent. per annum or more; but they had never previously contradicted the Bible thereon. Of course they utterly misunderstood it. The crime, as Mr. Monck says, is now chiefly by borrowers; but the Bible forbad lending and not borrowing, because lenders alone have the power of preventing both.

The difference between letting on the *metayer* system or on ours, I, of course, regard as entire, and involving such flat contrast of direction that, as Carlyle said, "If you continue both lines far enough, they lead to heaven and hell." But I do so far receive the Mark of the Beast as to take the legal National Debt interest of 2¼ per cent., or 3 if possible, but always confessing it as such; and the receipt of a farthing more I regard as most damnable theft. Paying more or receiving more equally criminal.

Sept. 16. **E. L. Garbett.**

MICRATOMIC ETHER.

[42871.]—Those interested in the subject should read Prof. Poynting's address to Section A of the British Association. I agree with much of it, but strongly object to his statement that the Kelvin vortex-atom theory gives a *simplification.* Where many hypotheses are offered preference should be given to any tending to simplicity, especially as in considering varieties of matter we are trying to get at the simplest forms or conditions thereof. In attempting to analyse complex matter we simplify step by step until we reach molecules or chemical atoms. If at present we cannot practically analyse further, there is no reason why in theory endeavouring to analyse further we should proceed to increasing complexity instead of simplicity.

I scarcely think "J. M. W.," letter 42787, imagines the ether to be mere motion. There is motion, and there is something which moves; I call that something "matter," however different the matter of ether may be from other matter, gaseous, liquid, or solid.

In reply to R. A. Kennedy (letter 42788), I may say that in my opinion sound *in transit* is not capable of polarisation like light. In ordinary treatises on sound, the action of sound *in transit* (through air, for example) is confusedly and, in my opinion, erroneously mixed up with the actions by which sound is produced or started—that is by which the succession of impulses constituting sound in transit are originated.

I thank W. Howse (letter 42825) for his criticism of "J. M. W." As to sound and colour, however, I may say that many years ago I made careful experiments which showed no correspondence whatever between particular notes and particular colours.

Lucretian.

HEAT AND GASES.

[42872.]—I wish to thank our Editor much for allowing us a little space to gain information on the effect of heat on gases, and on that to me wonderful point "absolute zero." I wish also to thank the correspondents who have been pleased to offer assistance. I beg to ask some questions on the theory of the above in this letter, and possibly the replies will enlighten others as well as myself who have not especially studied either light or heat. Anything from the pen of "J. M. W." or "M.I.C.E." will be esteemed a favour. The quotation in letter 42807, p. 93, is taken from "Elementary Hydrostatics," by W. H. Besant, M.A., F.R.S., lecturer and late Fellow of St. John's College, Cambridge, dated 1875, art. 84, p. 75 (Deighton, Bell, and Co., Cambridge).

I also find stated there that Regnault's results for different gases varied from ·003665 to ·003689. I also find in a small book on the "Theory of the Steam Engine," by Baker, that the increase in volume from 32° F. is ·00202 of its volume per degree Fahr., according to Gay-Lussac, which is equivalent to ·003636 C.

From the same book I quote the following: "From the experiments of Regnault, it appears that air expands 0·3665 of its volume at 32° of Fahrenheit by being heated from that temperature to 212° on the same scale." Now as raising from 32° Fahr. to 212° Fahr. is the same as raising from 0° C. to 100° C., we find that Regnault got the ·3665, which divided by the 100, gives probably his method of obtaining the ·003665.

What I wish particularly to know is, has the same result been arrived at by sufficiently correct apparatus by raising the temperature of a given mass one degree at a time? Here I will call attention to the formula arrived at in letter 42807, p. 93, and substituting ·003128 instead of ·003665, then by taking $M = V r^n$, we should get for a rise of 100° C. the increase of ·3665 of its volume. The ·003128 would, according to the ordinary method of calculation, be an error to the amount of approximately $\frac{1}{2000}$ of the volume at 0° C.

Taking the ordinary method of calculation, I cannot quite agree with Mr. Webb, letter 42818, p. 115, that "At 100° C. the volume would be $\frac{100}{273}$ of its volume at 0° C.," as at + 100° C. I make it $1 + \frac{100}{273}$ of its volume at 0° C., and at − 100° C. I make it $1 - \frac{100}{273}$ of its volume at 0° C. *I fear* others may share my faults.

I am not allowed to assume that an increase of one degree in temperature in a given mass of air increases its volume at any named temperature by a fixed percentage of that volume, the pressure being constant; but the following pill I must swallow—viz., that in a given mass at − 272° C. an increase of 1° C. *doubles* the volume, whilst at + 273° C. an increase of 1° C. only increases the volume by $\frac{1}{546}$ of that volume.

Any information bearing on the foregoing, together with notices of books on the subject, will be esteemed a favour. **William E. Tanton.**

USEFUL AND SCIENTIFIC NOTES.

The total mileage of the railways in the United Kingdom in 1878 was 17,333, and the paid-up capital 717 millions. In 1898 the mileage had increased to 21,659, and the capital £1,134,461,000. Thus the mileage has increased in this period by 4,326, at an additional capital cost of 417 millions sterling.

With regard to sprinkling railway lines with petroleum, it is reported from America that an additional advantage has been found since moisture will not penetrate through the oiled outer crust. Instead of this the water runs off the track into the ditches at the side of the road. Vegetation along the sides of the rails is destroyed by the application of oil, and thus a saving of labour is effected.

It is reported from New York that the keel of the largest merchant steamer ever built on the Pacific coast has just been laid down at the yard of the Union Ironworks, San Francisco. The length of the new vessel is to be 450ft., and she is to have a beam of 51ft.; her carrying capacity is to be 8,250, and her displacement 12,000 tons. The new vessel is being built for the American-Hawaiian Steamship Company.

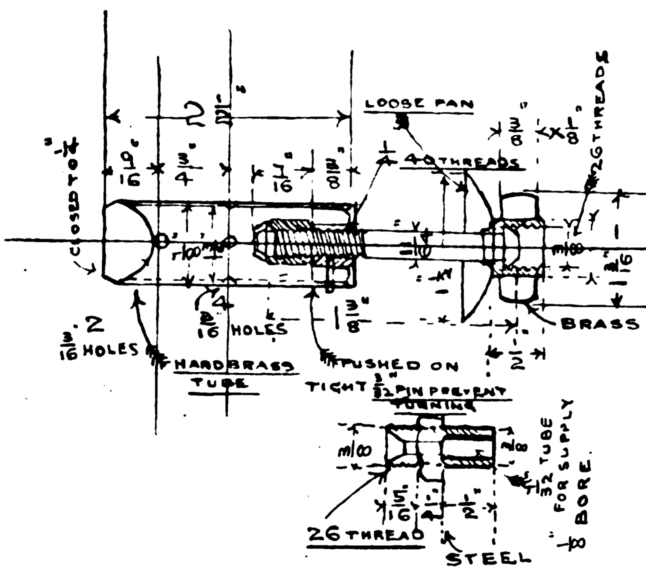
Cast aluminium is about equal in strength to cast iron in tension, while under compression it is comparatively weak. With a purity of 99 per cent. the ultimate tensile strength of aluminium per square inch is, in castings, 18,000lb.; in sheet, 24,000lb. to 40,000lb.; wire, 30,000 to 55,000lb.; and in bars, 28,000lb. to 40,000lb. The elastic limit of aluminium of this purity is, for castings, 8,500lb.; sheet, 12,500lb. to 25,000lb.; wire, 16,000lb. to 33,000lb.; and bars, 14,000lb. to 23,000lb. per square inch. Taking tensile strain in relation to weight, pure aluminium is as strong as steel of 80,000lb. per square inch.

The Lords of the Admiralty have decided to strengthen the fleet of tugs at Devonport by the addition of a vessel to be built by the London and Glasgow Shipbuilding Co., Glasgow. The new tug, which will be larger and more powerful than any tug yet built for the naval service. Her dimensions are: length, 144ft.; breadth, 27ft. 3in.; mean load draught, 10ft. 9in.; displacement at load draught, 700 tons. She will be constructed on the ordinary paddle-wheel principle, in order that she may be of greater service in shallow water than if fitted with propellers. Her engines are to develop 1,250I.H.P. on an eight-hours' trial, under which conditions the vessel is expected to attain a speed of 12 knots per hour.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96374.]—**Lamp for Firing Tube Motor.**—Sketch shows latest pattern for pressure burner for lamp ignition. You will want to drill within $\frac{1}{32}$ of



top of nipple, then punch hole through with a needle threaded through a cork. The nipple tube must have a hole $\frac{1}{32}$in. through it, and inside fill with a plug made of finest possible copper wire gauze rolled up tightly on a piece 20-gauge steel wire 1¼in. in length. MONTY.

[96457.]—**Widened Railway Carriages.**—The coaches on the Midland Railway running on the Tottenham branch and also to St. Alban's (local trains) were made to seat six on each side of a compartment, about fifteen years ago. At any rate, I know that I travelled in them in 1883 daily, and the paragraphs going round about the improvements introduced by the Great Eastern are simply "slop." But is it right to speak of it as an "improvement" to crowd six passengers on a seat by adding about 8in. to the width of a carriage? The simple fact is that the traffic has grown so enormously that the railway people do not know what to do to meet it. METOPS.

[96458.]—**Silver Coins.**—It is quite true that silver coins anterior to the date of the Queen's accession are refused at many places (I speak from personal experience), but, of course, the blunder lies with those who refuse them. The Bank of England (by courtesy) will always change worn silver tokens (shillings, sixpences, &c.), but it will not change those coins which have had a hole made through them. Personally, I think the Government Post-offices ought to be compelled to change the worn "coin," and it might be made a condition of a license that worn tokens should be accepted, because they are easily sorted at a bank. That is done—sometimes. A coin that is not defaced can be changed at the Bank of England. S. R.

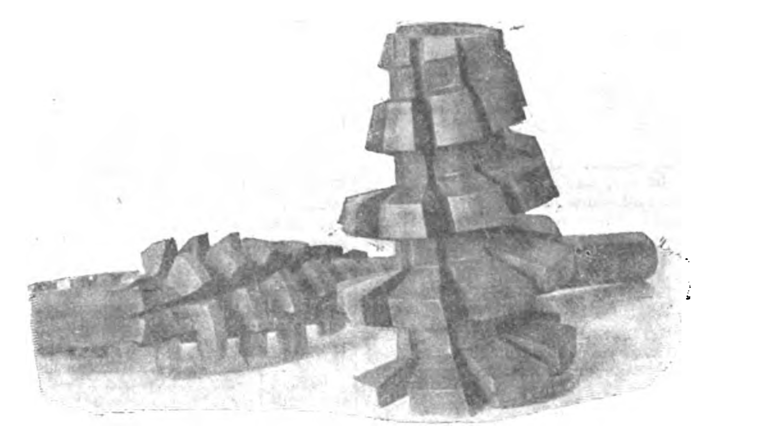
[96471.]—**Loan Amortisation.**—I regret that at lines 31 and 32 of my reply (p. 118) are errors of computation. "The equal annual repayments for 44 years for a loan of £1,000 at 4½ per cent. there stated to be £59 6s.—viz., £45 for interest, and the surplus £14 6s. to be reinvested to replace capital" should read respectively "£52 11s. 7d.—viz., £45 for interest, and £7 11s. 7d. to be reinvested at same rate of interest to replace capital." There is an error also in my estimate of the rate of percentage in the building society transaction. "Garsdale" in the next answer gives a correct reply to this part of the question. A. H.

[96488.]—**Pitch of Worm.**—A very neat and efficient method of measuring the pitch of screws and worms, as described by "H." in the issue of 8th, is to place them on the scale in the sun in such a manner as to get a clearly-defined shadow of the threading on the graduation. JERSEY.

[96504.]—**Macadam.**—This query seems to have been unnoticed, and probably those who are responsible for what are called macadam roads are in sublime ignorance of what is wanted. A macadam road, properly made (that is the point), is as good a road as can be desired; but where do you find one properly made? Macadam gave his directions as plainly as possible; but, strange to say, those directions are just what modern roadmakers will not follow—they know better, and they make more work. J. L. Macadam stated distinctly and expressly that the broken stone, whether flint, granite, whinstone, or what, should not be in larger pieces than would weigh 6oz., and pieces of one to two ounces are to be preferred; but our modern roadmakers use pieces weighing a pound and more, and doubtless consider they are improving on Macadam. Result: Mud and muddle. There is no better road than a well-made "Macadam." S. R.

[96555.]—**Equations.**—I am obliged to Mr. Burgess for his reply to the above; but his method of solving is not satisfactory, as he assumes the value of x, which has to be found. I had previously obtained the same roots by assuming them to be in arithmetical progression. But these are not mathematical methods of solution, and as all writers agree that, given the same number of equations as the unknown, a solution can be found without any guesswork, thus this problem ought not to be any exception to the rule. Perhaps Mr. "C. J. M.," or "Scorpio," or Mr. J. S. Vincent would favour the writer with a reply. Most of the devices given in the books on "Theory of Equations" and "Higher Algebra" have failed to obtain a solution of this problem. J. HARDING.

[96602.]—**Cutting a Worm-Wheel.**—Yes; in the first place, the shape of the hob is wrong. Your pattern commences cutting at the point of the worm, whereas it should commence at the root. Taper the hob off as per the sketch (borrowed from



Reinecker's Catalogue) and commence cutting with the smallest diameter of the worm, gradually traversing towards the largest end. As the cutter has to rotate the wheel, the teeth seldom come out as desired, and I would advise you to divide the wheel into 50 parts. This can easily be done with a change-wheel. Now with a narrow cross-cut chisel chip 50 spaces out, slightly at an angle. You have got 50 teeth, and none of the playfulness of the hob will give you more or less, so you can proceed with the hobbing with success. CLYTIE.

[96600.]—**Astronomical Signs.**—In reply to the question, "Where the Signs of the Zodiac Originated?" it seems that some time between the Flood in 1656 A M. and the Confusion of Tongues in 1771, the heavens were arranged into constellations. We find this to be so by the constellations then on the Equinoxes. Again, all the constellations are in the North, and none in the South. This fact shows that the persons who arranged them lived in, or not far from, Babylonia. We are, indeed, told by great Jewish writers that the constellations were mapped out by Noah soon after the Deluge. But if F. C. Lambert writes to Observatory House, Wanstead, E., he will get a lot of information about the Zodiac. All the eclipses wheel round it like the hands of a clock, for which reason it is a dial-plate of all time.

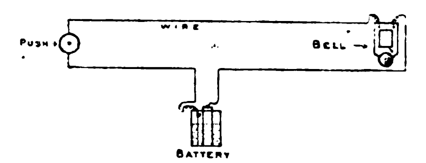
MEMBER OF BRITISH CHRONOLOGICAL AND ASTRONOMICAL ASSOCIATION.

[96604.]—**Transformer.**—No; not by a transformer in the ordinary sense of the word. To transform a continuous current to higher or lower potential a "motor-generator" is necessary—i.e., a machine similar to a dynamo, but with two separate windings to the armature, and two commutators, one being fed as a motor, and the other delivering current as a dynamo. The amount of transformation effected in the voltage depends on the proportioning of the two armature windings. A No. 4 Lahmeyer dynamo could be adapted for this purpose, and I can give "E. A. W." particulars on receipt of his address. But why not accomplish the desired object by charging accumulators in parallel, and then rearranging in series?

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96604.]—**Transformer.**—You cannot use what is commonly called a transformer, it being only operative with alternating currents; but you could use a Booster, which is simply a motor and dynamo combined, the armature being wound with two sets of wires—the one heavy, to take the large current of the dynamo and cause the motor to rotate; the second finer, and generating a current at an increased voltage through the rotation of the armature. There is very considerable loss in the double transformer, quite 30 to 40 per cent. You would probably get a better result by winding a spare armature to give the required voltage, and inserting a corresponding resistance in the shunt circuit. So altered, the dynamo should light five 16c.p. lamps. W. J. G. F.

[96606.]—**Defective Battery.**—First soak the porous pot in water for about two hours, then



dissolve 4oz. of salammoniac in 1 pint of cold water, and fill glass jar to within 2in. of top, and your battery will be ready for use. If you connect it up as per sketch, you will find it work all right; but for practical work you will want two batteries. S. ELLIMAN.

[96614.]—**Charging Pocket Accumulator with Small Dynamo.**—Dynamos with Siemens H armatures will not charge accumulators; but an armature of the tripolar type could easily be substituted at a small cost, and the machine would then do all that you require.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96614.]—**Charging Pocket Accumulator.**—If the dynamo is shunt-wound, it is possible to charge the accumulator, but very difficult. The commutator slit must be quite parallel to the axis and abnormally wide; so that the brush will be quite clear of the one segment before making contact with the other: otherwise the cell will be short-

circuited every half-revolution, and no charging will result. W. J. G. F.

[96618.]—**Reducing Temperature.**—Put in an electric fan. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96619.]—**Electric Organ.**—I am interested in "Diapason's" remarks as to the balancing of harmonium and organ reeds with organ-pipes. As an amateur I never could quite understand why this cannot be done. Reeds form some of the most beautiful stops in most organs, though they are not very often found in chamber-organs. Is it to be inferred that the particular construction employed tends to harmoniously reduce the errors due to temperature, or are such errors tolerated but corrected by more frequent tunings? I have experimented a little in this direction, using the 16ft. reeds "Bourdon" in a very old and fine-toned French harmonium, and these have a very mellow and rich tone, and blend well. I raised the wind-pressure and revoiced them, thereby getting rid of the drone peculiar to heavy harmonium reeds, and causing them to speak up crisply. So far I have been encouraged, and I am now on with the 8ft., and have put in two stops on vacuum which are bright and mellow. Unless "J. S. Z." is a practical electrician, I advise him to let electrical actions alone; when used, they must be well made, the magnet cores annealed and carefully wound with paraffined wire, and the contacts so made as to be unaffected by corrosion or oxidation due to sparking. Some day currents of greater certainty and volume than those obtainable from any battery may be had from the street mains, and then direct electrical actions will be possible. I have tried this form upon small pipes, and they work promptly enough—so much so that I doubt if motors could be used for part of the action with it, as their inertia causes them to lag. If "J. S. Z." couples up his instrument, let him still keep it independent, and if it can be done, use tubular pneumatic action. This can be readily made by a careful amateur. He could then play his organ from its own, or the American organ manual, and that without injuring either. ELECTRICIAN.

[96621.]—**Warts.**—Ask your chemist for some "Liquor sodii ethylatis." It should be freshly made, as it does not keep good many weeks. It destroys anything in the way of warts or growths, such as moles standing above the skin. Paint the wart carefully, and it will probably come off next day. If not, repeat the application. GLATTON.

[96623.]—**Steamer.**—The *Empress Queen* was built by the Fairfield Company in 1897 for the Isle of Man Steam Packet Co. Her gross tonnage is 2,140 tons. She is fitted with compound engines, developing about 10,000I.H.P. Her registered dimensions are:—length 360ft., breadth 42·3ft., and depth 17ft.; length over all 375ft., breadth across paddle-boxes 83½ft., moulded depth to spar deck 25½ft. She has four decks—viz., spar deck, main deck, lower deck, and 8ft. above the spar deck is a promenade deck 210ft. long, which reaches from fore-end of boiler room to the aft-end of first-class cabin. In the first-class dining saloon on lower deck there is accommodation for 124 passengers; besides this saloon, there are cabins, fitted with sofas, a social hall on main deck, and a ladies' first-class saloon. The second-class accommodation is situated at the forward-end of the vessel, and consists of a dining saloon on lower deck; also a pantry, bar, and a little further forward a ladies' second-class dining saloon. On the spar deck are several private berths, cabins, and deck-houses; also a cloak-room and smoking-room and bar combined. The vessel is fitted with electric light, and has two navigating bridges, one forward and one across paddle-boxes. Her engines are of the compound diagonal surface condensing type, having three cylinders, the h.p. one in the middle, with a l.p. on each side of it. The h.p. cylinder is 68in. in diameter, and the l.p., each 92in. stroke, 84in., pressure 140lb. In her speed trials she made 21¾ knots in a heavy sea. She now runs from Liverpool to Douglas in from 3½ to 4 hours. For further information, with plans of steamer, "A. G." should refer to the *Engineer*, Sept. 3, 1897.
RED ADMIRAL.

[96627.] — **Foreign Currency.** — Inquire of Effingham Wilson and Co., Royal Exchange, E.C., for his shilling work on "Chain Rule."
REGENT'S PARK.

[96629.]—**Linoleum Polish.**—A good general varnish may be made thus:—Waterproof, pale shellac 5oz., borax 1oz., water 1 pint. Digest at nearly the boiling point until dissolved, then strain. Or, sandarach 6oz., elemi (genuine) 4oz., anime 1oz., camphor ½oz., rectified spirit 1 quart. When dissolved strain through muslin into bottle for use and allow to settle; heat (water bath if possible) to be applied if wanted. REGENT'S PARK.

[96629.]—**Linoleum Polish.**—(1) Try wiping over with milk, or (2) beeswax and turpentine put on thinly, and well rubbed off. PHILOS.

[96630.]—**50-volt Overtype Dynamo.** — Armature: cogged drum, 4in. diameter by 8in. long, 16 or more teeth, wound with 5lb. No. 16 S.W.G. Field-magnets, 8in. deep by 2in. thick by 4in. clear winding space on each limb, wound with 20lb. No. 19 S.W.G., speed about 2,200 revs., shunt wound and suitable for arc as well as incandescent lighting. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96631.]—**Eight Queens Problem.**—Here are four solutions, and "Q. R." may like to exercise his ingenuity in discovering some of the other "number of ways." 1. Queens at K sq., K R 2, Q 3, Q R 4, K Kt 5, Q Kt 6, K B 7, and Q B 8. 2. Queens at Q Kt sq., K 2, K Kt 3, Q R 4, Q B 5, K R 6, K B 7, and Q 8. 3. Queens at K B sq., Q B 2, K Kt 3, Q Kt 4, K R 5, K 6, Q R 7, and Q 8. 4. Queens at K sq., Q B 2, Q R 3, K B 4, K R 5, Q Kt 6, Q 7, and K Kt 8.
W. F. WEBB.

[96631.]—**The Eight Queens Problem.**—I cannot see anything vague in this problem, for it is evident that by "pieces" you can use blocks of wood to represent the eight queens, or eight pawns might be used. I send one solution:—

Place a pawn on Q B square
the 2nd „ K 2
3rd „ K Kt 3
4th „ Q R 4
5th „ Q 5
6th „ Q Kt 6
7th „ K R 7
8th „ K B 8

and you will find that no piece can take any other piece by the queen's move. A. TUPMAN.

[96631.]—**Eight Queens Problem.**—This problem, as your querist surmises, is to place eight queens (or pieces having the power of a queen) on a chess board so that neither one can take the other. He will find it an interesting problem to solve, and not so difficult as it appears. There are, I believe, nearly one hundred ways of placing them, but the few I have appended will suffice to prove its possibility—

4 .. 10 .. 24 .. 29 .. 39 .. 41 .. 51 .. 62
7 .. 9 .. 19 .. 32 .. 38 .. 44 .. 50 .. 61
1 .. 14 .. 24 .. 27 .. 39 .. 44 .. 50 .. 61
1 .. 15 .. 21 .. 32 .. 34 .. 44 .. 54 .. 59
2 .. 12 .. 22 .. 32 .. 35 .. 41 .. 55 .. 61

CHARLES BUCKNELL.
258, St. Paul's-road, Highbury, N.

[96632.]—**Motor Batteries.**—TO MR. BOTTONE.—(1) Yes, provided sufficient zinc be added to thoroughly neutralise the acid. But chloride of zinc can be obtained very cheaply in bulk from any manufacturing chemist. (2) Having procured the zinc cylinder with a bottom to it, put a piece of cork, about ½in. thick, across the bottom for the carbon rod to rest on, so as to prevent actual contact with the zinc. Now make a canvas sack of half the diameter of cylinder, and having placed the carbon rod in this, pack it tightly with a mixture of 40 parts by weight of granular black oxide of manganese, 5 parts of colcothar or rouge, 5 parts potassium permanganate, and 50 parts of coarsely-crushed graphite. Now stand this upright in the zinc pot, and ram round tightly sufficient sawdust, previously soaked in the salammoniac and zinc-chloride solution recommended last week, to fill up to within ½in. of top. Pour in the same solution into the sack until the contents will take up no more. Pour off the superfluity, dry carefully round the edges of the zinc, and seal up with melted pitch. When quite cold, with a red-hot knitting-needle make a vent-hole, reaching through the pitch to the mixture below. Solder connecting-wire on zinc. The carbon should, of course, have a terminal affixed to it before placing in sack. (3) The canvas requires no special preparation. (4) The zinc must not be amalgamated. (5) Because unless vent-holes are left, the gases given off during the action of the battery, finding no escape, lift up the pitch bodily. S. BOTTONE.

[96633.]—**Green Water.**—Perhaps your best plan will be to keep a few water-snails (Planorbis) in your bath. S. BOTTONE.

[96634.]—**Injector.**—No injector will work with hot water. The action of an injector is partly dependent upon the sudden condensation of the steam by the inflowing water. If the water is too warm to effect this properly, the injector will fail to act. W. J. G. F.

[96635.]—**Solder.**—Malleable solder: Copper 72, zinc 18, tin 4. Readily fusible Argentan solder: Copper 35, zinc 57, nickel 8; or, copper 38, zinc 50, nickel 12. REGENT'S PARK.

[96636.]—**Accumulator.**—Cut three plates out of sheet lead, about ⅛in. thick, 3½in. by 1½in., with a short lug at one corner for connections. Punch each plate full of holes about ⅛in. in diameter, and afterwards countersink all the holes on both sides with an ordinary joiner's brace and countersink-bit. Take two parts of water, and into the water pour slowly, and with constant stirring, one part of strong sulphuric acid. Take as much red lead as will serve to paste one of the plates, and make it into a stiff paste with the sulphuric acid and water. Lay the plate on a flat surface, and work the paste well into the holes, first from one side and then from the other, with a flat piece of wood, and afterwards smooth off the superfluous paste. Allow the paste to harden for twelve hours, and then immerse the plate in a strong solution of bleaching powder till the paste has turned a dark chocolate colour. The positive plate is now ready. For the two negative plates make up a strong solution of lead acetate, and in it hang several pieces of zinc by threads. In some hours the zinc will have dissolved, and the lead will have been thrown down from the solution in the form of fine crystals. Paste the two negative plates with this. Bend two short lengths of fine glass tubing into the shape of a long U, and having washed the positive plate quite free from chloride of lime in a gentle stream of water, slip the two pieces of tubing over it, and then place a negative plate on each side, and join their lugs together by soldering. Vulcanite makes the best containing cell for so small an accumulator. Fill the cell with a mixture of two parts of water to one of sulphuric acid. The three plates will give about 2½ to 3 ampère-hours at 2 volts. W. J. G. F.

[96636.] — **Accumulator.**—"Mousetrap" will find all the necessary information in "Small Accumulators," published by Dawbarn and Ward, 6, Farringdon-avenue, E.C., price 7d. Instructions have been given, too, times without number in back volumes. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96638.] — **Electric Lamplighter.** — TO MR. BOTTONE.—Procure two good dry cells, size about 6in. by 2½in. diam.; connect these up in series with a little push, as used in ordinary bell-work. Arrange in connection with these two stout copper wires, not touching, but bridged across, just over the wick of the spirit lamp, with about ¼in. of No. 36 platinum wire. On pressing the push, the platinum wire will become incandescent, and light the spirit-lamp. The addition of a little benzine to the spirit makes this result more certain. If ¼in. of platinum wire fuses with the current (as it will sometimes do if the batteries are very strong), use ⅜in. Ordinary soft iron wire, No. 22 gauge, runs about 15ft. to the ohm. S. BOTTONE.

[96640.] — **Silver-Plating — Sand-Bag.** — TO MR. BOTTONE.—Take 2oz. of nitrate of silver and dissolve it in half-gallon of distilled water. Now dissolve 2oz. of cyanide of potassium in two quarts of water. Add this latter to the former very gradually, and little by little, as long as farther addition produces a precipitate, but no more. The supernatant liquid clears when this point has been reached. Allow the cyanide of silver to settle, then cautiously decant the clear solution, which is of no use. Now add to the precipitate (which is silver cyanide) sufficient solution of cyanide of potassium, made up as before, 2oz. to the 2 quarts of water, to entirely redissolve the white precipitate of silver cyanide. Lastly, add sufficient water to make up one gallon. For further information, consult Bonney's "Electroplater's Handbook," pp. 115 *et seq.* (2) I know nothing about sand-bags. Perhaps my wife may, if you will kindly specify what kind of sand-bags. S. BOTTONE.

[96642.]—**Irritation.**—Have you tried camphorated oil? This is generally efficacious. Use it only when the pruritus is felt. The application of gall and opium ointment is often very beneficial.
S. BOTTONE.

[96642.]—**Irritation.**—Throw away all ointments, &c. Wash the part daily with soap, and dry carefully. JERSEY.

[96642.]—**Irritation.**—Has J. Hope tried boracic ointment? If not, let him do so. Anoint and well rub in to parts affected before dressing in the morning, and again on going to bed. If not in possession of silk drawers, have a piece of white silk sewn in the fork of those he has, to reduce friction, and if he wears blue serge trousers leave them off till quite cured. Of course, extreme cleanliness is a *sine quâ non.* DESMOND.

[96643.]—**Relief Stamping.**—When counterpart is made, mix colour (on slab, using best pale paper-varnish) to the substance of thin gum, take die out of press, brush colour well into it, exchange into right hand face downwards, wipe off colour on to printing-paper (about a quire of rather rough quarto) on to bench. Do it systematically, so that paper is not wasted. Colour taken off surface, but left in engraved work. Place die in press, insert paper, bring down lever with a sharp blow. If colour on slab and brush get dry, a few drops of turps soon moisten. To keep brushes moist, wrap them in paper after use, to keep air from them. To make impression shine, mix colour a day or two before use, and use no turps. Never let the colour remain on slab, as it dries up. Keep in small gallipots, covered. REGENT'S PARK.

[96645.]—**Arc Lamp.**—TO MR. BOTTONE.—It would take too much space here to illustrate and explain what you require. I may say that no choke coil would be needed. If you care to write to me,

I shall be pleased to lend you a dimensioned sketch of one of the best types of hand-fed arc lamps.
S. BOTTONE.

[96647.] — **Knife - Handle Cement.** — The handles of knives are not meant to be put into boiling water, and I do not think you are likely to find any better cement than the ordinary one; but you might try sulphur, with some brickdust mixed with it.
PHILOS.

[96647.]—**Knife-Handle Cement.**—Mr. Cole evidently knows something when he asks how to fix metal handles to blades of table-knives. I do not know, but I suggest that probably (possibly) plaster of Paris mixed with a solution of alum may be found efficient, or melted alum itself; but that is not easily done. I think the plaster mixed with a solution of alum will do; but possibly waterglass may be better. Good plaster of Paris (such as is used by the makers of casts) seems to "bite" into anything, and the temperature of moulding should not affect the blades; but it is a tedious operation, as the plaster must be mixed frequently. I should try the plaster mixed with alum-water or a decoction of marsh-mallow roots.
M. T.

[96649.]—**Battery for One Light.**—As the candle-power of the "one light" is not specified, it is a little difficult to advise. But supposing it to be a 2-volt battery lamp of about 1c.p., then the most convenient battery is, perhaps, the National dry cell, and it is certainly cheaper to buy these than to make. Two cells will be necessary, and some No. 20 wire.
A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96649.]—**Battery for One Light.**—Procure an incandescent lamp of the candle-power you require, and of as low a voltage as possible, remembering that every 2 volts means 1 cell of battery, as described below. A convenient voltage is an 8-volt 3-candle-power lamp. For every 2 volts marked on your lamp, you must make up one cell as follows: One zinc plate 6in. by 3in. by $\frac{3}{16}$in., sandwiched between two carbon plates 6in. by $3\frac{1}{4}$in. by $\frac{1}{4}$in., separated above by a strip of ebonite $\frac{1}{4}$in. thick. The outer carbons must be electrically connected by a strip of copper. Attach a terminal to the zinc, and one to the copper strip connecting the carbons. The plates can be clamped together above by binding round with twine boiled in paraffin wax. The sandwich is to be placed upright in a Weston salt-jar, or similar size about 6in. high by 4in. diameter. Connect the required number of cells in series—*id est*, the zinc of the first to the carbon of the second, and so on; and then the first carbon and last zinc to the lamp by No. 16 copper wire. Fill the cells with the following solution:—Water, 1 pint; chromic acid, 3oz.; oil of vitriol, 3oz.
S. BOTTONE.

[96649.]—**Battery for One Light.**—Your query is somewhat vague, as you do not state the voltage of your lamp, which may be anything from two volts upwards. Small lamps can certainly be lit by means of a dry or wet battery; but in the former case the light could only be used at intervals, such as seeing the time at night, &c., as dry batteries soon run down, and do not give a continuous current. A very useful battery suitable for your purpose would be the double-fluid chromic-acid cell. This can be made up as follows:—Procure a large jam-jar, and stand in its centre a porous pot, about 6in. by 3in., into which place a zinc rod (like that used for a Leclanché cell). Now surround the porous pot with the largest carbon plates obtainable, and connect them all by a stout copper wire. Charge the porous pot with sulphuric acid, 1 part to 20 of water, and the carbon compartment with chromic acid 3 parts, water 30 parts, sulphuric acid 3 parts. Such a cell should give about two volts, and three connected in series will light a 5-volt lamp well for about eight to ten hours.
VICTOR E. ARMSTRONG.

[96652.]—**Calcite.**—I am not aware that this particular form of spar is found anywhere else than at the place "Fleur-de-Lys" mentions. $CaCO_3$ also crystallises in rhombic form as "arragonite"; thus it is dimorphous.
B.Sc.

[96656.]—**Bookbinding.**—I have for some few years made a hobby of bookbinding, and consider that the best books upon the subject are the ENGLISH MECHANIC, Vols. LI., LII., and LIII., and "Bookbinding for Amateurs," by W. Crane, published by Gill, 170, Strand, at half a crown. By the careful study of these and a large amount of practice you should be able to turn out very good work. I have found that all the tools absolutely necessary are a sewing press, a laying press and plough, some pressing, cutting, and backing boards, a lettering stove and letters, gold knife and cushion, backing hammer, shoemaker's knife, and a paste-brush and a glue-brush. The most difficult work I have found is the proper cutting of the edges, but with a plough knife properly adjusted you can make a much better job than by any other process. You will see many other ideas for cutting in the volumes of "Ours" above mentioned.
BLUE BEAR.

[96656.]—**Bookbinding.**—Before going in for a press and plough I used to cut edges by pressing straight edge on top of book, and cutting gradually through with a shoemaker's knife kept very sharp. With care a very good job can be made this way. You will find that the use of glasspaper will remove any little roughness that remains after the cutting.
BLUE BEAR.

[96658.]—**Rheumatism.**—If "Finem Respice" has the courage to adhere to the following for a few weeks, he and rheumatism will henceforth be strangers. Let him take a teaspoonful of *kerosine* oil in a wineglassful of water every *other* night, and he or any other person suffering from rheumatism will shortly be free from its pains. It produces no unpleasant symptoms, no loss of appetite, and no effect on the bowels or kidneys. The principal objection is its nauseous taste and smell, but a pinch of salt being put in the mouth and allowed to dissolve and the oil then swallowed will make it less unpalatable.
DESMOND.

[96662.]—**Thunderstorm.**—Faraday, it is said, once attempted to kill a rat by electricity, but failed to do so as long as the skin of the animal was drenched with water. From this it was probably concluded that the safest condition during a thunderstorm was to be thoroughly wet through, a conclusion perhaps not to be taken too seriously. The destructive effects of thunderstorms have indeed never been systematically observed and tabulated, and, although there are numerous accounts of accidents due to lightning, it is not always possible to compare these accounts with one another. But by noticing which trees are most frequently struck by lightning it is possible to learn much concerning the behaviour of atmospheric electricity, and there are reasons for believing that the quality of the soil as regards its mineral constituents largely regulates the destructive effects of lightning. Few observations, however, of "lightning strokes" have much to say concerning the quality of the ground over which any given storm was operating, and it is possible that further information on this part of the subject would do much to explain many of the accidents which occur to animals and trees during violent thunderstorms.
NERPS.

[96662.]—**Thunderstorm.**—It is not the case that a person is in less danger of being struck by lightning when wet than when dry; but it is the case that the danger of being struck is very much mimimised during rain. The air full of rain offers a ready path to the flash, which therefore strikes more or less straight to earth. Dry air, on the other hand, offers great resistance to the passage of the flash, and in following out the line of least resistance the flash may cover quite a wide area before reaching earth. In the case of the man mentioned it was the tree which attracted the lightning. If a tree and a man are at a short distance from one another, the tree being the higher is more likely to be struck; but a man or beast out on flat ground is more likely to be struck than the ground for a little distance round them.
W. J. G. F.

[96662.]—**Thunderstorm**—Cattle in a herd are very liable to be struck by lightning even when wet through, because the body of vapour arising from them increases the conducting power of the air above them. On the other hand, a man is much safer when drenched to the skin. Dr. Franklin was unable to destroy a wet rat with electricity, although he could a dry one. The reason it is risky to stand under a tree is that the discharge between the cloud and the tree may divide, part passing into the better-conducting, dry human body.
B.Sc.

[96663.]—**Wimshurst.**—To MR. BOTTONE.—It is evident from your description that the glass tubes carry the upright conductors. These tubes are really unnecessary, unless you are passing the rods through a glass case; and even then stout ebonite is better. The cause of the discharge across from outside of jars and along the neutralising rods, which must not be insulated, is simply because as the jars are not metallically connected together, as they should be for long sparks, and as they are nearer the neutralising rods than is the limit of their sparking distance, they discharge across to them. Polish your bolts carefully with rouge and chamois, until they reflect like mirrors. Varnish your jars, glass tubes, &c., with good, thick shellac varnish, and allow to dry thoroughly in a warm place. Connect your four jars below by a brass strip, and you will find you will easily get a 7in. or 8in. spark.
S. BOTTONE.

[96665.]—**Coal and Electricity.**—It would be quite feasible for you to generate electricity at the station and transform it into power by motors at your works, and we have no doubt you would effect a considerable saving thereby. You do not give sufficient particulars to enable us to say what the saving would be; but assuming you use 5lb. of coal per I.H.P. hour (a very moderate estimate), you would be using about 1,600 tons per annum (if working 10 hours per day and $5\frac{1}{2}$ days per week), which, at 3s. 4d. per ton cartage, is £266 per annum, equal at 4 per cent. to a capital of £6,700. The cost of two constant-current 500-volt generators of 100 to 125B.H.P. each would be from £800 to £850. You would require eight miles of cable carrying 200 ampères, which would cost £165 per mile = £1,320, and four miles of cable to carry, say, 50 ampères at £60 per mile = £240, and 100 wood poles and fixing, say, another £100. Then the cost of seven 35B.H.P. motors would be about £120 each = £840, totalling £3,350, which at 4 per cent. would be £134 per annum. There must be added to this, however, the cost of moving and re-erecting your engine and boiler at the station. Depreciation would not be more, if so much, as your present system; and as the capital charge would not be increased if your works were running day and night, the cartage on another 1,600 tons of coals for night duty would be entirely saved, so that by working daytime only a saving of £130 per annum would be effected; but if working day and night, a saving of cartage on a total of 3,200 tons of coal = £400 per annum would be effected. These figures are based on the assumption of working at a voltage of 500 and on the three-wire system. This pressure is what is generally used by the electric tram systems, and although not so economical in cables as a higher voltage (1,000-volt generators would only require about half the size cables), yet there is more risk of breakdown, more loss through leakage, and more personal danger than by the lower voltage. We should be glad to give H. Jay any further particulars and information.
WEBSTER MICHELSON AND CO.,
Dudley. Electrical Engineers.

[96665.]—**Coal and Electricity.**—Anything like a satisfactory reply to this query would occupy far too great space. If H. Jay cares to write to me, I will be very pleased to look out the pros and cons. of the question for him.
Moffat. W. J. G. FORMAN, C.E.

[96665.]—**Coal and Electricity.**—The data are hardly sufficient for any definite reply to be given. Some kind of idea might be put forward; but being based upon such insufficient particulars, it could only be misleading. If H. Gay will advertise his address, I will put myself into communication with him, and go into the matter thoroughly.
PHILOS.

[96669.]—**Mercury's Mass.**—The mass of any planet without a satellite can be determined in terms of the sun's mass by means of the perturbations it produces on the orbits of other planets. The amount of these perturbations is always proportional to the disturbing force, and this again is proportional to the mass of the disturbing planet. In this manner the mass of Venus has been found to be about 1-400,000th of the sun's mass and that of Mercury about 1-5,000,000.
Llanrwst, North Wales. J. C. M.

[96669.]—**Mercury's Mass.**—Taking the mass of the earth at 100, that of mercury is 7.
B.Sc.

[96670.]—**Spring Motors.**—Purchase an old Morse train. These can be often seen on coster's barrows in the Farringdon-road. They may generally be depended on for even speed, and can be had for a few shillings.
ELECTRICIAN.

[96674.]—**Model Dynamo.**—To MR. BOTTONE.—Premising that a dynamo with H armature can be by no means called a "standard type dynamo," the following data will enable you to wind your castings so as to get 20 volts at 3,500 to 4,000 revs. per minute. Wind the armature with 5oz. No. 22 d.c.c., and the field-magnets with $2\frac{1}{4}$lb. wire of the same gauge connected up in shunt. (2) The best form of armature for accumulator charging is certainly a many-sectioned drum. The most convenient and the one giving the most satisfactory results in such small machines as you describe is a laminated tripolar.
S. BOTTONE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

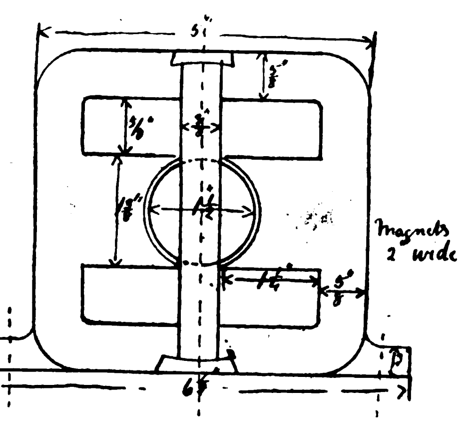
THE electrical energy required to produce a ton of calcium carbide is 4,260 kilowatt hours; or, in other words, a kilowatt will produce about $12\frac{1}{4}$lb. of the carbide in twenty-four hours.

QUERIES.

[96677.]—**Voltage.**—In magnetising a rod of iron, should be grateful to know what size copper-wire will be most convenient or most proper to use? Will the current from a dynamo do, or must cells be used? What would be the best dynamo to use, one giving a great amount of voltage or ampèreage? What is wanted is a high degree of magnetism in large iron rod.—Ivanhoe.

[96678.]—**Spark Coil.**—I have commenced to build a spark coil whose core is 11in. long, ⅞in. diameter, wound with two layers No. 18 wire, saturated with paraffin wax, and inclosed in ebonite tube ⅛in. thick. The secondary is of No. 36 silk-covered wire wound sectionally, each section being ⅛in. bare in thickness, so that when all wound there will be about 40 sections on tube. I am making the secondary slightly barrel-shaped, also leaving greater space at ends of coil between sections and tube than in middle. I have already wound and properly connected up nine sections (containing altogether 1lb. wire) at one end of coil; but on testing with current from eight bichromates (each exposing a negative surface 3in. by 4in.), the spark produced was barely $^1/_{32}$in. The condenser (already made) has 120 tinfoil sheets 6in. by 5in., but I did not put it in circuit when testing. Now what I want enlightenment about is this: Seeing that the secondary already wound is over one-fifth of what the whole will amount to, should I not now obtain a better spark than $^1/_{32}$in.? I may mention that there is no break in the nine sections wound, and that all is thoroughly insulated with paraffin-wax. But supposing that a better result cannot be expected at this stage, what spark (approximately) may I look for when all 40 sections are wound (when the total weight of wire will be about 6lb.) and condenser in circuit, using same battery power? What should be the ratio of increase in length of spark for each added section?—Wm. Hy. Bell.

[96679.]—**Dynamo.**—To Mr. Avery.—I am making one of your Lahmeyer dynamos as per sketch. Could I wind it to give an output of 10 volts at 10 amps. 100



watts either in compound, shunt, or series? If so, please give me size and quantity of wire. I want to keep carcase as small as possible. If any enlargement, please state. Would a ¼H.P. engine drive it with constant steam-pressure?—Dudley.

[96680.]—**Temperature.**—Would some reader kindly inform me of a cheap and effective means of reducing the temperature in a chamber 15ft. square by 8° or 10°?—N.

[96681.]—**Boilers Fitted with Projecting Studs.**—Can any correspondent kindly inform me in what respects Fletcher's method of using studs projecting from boilers differs from that formerly used by G. Wye Williams? Has either been applied to the bottoms of ovens or kitchen ranges to increase the heating power?—Stud.

[96682.]—**Nibbling Machine.**—Will someone give a drawing of a nibbling machine of 1H.P., and say how to drive it from an electric cable?—T. G. W.

[96683.]—**Cycle-Motors.**—Would "Monty" or "The Writer of the Articles" kindly tell me what he thinks of the "Endurance" tricycle-motor? I purchased a set of castings about eight months ago, and have not yet had time to start on them. They seem a good bit different to the one described in "E.M." The cylinder is 3 by 4, and is only supposed to be 1½H.P. How is this?—it is a bigger motor and less power. Would you suggest any alterations before I start? Also, by doing so, should I increase the power. Also, is their vaporiser all right, or would it be best to fit one as described in the articles? I should be very pleased for a reply, as I have heard no report on them or anyone's opinion, and don't want to waste my time and money on something which I should in the end be disappointed with, which a little tip at the beginning might have altered.—Lanky.

[96684.]—**Telescopes.**—I was much struck with Mr. Clarke's letter (No. 42784) *re* his corrector. I have myself been experimenting in this way lately; but hitherto without much success. Would some reader "in the know"—might I venture to ask our good friend "F.R.A.S."?—kindly comment on this method, and also say whether it would be possible to use smaller lenses than W. Clarke's, say 1in. or 2in. diameter, at a greater distance from o.g., supposing diameter of the latter to be 5in., and its focal length 72in.? What would have to be their distances from the o.g. for achromatism, and what the distance between them for correcting spherical aberration?—A Beginner.

[96685.]—**Motor-Cycles.**—Will "The Writer of the Articles" kindly say—(1) Would not hard gunmetal do equally as well as steel for the bushes of the connecting-rod? (2) Will cast-iron lathe change-wheels with uncut teeth answer instead of the cut gearing?—Motormad.

[96686.]—**Motor-Cycles.**—Will "The Writer of the Articles" or "Monty" please state the objections to injecting or rather pumping the petrol directly into the engine cylinder? Would this not do away with a great deal of the space and also weight now taken up with a carburettor?—Wm. F. Rigby.

[96687.]—**Black Straw-Hat Polish.**—Will any reader be kind enough to supply writer with particulars how to make black straw hat polish?—Milliner.

[96688.]—**Oil-Engine.**—I have an oil-engine, using common petroleum. The diameter of cylinder is 4in., length of stroke is 8in., and the power is said to be 1B.H.P. I would like to get an increase of power. "Monty," at p. 96 (96566) of your last issue, advises "trike" owners to use electric ignition, and the gain in power would be 25 per cent. Might I expect the same increase in my case if I were to substitute electric ignition for the lamp now used? And if, instead of using petroleum, I were to use petrol, would the power of my engine increase? If not, how is it that the motor-cycle now being described in the "E M." is 1¾H.P., the dimensions of cylinder being only 2⅝in. diam. by 3⅛in. stroke?—Bivalve.

[96689.]—**Cooling.**—Will some correspondent kindly inform me what the temperature of air would be when expanded from 360 to 33 atmospheres, and from a temperature of − 50° C., the air to do work in a cylinder during expansion?—F. P.

[96690.]—**Dynamo.**—I have the castings of a dynamo of the Lahmeyer type and I require 65 volts. Dimensions: Core of magnets 1⅞in. high, 3in. wide, 1¼in. long; armature diam. 2⅛in., 3½in. long. Would Mr. Bottone greatly oblige by informing me what quantity and size of wire (in mm.) I would require to wind the armature in coils, and how many ampères I may expect?—Sala.

[96691.]—**Acetylene Gas.**—I am desirous of illuminating my premises and shop with acetylene gas. All the price lists which I have from the different firms seem to speak very highly of it, not only with regard to the clean light for shops and for its brilliancy, but also the saving in expense, for the makers claim that the gas can be made for 2s. 6d. per 1,000ft., whereas the coal-gas in this town is 3s. 9d. per 1,000ft. As you can see, we have coal-gas in this town, but it is not satisfactory unless mantles are used, which soon seem to diminish in illuminating power, as well as requiring a lot of attention. I am rather dubious of trying the experiment, for the reason I cannot understand why acetylene is not in more general use than it seems to be if it has all the advantages claimed for it. Should you advise the use of acetylene where coal-gas is laid on in the town?—Percy Wadham, Newport, I. of W.

[96692.]—**Liquid Nitrogen.**—Suppose some liquid nitrogen were placed in a vessel, and sealed down so that it could not expand, its temperature being − 146° C. The temperature is now raised to, say, − 136° C. What would be the pressure exerted, as it would now be 10° above its critical temperature, and, therefore, must be in gaseous state?—Pressure.

[96693.]—**Colouring White Metal.**—I shall be much obliged if a reader would say which would be the best way to colour white metal sheet—red, black and blue, or yellow. Wanted to stand the weather and bear knocking about without losing colour. A way to colour without enamelling will oblige.—G. S. Wade.

[96694.]—**Circular Saw.**—Could any kind reader inform me the cheapest way to fix up a bit of machinery for a donkey to work to drive a circular saw at a high speed to cut deals.—R. T.

[96695.]—**Dipleidoscope.**—Is it possible to obtain true time with a dipleidoscope? I cannot undertake siderial observations, but should like to be able to get the time with some such instrument.—Tempus.

[96696.]—**Cycle-Motor—Spring Tempering.**—Will some kind reader of "ours" who have had experience in such matters explain to us what kind of motor is the best, and most light and compact for attaching to drive a safety bicycle? The power of motor need not be more than about $^1/_{20}$H.P. or so—i.e., sufficient to drive the machine on the level, and to assist one when pedalling uphill. Would it be practicable to fit up an electro-motor of that power to receive current from a small accumulator, the motor to work as a dynamo to charge same when machine is going downhill? Or would a small oil-motor be better? What about the heat given off by the latter? In what book can I get full particulars for tempering all kinds of steel springs—coil, conical, spiral springs, &c.?—Fiat Lux.

[96697.]—**Lime-Water.**—From what kind of lime is lime-water prepared for medical use? Is it from the comparatively pure, fat, upper white chalk-lime, or from the poorer mixed lime made from the grey chalk lime of the lower beds, known in London as grey chalk lime?—R. S.

[96698.]—**Scene Painting.**—Can anyone give me any information concerning the following queries? (1) What material to use for the painting of scenes for a small school cantata? (2) What colours, paints, &c., are used? (3) The name of any book containing directions, &c., as to mode of procedure?—T. Thomas.

[96699.]—**Purification of Well.**—The water which I use from my well I find to be slightly contaminated with some impure matter. The colour is slightly reddish, and the odour points to a small amount of nitrogenous matter. I cannot trace any connections with the sewerage, nor even with any surface water. I have been advised to place some charcoal in the well, or even a small amount of lime. Can anyone advise me what would be the effect of the use of this charcoal or lime? Would not the charcoal itself become putrid after a time? I would be pleased to have some advice on the subject.—Kitwell.

[96700.]—**Shaving.**—Why is it that a barber or nearly everyone who shaves himself warms the razor in hot water before shaving? Does it really cut better (everyone whom I have asked says it does), and, if so, for what reason? The native barbers of India and the East seldom use hot water, and they seem to shave all right.—Nix.

[96701.]—**Invisible Light.** — In this month's *Chambers' Journal* we read that a modification of the X-rays has been discovered by a Frenchman. His theory is that ordinary light is composed of visible as well as invisible rays. To produce these you merely cover up your light. If then you wish to discover anything hidden—in a box, for instance—you place a screen covered with sulphuret of zinc in front of the box. The object is then shadowed (?) on the screen. Have any other readers seen this, and have they tried it? Also, what is sulphuret of zinc?—Alpha.

[96702.]—**Glue.**—Could any reader tell me of anything you could mix with glue so as it will stand a gentle heat without going soft?—Chips.

[96703.]—**Cycle Chain.**—Can any of "ours" tell me how I can prevent a cracking noise in the chain of my cycle? If I take it off and wash it in paraffin, and wipe it quite dry, and put it on again, it stops; but after riding about 15 miles it wants lubricating, and then it starts making the noise again.—Welsh.

[96704.]—**Ivory Polish.**—Will any reader kindly give recipe and method of polishing ivory billiard balls?—W. T. G.

[96705.]—**Jupiter.**—On August 31 a spot passed the C.M. about 11.30 p.m., and again noticed some days afterwards. Will someone kindly work out the longitude, giving detail in full, according to system 1 or 2? Would "Chambers' Practical Astronomy" explain the working out, or any other handbook?—Novice.

[96706.]—**Cutting Up Slate.**—Can any reader give me any hints on cutting slate up? I have a milling-machine, and have tried to use a cutter with teeth; but it will not do. I have got a lot to cut, so should like to cut it quick. I have also got to enamel the slate, so should like to know how to do this? I am making an iron stove to bake it, as I was told to do. I was told that to get a fine, smooth gloss on the slate it has to be done by hand. Is this right? Any hint will greatly oblige.—Enamel.

[96707.]—**Bus Bars.**—I should like to know if anyone can tell me the rule to make bus bars for fuse-boards, or can I get a book on same—I mean bus bars for three-way boards? What should be the thickness, length, and width?—Enamel.

[96708.]—**To Mr. Bottone.**—Will you kindly tell me how one may obtain the D.Sc., or corresponding degree, at any of the Italian Universities, or tell me where I could get the information?—Chemist.

[96709.]—**Hovis Bread.**—Will some reader kindly tell me how Hovis bread is made? Is it easily mixed and nutritious?—G. Calver.

[96710.]—**Surface Tension.**—Can any reader give me help with the following problem? Calculate the work done on the film in blowing a soap-bubble from a diameter of 3cm. to one of 30cm., if its surface tension be 45 in C.G.S. units.—J. Bennett.

[96711.]—**Spiral Gear-Wheels.**—Can any reader tell me if spiral gear-wheels for gas-engines can be cut in an ordinary 9in. lathe? If not, how could it be done, and how many cutters would it need to do both wheels? Give rough sketch, please, if needed.—J. C.

[96712.]—**Lantern Slides.**—Can anyone give me some help in the choice of a hand-camera for snapshots to be used in the lantern? I want to take the pictures of the size suitable for the lantern, so as not to have to enlarge or reduce them, and my idea is to have the cheapest reliable camera capable of carrying, say, twelve plates. I believe the "Fram" is a very good camera, but it is far too expensive for my purse, and the specially-shaped films are a drawback. Are the Kodak films easily detached and developed, or must one expose the whole cartridge before commencing to develop any one picture? What are the objections to films as compared with plates for my purpose? Sometimes a reversal is found in a negative: for instance, the sun appears as a positive image. I presume this is from considerable over-exposure? Now, is it possible for our chemists to devise a plate which shall always give a reversal—i.e., a positive instead of a negative image? I believe this is already done in ferrotypes and other cheap photographs. Such a plate, when developed and fixed, could be put at once into the lantern, thus doing away with the trouble and expense of printing another plate. Wishing to use a lantern for perfecting sharp shadows of solid pieces of apparatus placed between it and the screen, I am disappointed in getting only a shadow with an indefinite outline. My lantern is an oil one. I was undecided as to whether to get an oil or a limelight one, although I favoured the former on account of its greater portability; but my choice was determined by the statement in the maker's catalogue that this lantern would give a parallel beam. If this is correct it would obviously be possible to converge the parallel rays to a point (by means of a lens) where they would cross and give as sharp a shadow as if the original source of light were a point. This does not "come off," however, and I cannot focus them so as to produce a point. I conclude, therefore, that the statement as to a "parallel" ray being producable should not have appeared in the catalogue. If I am wrong, perhaps some expert will tell me how to produce the sharp shadows I desire without a limelight.—A. Tester.

[96713.]—**Test for Arsenic.**—Can any reader of the "E. M." give me the information how to discover the presence of arsenic in wall paper?—Desmond.

[96714.]—**Electrophorus for Wireless Telegraphy.**—I wish to make a few experiments in wireless telegraphy, but, having no machine or coil capable of producing a suitable spark, I am looking about for the cheapest substitute. Would a common glass plate electrophorous meet the case if used with the three-ball transmitter previously described? If so, what sized plate should be obtained? I do not require to ring a bell, but merely to produce a deflection in the needle of a delicate galvanometer.—Wireless.

[96715.]—**Quadruple Telephony.**—I understand that one of the American Telephone Co.'s have offered a prize for a system of quadruple telephony. Have you any particulars of this competition, please, and does it imply that four persons are supposed to be actually speaking at one time, or only two persons speaking and two listening? If the latter, I think I have struck the oil?—Wireless.

[96716.]—**Solenoid.**—Will Mr. Bottone or any other

kind reader give me advice? I have a bar magnet of soft iron, ⅝in. diameter, 1ft. long, and the same, when excited by three bichromate cells, will lift 12lb. I am thinking of turning it into a solenoid by drilling a ⅜in. hole through centre of core. What fraction of lifting power will magnet now have of what it had before (supposing the weight to be raised is attached to a soft iron rod 1ft. in length, and thick enough to fit nicely into bore)? And to what distance would the rod travel up the bore when no weight were attached?—C. V. E.

[96717.]—**Shaving Cream.**—Can anyone give a good recipe for shaving paste or cream?—H. H.

[96718.]—**Bonetti-Wimshurst.**—Where can I find a detailed description of this machine? Is it superior to the ordinary Wimshurst for X-ray work?—P. H. CULEIS.

[96719.]—**Gauging Tanks.**—I wish to gauge contents for each inch in depth of flat-ended cylindrical boiler tanks, lying horizontal. A formula or graphic method for any size is desired, but 28ft. by 7ft. might be used as illustration.—CHEMICAL.

[96720.]—**Hotel Problem.**—During a month of 31 days, an hotel averages 34 visitors daily, who pay per week—on the average—three guineas each *en pension*, which sum shows a weekly average profit per visitor of 17s. 2d. For three weeks of the month, two of these visitors pay £2 3s. 4d. per week each. Are they a source of gain or loss, and how much?—P. E.

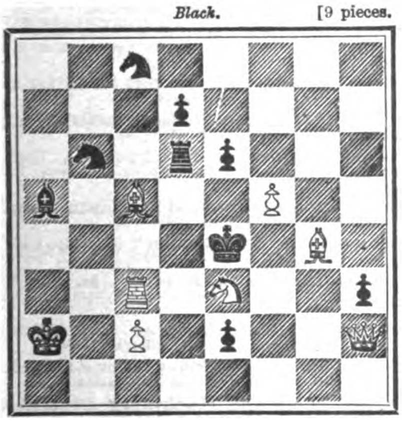
[96721.]—**Launch.**—I wish to construct a small launch 18ft. or 20ft. long, to be driven by gasoline engine. Can any reader give me a few pointers as to dimensions and model of boat, method of construction, &c.? Also, could engine be easily made by amateur? A rough sketch would be appreciated.—J. H. WINFIELD, Nova Scotia.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1693.—By C. PLANCK.

Black. [9 pieces.



White. [8 pieces.

White to play and mate in two moves.

(Solutions should reach us not later than Oct. 2.)

Solution of PROBLEM No. 1691.—By C. A. GILBERG.

Key-move, R-Q 4.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1691.—Correct solution has been received from Rev. Dr. Quilter, A. Tupman, W. F. Webb ("A pretty little problem") G. S. Hardy, Quizco, T. Clarke, J. E. Gore ("Pretty, but easy"), Hampstead Heathen, Richard Inwards, Whin Hurst, Geo. Christie, G. W. M. ("Key-move will suffice, and, of course, solve from the diagram"), E. C. Weatherley, E. Lobell, jun.

IT is believed by oil experts that West Virginia, in America, is underlaid by a real sea of petroleum. The output of one kind of oil last year amounted to over 18,000,000 barrels.

A MOVEMENT is said to be on foot in Ireland to develop the Queen's County anthracite mines, in so far as providing a railway connection between the pits and the main line of the Great Southern and Western Railway Company. Efforts are being made to induce the Chief Secretary to recommend the Treasury to grant a sufficient sum to make the line to Portarlington.

A FIVE-INCH Brown segmental wire gun, the first completed, has successively passed the official tests of the United States Government at Birdsborough. The gun was required to give a muzzle velocity of not less than 2,600ft. per second, 295 shots being fired with a 55lb. projectile and smokeless powder, developing a mean pressure not exceeding 40,000lb. per square inch. Following this, five shots were to be fired with powder pressures varying from 45,000lb. to 50 000lb. per square inch. The peculiarity of the gun lies in the fact that the circumferential strength is obtained practically entirely from the wire winding, the barrel being built up of staves of a hard steel, round which the wire is wrapped. These staves give the necessary longitudinal strength of the gun, but obviously do not add to its strength against bursting.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 20, and unacknowledged elsewhere:—

F. E. A.—Lucio.—J. S. Z.—Bunsen.—W. H. Bland.—G. E. O.—Improver.—R. A. Kennedy.—S. R. Bottone.—W. J. G. F.—L. Panton.—F. Baird.—Monty.—C. P.—T. E. Espin.—Pierre.—Raymond.—G. S. Hardy.—J. Bennett.

H. JARVIS.—Thanks; no. Very full up just now.

H. H., Croydon.—Too far back; besides, we are really too full just now to discuss illustrations in other periodicals.

R. G.—Please see some recent letters on the subject, and the full directions given for making reflecting telescopes in recent volumes. Do you intend to grind the speculum yourself, or are you going to purchase that and mount it? Anyway, you will find full directions and many hints in, say, the last six volumes.

A. R. CRANE.—Do you mean 3-4H.P., or an engine with a 3-4in. cylinder?

JOHN THOMAS.—1. It is usual to serve a term of apprenticeship in a shop where such work is done. 2. Maxton's "Engineering Drawing," published by Crosby Lockwood and Son, is a good work, and Campin's "Mechanical Engineering," from same publishers.

WORRIED.—The remedy for blackheads, frequently given, is to wash the parts with warm water and soap, and squeeze them out; but it has also been recommended to use paraffin oil after the washing, kneading the parts well to work them out. You will find several replies on the subject in the back volumes.

IGNORANCE, Ontario.—"Guide to the Social Marine Board Examination," G. Philip and Son, Fleet-street, London, 1s. 6d., will help, and ask them to send their catalogue. Norie's "Epitome of Navigation," Norie and Wilson, Tower-hill, London, 16s. Cannot answer the other questions; but a little personal inquiry amongst seafaring men will give you some useful hints.

NIX, Jeypore.—Yes, quite true. The warmth softens the hair, and also expands the microscopical saw-like edge of the blade. But there is not much in the notion. Probably it runs easily over the surface when warm. As you live so far away, the query is inserted.

ALPHA.—There are several works of the kind, giving "restorations" of the prehistoric animals and fancied reproductions of the conditions in which they lived. You could see many at the British Museum Library.

C. A. NAYLOR.—The aneroid barometer is described in many of the textbooks. The name means "without moisture." It consists of a box or case of metal so flexible as to be acted on by variations in the pressure of the atmosphere when the air is exhausted from its interior.

A. S. GEORGE.—Try Lancaster and Son, Colemore-row, Birmingham.

G. S.—Such questions should be put to a patent agent, giving him all particulars. His charge will depend on the time he has to expend in searching. Whether it is patented in this country or not is of little interest to our readers.

P. H. CULEIS.—As to superiority, you could find opinions of correspondents in back volumes; but as a detailed description is required, query is inserted.

J. B. T.—The cost will depend on the quantities of the materials that are purchased at a time; but have you not made some mistake? For what purpose are such preparations required?

JUPITER.—Something else to do besides discussing old wives' tales about cauls!

W. MATTHEWS.—All such inks harden. Thin it down with a few drops of methylated spirit or benzoline.

METEOR.—Mr. Ivo. F. H. C. Gregg, in a letter received too late and too long for publication, thinks he saw the meteor referred to by Mr. Lynn (letter 42780, p. 89) at Great Malvern at 9h. 10m. G.T., but from R.A. 16h. 30m. N. Dec. 3 to R.A. 15h. 40m. N. Dec. 8, or in quite the opposite direction to that in which the meteor seen at Blackheath went.

JOHN WALKER.—The debility is due to quite other and natural causes. If you are single and leading a regular life, the rest is quite natural. Get Dr. Allinson's "Pamphlets for Young Men" from their author at 4, Spanish-place, Manchester-square. They only cost a few pence, and contain sensible advice. As to diet, &c., read his articles weekly in the *Weekly Times and Echo.*

IN TYPE.—Martin Luther Rouse.

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Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

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5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

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s Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

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All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the ENGLISH MECHANIC Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to THE STRAND NEWSPAPER COMPANY, LIMITED, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

What Offers for about 350 Back Nuumbers "**English** MECHANIC, or exchange?—W. UPTON, Bridge-street, Banbury.

3H.P. Tangye's **Gas-Engine** and 50-volt, 15-amp. DYNAMO; can be seen running; wanted £30, or exchange smaller Gas-engine or Steam Boiler, or offers.—Particulars stamp.—CHAS. FORD, Electrician, Stalybridge.

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Astronomical Telescope, 4in. altazimuth, by Wray, complete, £30.—CLARKSON and Co.

Astronomical Telescope, 4in. altazimuth, by Troughton and Simms, £25.—CLARKSON and Co.

Astronomical Reflector, 8½in., Browning, with slow motions, £35.—CLARKSON and Co.

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"Seal" Oil-Engines for all purposes. State requirements.—J. SEAL, Oil-Engine Works, Castelnau, Barnes, London, S.W.

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"How I First Saw Saturn" (telescope making, paper mounts), illustrated, 7d.—WALTER BELL, Architect, Cambridge.

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Books Out of Print Supplied. State wants. —THE HOLLAND COMPANY (Cheapest Booksellers in the World), Birmingham.

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Rubber Outer Covers, 3s. 6d. each, 36s. per dozen. —FRANKLANDS.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—FRANKLANDS.

Air Tubes, best quality rubber, 2s. 9d. each. Fitted with Dunlop valve, 3s. 9d.—FRANKLANDS.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, SEPTEMBER 29, 1899.

MOTOR CYCLES.—XIX.

FIG. 108 shows the shape of the two main tubes of the quadricycle attachment. They are made from 1¼in. by 18 gauge weldless steel tube, and should both be carefully bent to the same shape. Avoid denting the tube, for, besides spoiling the appearance, the strength is reduced. At their rear ends a mild steel forging, of the shape and dimensions given in Fig. 108, is brazed. It is by means of this forging that the tubes are bolted to the lugs on the bridge-tube. The part of Fig. 109 marked X is to be turned a good fit to the interior of the tube. Note that the forging is bored out;—this is done not only for the saving in weight, but also to increase the strength of the joint. If left solid, the vibrations of the tube will be suddenly checked, causing the metal to crystallise around the end of the solid lug, and become brittle and very liable to snap. The lugs for the bridge, by means of which the side tubes are clipped to the down tube of the tricycle, are shown in Fig. 110. They are of malleable cast iron, and require no special remarks. They are to be brazed to the side tubes as shown in Fig. 107, their centres being 33in. from the centres of the eyes in the lugs at rear end of tubes. Before brazing them in position put the tricycle into position, having previously removed the front wheel. Now fasten the clip, Fig. 111, on to the bottom tube of tricycle, and proceed to get the 1¼in. sockets of clip in line with the side lugs. At the same time, the lengths of the two pieces of 1¼in. tubing can be determined. When the two lugs, Fig. 110, are correctly adjusted, braze them securely in position. At the same heat it would be as well if the 1¼in. tubes were brazed in, too. The bridge clip (Fig. 111) is also of malleable cast iron. I have shown it with the caps bolted in position by two ⅜in. stud-bolts; but of course it is a separate piece. I give a plan of the cap in Fig. 112 to show shape and size of the lugs for bolts. In machining this casting, I should first face the joint between main casting and cap; then having drilled and tapped the holes for the screws, bolt the two parts together with a strip of 1/16in. sheet brass between them on each side, and bore out the central hole 1¼in. diameter. The brass strips are interposed, to allow of the clip closing down tightly on the tube when in use. The two sockets for 1¼in. tubes should be carefully bored to the correct angles, taking care to make them both the same. At the extreme front end of the side tubes is a cross-tube, also 1¼in. diameter by 18 B.W.G. This is brazed to the side-tubes by means of a tee-lug at each end. If preferred, the sockets can be formed at the ends of the cross-tube from the tube itself, as is done in the case of the stem-tubes of cycle handle-bars. But it will require to be well done, and in the case of an amateur I should advise malleable cast iron tee-sockets being used.

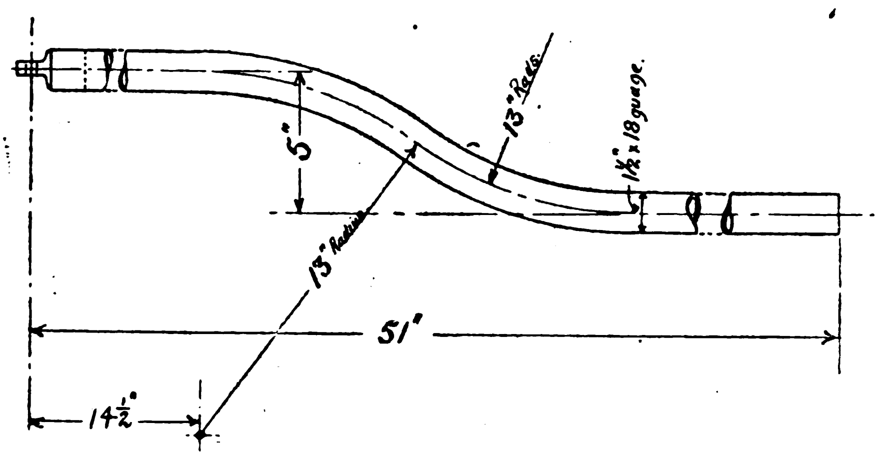


FIG. 108.

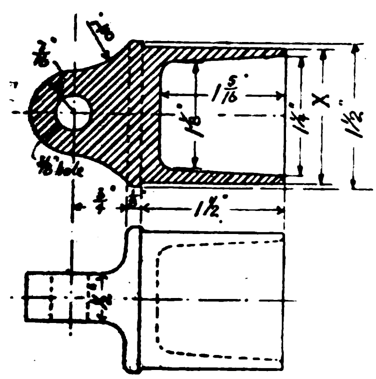


FIG. 109.

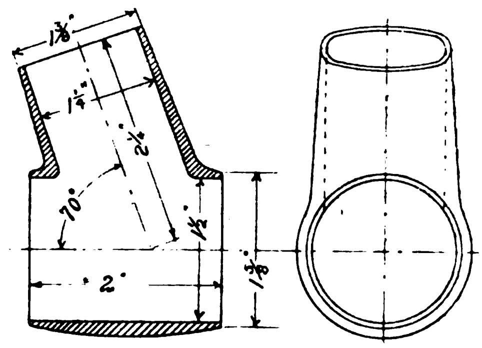


FIG. 110.

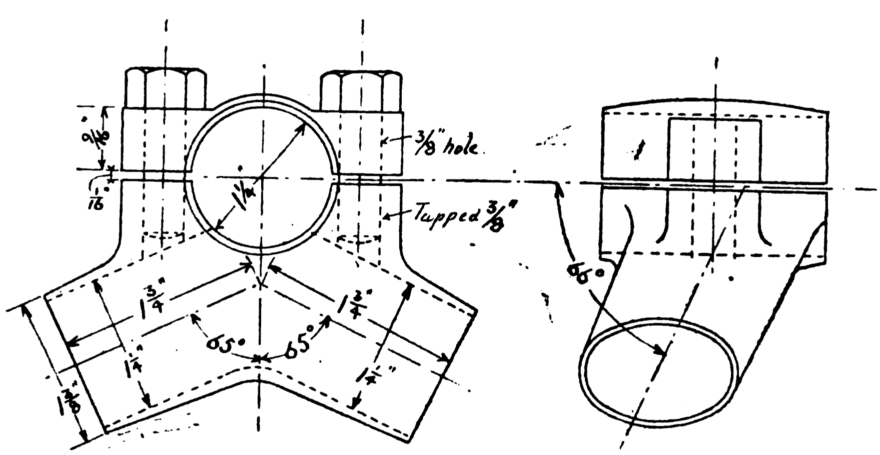


FIG. 111.

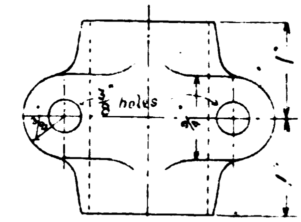


FIG. 112.

The front axle is made from steel tubing of the same diameter and gauge as the side tubes, the exact length being 28½in. At each end of the axle a lug, of the dimensions given in Fig. 113, is to be brazed. These lugs take the steering pivots, and are malleable iron castings; forged steel would be better, in which case the 5/16in. rib would be omitted. In machining these lugs the utmost care must be taken to insure the centre line of the two screwed holes being truly at right angles to the bore of the 1¼in. socket. See also that those screwed holes are dead in line

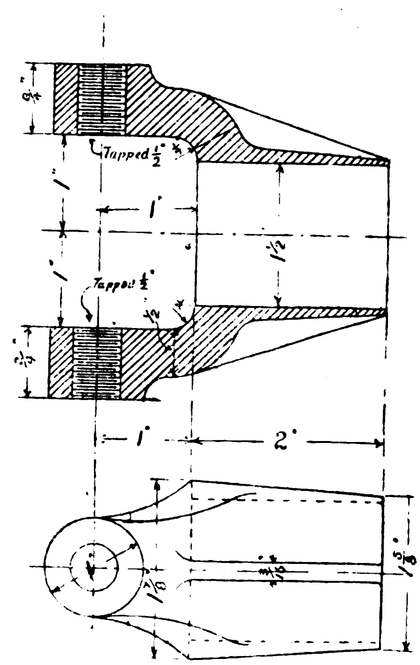


FIG. 113.

with each other. When brazing them to the axle tube, make sure that they are both upright, otherwise the steering will be thrown out. The centres of the steering pivots should be, when brazed up, *exactly* 30½in. apart. We will assume the springs to have been procured. To hold them to the axle and the side tubes, mild steel clips, as Fig. 114, will be used. Of these, eight will be required; the bow will embrace the axle (or side tubes),

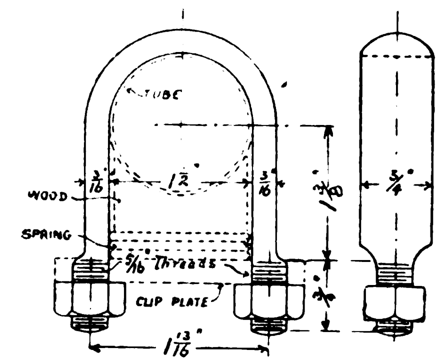


FIG. 114.

the spring being held by mild steel plates, ¼in. thick by ⅞in. wide, through the ends of which holes are drilled to take the clips. Wood packing must be placed between the springs and the tubes, the wood being hollowed out to fit each. These clip-plates and wood-packing are shown dotted in Fig. 114. The clips should be spaced 2in. apart, centre to centre, along the tubes.

ASTRONOMICAL NOTES FOR OCTOBER, 1899.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 49 40 81 a.m.	12 29 41	3 12 26	12 40 0 37
6	11 48 9 42 ,,	12 47 52	5 8 27	12 59 43·12
11	11 46 47·67 ,,	13 6 13	7 2 49	13 19 25·90
16	11 45 37·64 ,,	13 24 46	8 54 46	13 39 8·67
21	11 44 41·79 ,,	13 43 33	10 43 31	13 58 51·43
26	11 44 2·64 ,,	14 2 37	12 28 19	14 18 34·22
31	11 43 42·21 ,,	14 21 59	14 8 19	14 38 16·97

The method of finding the Sidereal Time at Local Mean Noon at any other station is described on p. 454 of Vol. LXVIII.

The Sun's disc is still blank, and void of spots.

The zodiacal light may still be looked for in the east before sunrise.

The Moon.

New Moon....	Oct. 4	7h. 14·0m. p.m.
First Quarter..	,, 12	6h. 9·7m. a.m.
Full Moon....	,, 18	10h. 4·8m. p.m.
Last Quarter..	,, 26	9h. 40·1m. a.m.
Perigee	,, 16	10h. 18 m. ,,
Apogee	,, 28	5h. 18 m. ,,

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	Sun.
	Days.	h. m.	°	
1	26·35	9 22·4 a.m.	52·0 E.	S.
6	1·70	0 58·1 p.m.	65·2 W.	R.
11	6·70	5 28 6 ,,	2·0 W.	R.
16	11·70	9 56·5 ,,	61·3 E.	R.
21	16·70	1 32·8 a.m.	68·2 W.	S.
26	21·70	5 51·8 ,,	5·1 W.	S.
31	26·70	9 23·0 ,,	57·6 E.	S.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

Occultations of (and near approaches to) Fixed Stars by the Moon, visible at Greenwich.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
10	4 Sagittarii	4·6	7 3 p.m.	Dark	96	74	8 10 p.m.	Bright	242	211
12	57 Sagittarii	6·2	4 19 ,,	Dark	58	77	5 30 ,,	Bright	269	278
14	c^2 Capricorni	6·2	†6 1 ,,	N.N.W.	334	356				
16	16 Piscium	5 6	6 3 ,,	Dark	41	75	7 2 ,,	Bright	263	292
16	19 Piscium	5 2	11 53 ,,	Dark	52	30	1 0 a.m.	Bright	251	221
19	27 Arietis	6 5	9 22 ,,	Bright	78	114	10 28 p.m.	Dark	238	266
20	65 Arietis	5·6	†7 56 ,,	N.by W.	344	25				
21	D.M. + 20°602	6·2	†3 16 a.m.	S. by E.	171	144				
21	56 Tauri	5·4	†6 42 p.m.	S. by E.	170	205				
21	κ^1 Tauri	4·6	8 37 ,,	Bright	76	118	9 35 ,,	Dark	261	303
21	κ^2 Tauri	5 5	8 38 ,,	Bright	97	139	9 34 ,,	Dark	240	282
22	τ Tauri	4·4	†6 2 a.m.	N.	2	321				
25	5 Cancri	6·4	†10 6 p.m.	S. by W.	189	224				

† Near approaches. A description of the above table will be found on p. 455 of Vol. LXVIII.

The Moon will be in Conjunction with

——	Day of Month.	Hour.	Planet.
			° ′
Mercury	5	6 a.m.	5 56 N.
Venus	5	11 ,,	6 5 ,,
Mars	7	6 ,,	3 15 ,,
Jupiter	7	10 ,,	4 14 ,,
Saturn	10	2 ,,	1 27 ,,

When our notes begin the moon is in Sextans. She enters

——	Day of Month.	Hour.
		h. m.
Leo	2	8 0 a.m.
Virgo	3	Noon.
Libra...............	6	7 0 p.m.
Scorpio	8	2 0 ,,
Ophiuchus	9	3 0 a.m.
Sagittarius	10	3 0 p.m.
Capricornus	12	Midnight.
Aquarius	13	5 0 p.m.
Pisces	16	3 0 a.m.
Aries..............	19	4 0 ,,
Taurus	20	9 0 p.m.
Gemini	23	3 0 ,,
Cancer	25	9 0 ,,
Leo	27	4 0 ,,
Sextans............	28	4 0 ,,
Leo	29	4 0 ,,
Virgo	30	7 0 ,,

Mercury

is too close to the Sun to be visible at the beginning of October, but souths after noon after the 4th, and becomes in that sense an evening star. He is, however, unfavourably situated for the observer throughout the month. His angular diameter increases almost insensibly from 4·8″ on the 1st to 5·2″ by the 31st.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 26·1	1 22·1	11 52·5 a.m.
6	13 3·7	5 58·1	0 4·0 p.m.
11	13 34·0	9 35·8	0 14·6 ,,
16	14 3·8	12 58·3	0 24·6 ,,
21	14 33·4	16 2·7	0 34·4 ,,
26	15 2·8	18 46·5	0 44·1 ,,
31	15 32·2	21 7·1	0 53·7 ,,

Starting thus from a point in Virgo a little below a line joining γ and η in that Constellation, Mercury will traverse the rest of it, and be found at the end of the month in the eastern confines of Libra. On the 9th he will pass about 2½° north of Spica Virginis, and somewhat less to the south of α Libræ on the 23rd. He will be in conjunction with Venus at 11 a.m. on the 10th, only 43′ south of her, and with Jupiter at 4 p.m. on 25th, 2° 20′ to the south of the great planet.

Venus,

in the sense of Southing after the sun, is an evening star throughout the month, but she is much too close to him for ordinary observation with the telescope. As she has so recently passed superior conjunction, her figure is to all intents and purposes circular, and her uninteresting little disc only increases from 9 8″ on the first to 10″ at the end of October—of course, wholly insensibly.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	12 46·5	3 40·7	0 6·4 p.m.
6	13 9·4	6 11·2	0 9·7 ,,
11	13 32·6	8 38·6	0 13·1 ,,
16	13 56·1	11 1·3	0 16·9 ,,
21	14 19·9	13 17·5	0 21·0 ,,
26	14 44·2	15 25·6	0 25·6 ,,
31	15 9·0	17 24·0	0 30·6 ,,

Like Mercury, Venus will thus travel from Virgo into Libra. At 6 p.m. on the 26th she will be in conjunction with α Libræ, and only 6′ north of that star. She will, however, have set some time previously in these latitudes. She will further be in conjunction (also below our horizon) with Jupiter at 1h. a.m. on the 30th (33′ south of him). Her conjunction with Mercury on the 10th has been referred to under the heading of that planet, above.

Mars, Jupiter, Saturn, Uranus, and Neptune

are one and all, for the observer's purpose, invisible; but the minor planet **Vesta** comes into opposition on the 14th, and may just possibly be picked up with the naked eye as a faint little star on the moonless nights at the beginning and end of the month.

Day of Month.	Right Ascension	Declination South.	Souths.
	h. m.	° ′	h. m.
1	1 48·8	1 18·2	1 16·5 a.m.
6	1 44·5	1 48·2	12 46·7 ,,
11	1 39 9	2 16·7	12 22·4 ,,
16	1 34·2	2 47·3	11 53·1 p.m.
21	1 29 4	3 9·0	11 28·7 ,,
26	1 24·8	3 26·4	11 4·4 ,,
31	1 20·5	3 39 0	10 40·5 ,,

Whence it will be seen that Vesta is travelling backwards through a perfectly blank region in Cetus.

Shooting Stars

are becoming somewhat more plentiful, slight, though marked, displays being predicted for the nights of the 2nd, 4th, 8th to 14th, 20th, and 29th. The principal shower, however, of the month—that of the so-called Orionids, from the position of their radiant to the east of γ Orionis —will occur on the night of the 18th—unfortu-

nately, that of the Full Moon. Watch should, however, be kept after the constellation rises.

Minima of the Variable Star Algol.

Day of Month.	—
	h. m.
2	4 40 a.m.
5	1 29 ,,
7	10 18 p.m.
10	7 7 ,,
25	3 12 a.m.
27	12 1 ,,
30	8 50 p.m.

And on other occasions, when daylight will render the phenomenon invisible.

Greenwich Mean Time of Southing of Twenty of the Principal Fixed Stars on the Night of October 1st, 1899.

Star.	Magnitude.	Souths.
		h. m. s.
β Cygni........	3·1	6 45 34·81 p.m.
γ Aquilæ	2·8	7 0 21·45 ,,
Altair	1·0	7 4 44·68 ,,
α² Capricorni....	3 8	7 31 16·67 ,,
β Capricorni....	3·4	7 34 9·39 ,,
γ Cygni	2·3	7 37 23·67 ,,
α Cygni	1·5	7 56 43·70 ,,
ζ Cygni	3·5	8 27 18·16 ,,
β Aquarii......	3·1	8 44 52·17 ,,
ε Pegasi	2·4	8 57 48·84 ,,
α Aquarii	3·2	9 19 7·81 ,,
η Pegasi	3·1	9 56 41·95 ,,
Fomalhaut	1·3	10 10 28·36 ,,
Markab	2·6	10 18 6·22 ,,
γ Piscium......	3 8	10 30 16·31 ,,
α Andromedæ ..	2·1	11 21 22·37 ,,
γ Pegasi	3·0	11 26 3·52 ,,
α Cassiopeiæ ..	2·2 to 2·8	11 52 54·76 ,,
β Andromedæ ..	2·2	*12 22 7·34 ,,
Polaris	2·2	*12 41 28·04 ,,

* Early morning of the 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list on any other night in October, as also that of determining the local instant of its transit over the meridian of any other station, will be found on p. 456 of Vol. XVIII. It must, however, be noted, as there stated, that the rules given are not rigidly accurate when applied to Polaris, nor, in fact, to any close circumpolar star, though in practice they will doubtless be found abundantly so for the regulation of any ordinary clock or watch.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—IV.

METEOROLOGISTS have always been attracted by the search for what may be called the smaller pulsations in the atmosphere, and recognising that an ordinary barometer does not respond to minute variations in pressure, instruments which have a very open scale, or which are very sensitive, are always being invented. There are numerous ways of rendering a barometer more sensitive, and, although some of them have been in vogue during many years, the early models still find favour with modern inventors. Only in very exceptional circumstances can the mercury in an ordinary barometer be seen in motion, the most familiar of these occasions, perhaps, being when the mercurial column oscillates in the peculiar manner commonly known as "pumping," and what is required is to make these and other similar movements easily recognisable. Numerous causes are by some authorities considered to be at work pressing on a barometer, but so sluggish is the ordinary mercurial column that it is not prompted to movement by these minute aërial pulsations, and before they can be seen, it is necessary therefore to make the scale of the barometer a very open one. Thus some meteorologists say that certain electrical forces in the atmosphere will at times produce strange oscillations in a barometer having a very open scale; while other effects are ascribed to the changes which occur from time to time in the tension of the aqueous vapour in the air, and it becomes of interest to use instruments which will collect observations with which these and similar speculations may be compared.

Most of these sensitive barometers call for some special construction or modification of their tube, and there are commonly other details which can only be executed by expert mechanicians, but since they often introduce the student of the weather to new fields of research, they are always instructive and of permanent interest. Similarly to other human interests, there are periods when certain methods of meteorological procedure are more in vogue than at others, and in recent years there has not been such activity in the matter of inventing sensitive barometers as was the case many years ago. Probably the most prolific time for the construction of barometers with an extended scale was during the years almost immediately following that in which the barometer was invented, and for a long time the sole desire seemed to be to make instruments that should increase the movements of the mercurial column. The barometer was invented in the year 1643, and as early as 1665, for instance, Hooke had designed the wheel or dial barometer, an instrument which is still the most favourite method of increasing the size of the barometer scale. Moreover, since the wheel barometer lends itself so readily to ornamentation, it is probable that, despite certain faults, it will continue to maintain its popularity.

A novel design in sensitive barometers there is in which the mercury as it rises and falls passes through a wide range, the instrument depending for the details of its structure on the fact that glass is lighter than mercury. An ordinary barometer tube is filled in the usual way with mercury, and into it is plunged a small glass rod which has previously been attached to the bottom of a glass vessel, which subsequently acts as a cistern. While the glass rod is being plunged into the mercury the tube is held upside down, but it is inverted as soon as the bottom of the cistern fits tight against its open end, a piece of cork preventing the mercury from running out. As soon as the tube is inverted the cork is withdrawn and a little mercury flows from the tube into the cistern, and an ordinary barometric column is produced. The peculiarity of this instrument, however, consists in the fact that the cistern is not fixed to the tube in the ordinary way, but is left suspended in what at first seems an impossible manner. The glass rod within the tube is, however, much lighter than the mercury it displaced when it was thrust into it, and has accordingly a considerable buoyancy which is sufficient to sustain the cistern and prevent it from falling down. If now there comes a decrease in the atmospheric pressure acting on the surface of the mercury in the cistern, a certain quantity of mercury flows out of the tube into the cistern, and making the latter heavier would depress it, and this has the effect of lowering the barometric column still more. On the other hand, supposing there is an increase in pressure, more mercury is forced up the tube, so that the glass rod gains an added buoyancy, and pulling the cistern upwards adds to the rise in the barometric column. The effects of this buoyancy therefore, added to those of the atmospheric pressure, have the effect of greatly increasing the range of the barometer oscillations, the amount of the increase depending, of course, upon the manner in which the details of the instrument are arranged. For ingenuity of design this sensitive barometer may safely be accorded a high place among its fellow instruments.

A very popular way of increasing the motion of the barometric column is found by adding to the ordinary tube supplementary tubes containing fluids of a less specific gravity than mercury. Very early in the history of barometers this was a favourite device, and naturally almost the first fluid to be thus placed on the top of the mercury was water; and with careful management this arrangement has the effect of greatly multiplying the amplitude of the oscillations. But from the surface of water vapour is continually escaping, and the tension or pressure of this evaporated moisture presses upon the surface of the column and reduces its movements. It is also difficult to exclude air from these supplementary tubes, and some experimenters have therefore introduced tartar-emetic into the water with the object of driving the air from it. As regards the evaporation of moisture from the column of water, this has been diminished by covering its upper surface with oil.

These added tubes, however, give a very unwieldy appearance to the barometer, which, even in its more common form, proves often of an inconvenient length, and, although they are very sensitive to atmospheric changes, they require rather more house-room than most people can afford. This is still more the case when an ordinary siphon barometer is selected for carrying these supplementary tubes. These barometers have been supplied with tubes extending both from their longer and shorter limbs, and in some instances a mixture of water and aquafortis has been used as the fluid with which to fill them. In a former article it was pointed out that when a barometer is not hung truly vertical the mercury runs higher up the tube, and exaggerates the movements of the column; and it is not surprising, therefore, that barometers have been made with the upper portion of their tubes bent considerably out of the vertical. By this simple device the scale of a barometer may be very much extended; but when this form of structure is applied to tubes filled with water and certain oils, there is a drag put on the movements of the column, and the records are not, therefore, always trustworthy. The supplementary tubes mentioned above have, as might be supposed, been thus bent diagonally, some very curious-looking instruments being the result. They, however, are constructed on right principles, and it is to be wished that they could be made in the light of modern knowledge, for there are reasons for supposing that records obtained by some such instruments as these would help to explain many atmospheric phenomena which are at present but little understood.

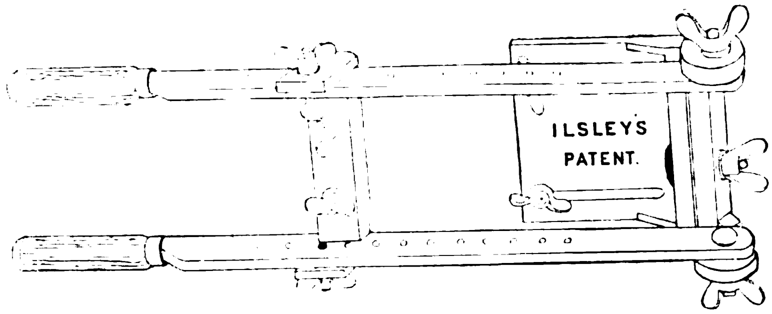
It is said by those who have watched some of these very sensitive barometers very closely that they may be seen moving very rapidly during thunderstorms, and that they oscillate considerably during each flash of lightning. Others again have stated that they have detected curious pulsations, which appear to accompany changes in the tension of the vapour in the air, and since it seems probable that discharges of atmospheric electricity play an active part in condensing vapour out of the air, a line of research is suggested which might lead to interesting results. As each atom of vapour rises from land and water it carries with it a tiny charge of electricity, and it is by these minute globules of moisture that the vigour of a thunderstorm is built up. It has also been conjectured that under certain conditions these drops of moisture are kept suspended because of the repelling action which they exert one upon the other, and it is when something occurs to lower the potential of their charge of electricity that they run together and fall as rain. That something of this kind may occur is evidenced by the heavy showers which so often follow brilliant flashes of lighning. When these discharges of vapour are very great the ordinary barometer responds to the accompanying changes in atmospheric pressure, these changes being best shown on the curves obtained from self-recording instruments. There are, however, all those smaller changes in pressure which occur during thunderstorms, and it is these of which it is so desirable to secure a record; and there are certain types of sensitive barometer sometimes called variometers which are well adapted for registering them.

Now the action of a barometer is not interfered with when its tube is twisted in a spiral, and there are many suggestions as to the best way of managing this alteration in structure. In some of these barometers it is the upper portion of the tube which is thus changed in shape, and in others it is the lower portion which is thus modified; while in other types, it is the mid-way portion of the tube which is selected for treatment. A siphon barometer may thus have the tube which connects the two legs or limbs arranged spirally, the short leg being left open in the usual way. In order that the movements of the mercury may be enlarged, the spiral portion of the tube needs to be of a smaller diameter than the two branching tubes, the spiral being arranged horizontally. The dimensions of one such barometer are so arranged that the spiral tube is 2 millimètres and the two branches 6 millimètres in diameter, this construction of the spiral resulting in a very large increase in the motions of the mercury. In order that these oscillations may be the better seen, a speck of air or a drop of sulphuric acid is introduced into the mercury, and this, like the bubble in a spirit-level, clearly shows any changes that may be taking place, and it is said that when

this speck is examined with a magnifying glass, it is seen to be in constant motion. Supposing the spiral were so arranged that the diameter of its tube were two millims and that of the two limbs of the siphon 20 millims, the motion of the barometric column would be increased one hundred times, and, indeed, there is no limit to the degree of sensibility to be gained by constructing a barometer on these lines. There are, of course, always possibilities of error, from the fact that it is extremely difficult to make such spiral tubes of the same calibre throughout; and hence arise differences in the value of the scale divisions which are placed on the instrument. With tubes of a certain diameter, the effects of capillarity would also make a correction necessary. These defects could, however, be allowed for if frequent comparisons at all points of the scale were made with a standard barometer.

A very favourite method of increasing the range of a barometer consists in floating the tube in a cistern of mercury. The tube is filled in the usual way and inverted, and is kept floating upright by means of friction guides. In this arrangement the tube floats higher or lower, according to the amount of mercury which flows to and from the cistern. With some self-recording instruments of this type the tube is attached to one arm of a balance, and is counterpoised by a weight on the other arm. The recording pencil is sometimes attached to this weight, or the arm itself may be made to record the oscillations by means of a pointer attached to it. It is well known that substances of a less specific gravity than mercury have been used as the barometric fluid, and barometers in which the tube is filled with linseed-oil, glycerine, or water are quite familiar, the great water barometer, for instance, being a popular exhibit at the Crystal Palace about 30 years ago. These are the giants among barometers, and although they are of certain interest as individual instruments, there is not much hope of their race increasing, and in the search for a sensitive barometer, something that requires less house room will find favour with the ordinary person; but, whatever their size, there are few instruments in the armoury of the meteorologist so full of potentialities as these sensitive barometers.

Ages of Birds.—It is only possible at present to collect data from the duration of lives of birds in captivity; evidence otherwise must be very unreliable, and it is purely a matter of theory as to whether the natural possible life is greater than that under the unnatural conditions of captivity. There are records of a nightingale having lived 15 years, a thrush 17, a blackbird that was still alive at 20½, a goldfinch 23, and skylarks of 24 and 20. Ravens, owls, and cockatoos are popularly supposed to live to a very great age, and the following records appear to be authentic: raven 50, grey parrot 50 and 40, blue macaw 64, eagle owls 53, and one still alive at 68. Some aquatic birds live to a ripe old age, for we hear of a hereon of 60, goose 80, mute swan 70. It is doubtful whether any of the foregoing ages are any true guide as to the longevity of the actual families the birds represent, or, indeed, whether the possible age of one family exceeds that of another; but the records are interesting, and form a step in the ladder of the investigation of this most difficult question. Mr. Gurney makes the statement that the colouring of a bird in perfect health and texture of its feathers are exactly the same at 50 as at 5, and that those signs that are popularly put down to age, such as bleached and faded plumage and misshapen claws or beak, are attributable to unnatural conditions of some kind. The great tenacity of life some birds possess when deprived of food is marvellous, and the following instances are given: Golden eagle 21 days, an eider duck 28, and albatross 35, and a penguin (Aptenodytes), it is stated, can live two months.—*Ibis.*



TOOL-GRINDING MACHINE.

THE illustration shows a tool-grinding appliance invented and patented in December, 1898, by Mr. H. S. Ilsley, technical instructor at the Westminster Bridge Road Board School, and will be appreciated by all who have to grind their own tools. By its means, not only the experienced workman, but the amateur, is enabled to grind accurately and quickly any tool to its required angle, and it obviates entirely the necessity and expense of turning up the stone. It has, we understand, been adopted by the School Board for London for use in their manual training centres, by the Royal Military Academy, Woolwich, and many other school boards, technical schools, and colleges. It can be fitted to any grindstone, and requires no previous experience. A full description will be found in Messrs. Francis and Company's advertisement on another page, and from them further particulars may be obtained.

MILLWRIGHT'S WORK.—X.

COMMON loose pulleys are generally retained in position with loose collars. These are either solid or split. The first are mostly made

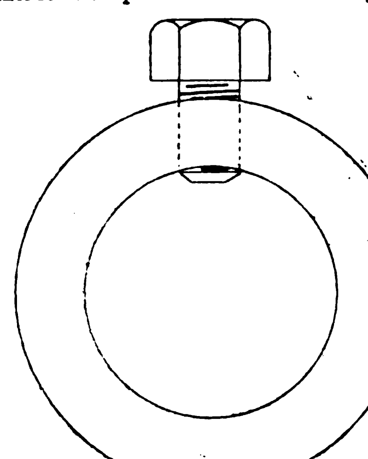


Fig. 58.

of wrought iron or steel, turned all over. Divided collars are chiefly in cast iron. The commonest type of solid collar, shown in Fig. 58, is a

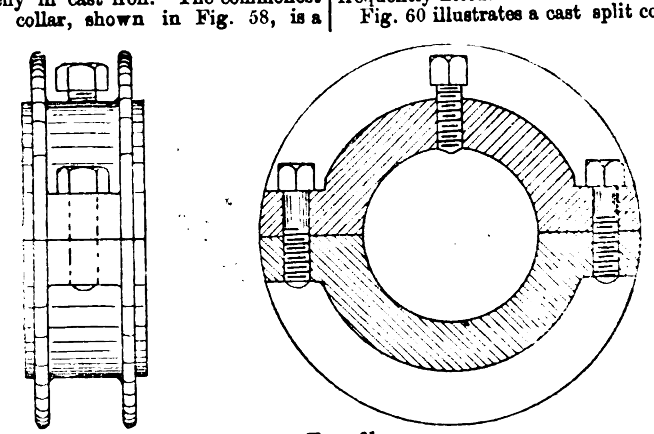


Fig. 61.

survival of an undesirable form, the only merit of which is its extreme simplicity. It is a little cheaper than the better ones, and these two features have insured its permanence. But it has been responsible, like the common coupling, for many accidents, and is not satisfactory in other respects. It lies open to the same objection as the ordinary coupling,—that it will only fit properly on a shaft which is of the same diameter as its bore. A thousandth of an inch, more or less, will cause a tight or a slack fitting. More-

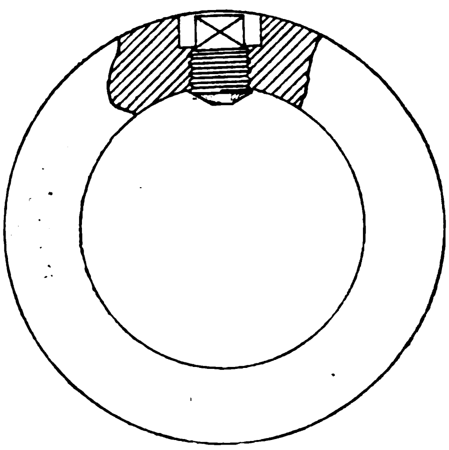


Fig. 59.

over, collars are liable to rust on their shafts, and the set-screws also rust up, and render their removal troublesome. Finally, they have to be slid on from the end, a generally undesirable arrangement.

The only improvement on the common collar is that in which the head of the set-screw is sunk

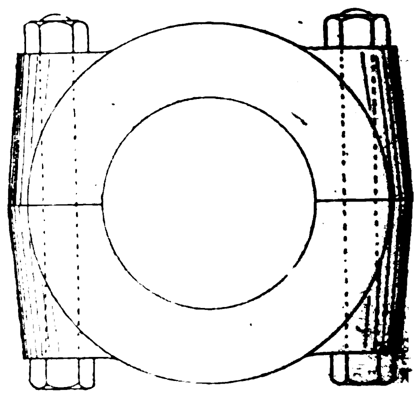


Fig. 60.

into a recess, Fig. 59. This avoids danger from entanglement with clothing, but leaves the remaining objections unaffected.

The set-screw in the figure has a square head, to take a box spanner. Sometimes the head is slotted, but the modern practice favours a screw, the head of which fills up the hole, and which has a square recess to receive a square tommy for tightening it up. In large collars two screws are frequently fitted.

Fig. 60 illustrates a cast split collar, with lugs to receive the bolts. It is not a desirable form, on account of the awkward way in which the bolt heads stick out. Fig. 61 is preferable, because the flanges protect the bolt heads. The

set-screw in this case is not always necessary, the gripping of the two halves being generally sufficient.

One of the best collars is that of Trier Bros., Fig. 62. It is not open to any of the objections just enumerated. The two halves are united

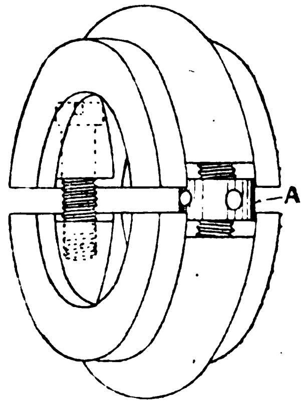


FIG. 62.

with screws. One screw is of the cheese-headed type, the other, A, is right and left handed, with a central boss and tommy holes. The collar being put on, the halves are nearly tightened with the double screw, then the cheese-head screw is run in tightly; the last grip is finally given with the double screw. The tightening of

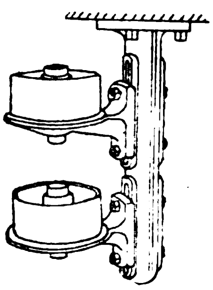


FIG. 63.

the latter screw keeps the former in tension, and prevents its becoming loosened by vibration. When closed thus, there are no projections, as the boss of the double screw presents the same section outside as that of the collar. The collar can be removed more easily than one which is driven or slid endwise over the shaft. A neat application of the Trier collar to a loose pulley was shown in the last article, Fig. 54.

Besides main pulleys there are numbers of

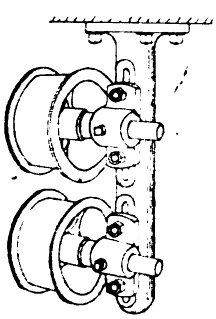


FIG. 64.

small ones which serve as guides, or binders or tighteners to the main driving belts. These are of small diameter, mostly under 12in. In some cases they are plain, in others they are double flanged, in others flanged on one edge only, as when they run in a horizontal plane. They often have to serve the functions of guides and binders. When they conduct belts at awkward angles it is frequently desirable to give them some range of adjustment for angle, hence the reason for the great variation in type which occurs.

Figs. 63—66 illustrate some guide pulleys as made by Croft and Perkins. In Fig. 63 a slotted bracket is bolted to the beam overhead. A bearing bracket slides in each slot in which it can be tightened within the range afforded by the slot, the belt running in a horizontal plane, and laying upon the flanges. Fig. 64 is a type for a belt running in a vertical plane, the bearing brackets

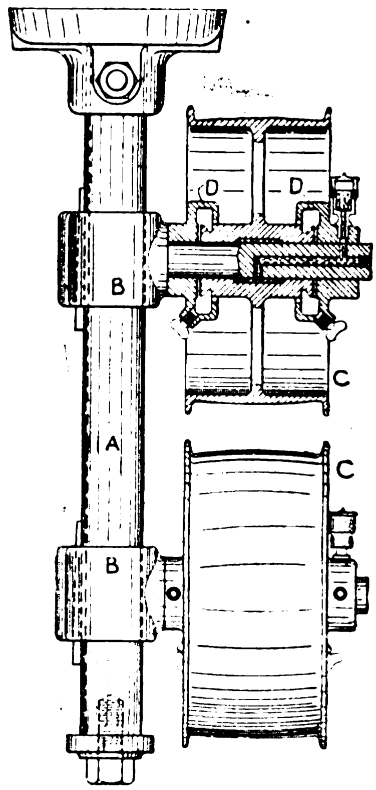


FIG. 65.

sliding in slots, and the pulleys running on pins pinched in the brackets with set screws. Pulleys without flanges can be similarly arranged. In another form the pulleys do not overhang, but run between bearings which are movable up and down a slotted plate.

In a third type, Fig. 65, the pulleys run on pins which have bosses adjustable vertically on a

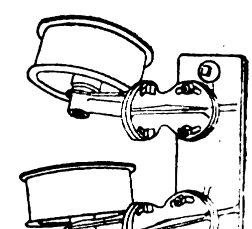


FIG. 66.

shaft of circular section. In this example special attention has been paid to the means of lubrication in conjunction with cleanliness.

The post A, of either cast or wrought iron, machined, and having a keyway cut its entire length, carries two trunnions, B B, of cast iron, bored to fit the post A, and having turned shanks

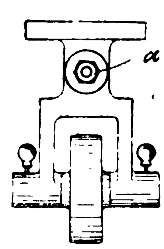


FIG. 67.

on which rotate the pulleys, C C, the shanks having a lubricating hole drilled up the centre, which is fed from a lubricator attached to the collar at the end of each shank. The trunnions B B are held in any position on the post A by means of keys. The two collars, D D, are arranged to form reservoirs for the waste oil, and catch it as it is thrown from the ends of the bosses of the guide pulleys. By removing a thumb-screw in each collar the waste oil may be run off.

In another type, Fig. 66, a universal movement is imparted to the pulleys by means of a double swivelling arrangement—one, that of the brackets, on the wall-plate, the other, that of the pulley-bearings, on the brackets in a plane at right angles with the first movement.

Fig. 67 is a binder-pulley which will swivel to any angle on the pin *a*.

ARTIFICIAL TEXTILE FIBRES.

THE following abstract of Mr. W. M. Gardner's opening lecture of the winter session in connection with the chemistry and dyeing department at the Bradford Technical College is taken from the *Textile Mercury*:—After describing the peculiarities of the three natural fibres, wool, cotton, and silk, Mr. Gardner said that if the structures of the three were contrasted, it would be seen that wool and cotton possessed a highly-organised or cellular structure, whereas silk, being merely a solidified liquid, had no special interior formation, thus resembling a thread of glass. It was therefore obvious that as regarded structure the silk fibre offered a much more promising field to the chemist who attempted its artificial reproduction than did the highly-organised wool or cotton. Given the requisite liquid, it would not be an insoluble problem to produce from it a

Fibre Resembling Silk

in every respect. On the other hand, it was hopeless to expect that an artificial fibre possessing the same internal structure as wool or cotton would ever be produced. No chemist had hitherto succeeded in reproducing the simplest body which exhibited a cellular structure. As regarded the chemical structure of the fibres, they found that cotton was the simplest in composition. Most of the artificial fibres were produced from cellulose as a basis, and thus were chemically more closely connected with cotton than with wool or silk; but one or two were obtained from gelatine, and thus approximated to silk. In appearance, however, they all, without exception, resembled silk rather than wool or cotton. The first attempts to produce a valuable fibre artificially consisted in dissolving waste solvent, and then saturating cotton yarn or thread in this solution, thereby greatly increasing the lustre. Mr. Gardner proceeded to mention a number of commercially valuable products formed by various reagents on cellulose, and similar to some of the artificial fibres in composition. Collodion silks constituted the ordinary "artificial silks" of commerce at the present time. The name, "lustro-cellulose," had been proposed for these products, but had not been generally adopted. It was proposed in 1894 to manufacture this product in England, and Bradford would in all probability have been fixed upon but for the fact that the heavy tax on alcohol in England rendered any manufacture in which it was largely used expensive. The works were, therefore, established near Zurich, but the company had an office in Bradford. The manufacture of art silk by the processes he had described might be considered as consisting in the solution of the cellulose, followed by its regeneration in the form of a fine thread, the increased lustre of the new fibre being due to its smooth external surface. Dealing with the action of reagents on cellulose, the lecturer said that the action of alkalis was not less interesting than the action of acids, since by the aid of alkalis several most important fibres, mercerised cotton, and several forms of viscose silk were obtained, as well as many other useful substances. The applications of the ordinary mercerising process were (1) to increase the affinity for dyes, (2) to produce crepon on cotton, (3) to produce crepons on wool, cotton, or silk-cotton unions. Now, it was possible to contract either the wool or the cotton in a mixed fabric. The most important outcome of the mercerising process, however, was the observation that by mechanically preventing the shrinkage which naturally occurred during the process, a greatly increased lustre was imparted to the cotton. By this simple modification of a fifty-year-old process, the textile industries had been enriched with what was practically a new fibre, which approached silk in lustre, but which was infinitely cheaper. He did not propose to embark upon the stormy seas associated with a discussion of the patent rights in connection with this process. Only during the last five years had it reached importance; but its enormous development, due largely to the skill and enterprise of the Bradford dyers, had been such that several thousand pieces of cotton cloth were lustred per day in that district, in addition to enormous quantities of hank and warp yarn. The magnitude of the trade was emphasised by the fact that, possibly for the first time on record, the value of the cotton material exported to the United

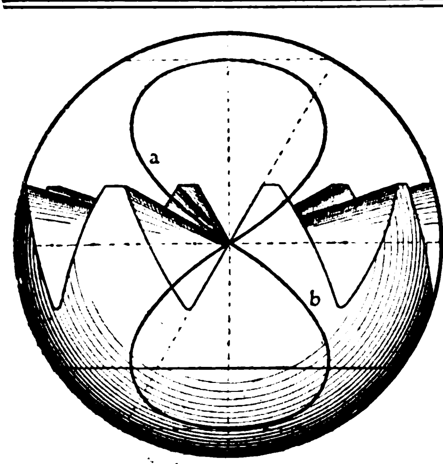


Fig. 1

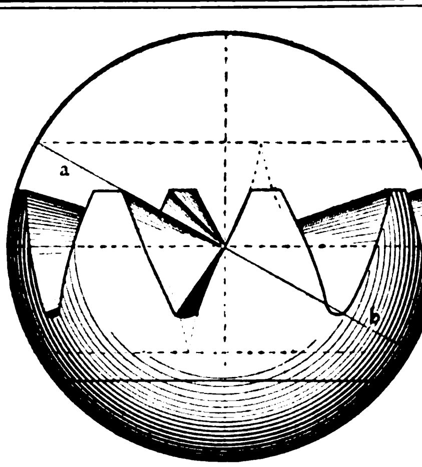


Fig. 2

States from the consular district of Bradford had, for the four months ended August 31, exceeded that of the dress stuffs, and was four or five times as great as the value normally exported during the same period. This was mainly due to goods lustred by mercerisation.

THE OCTOID SYSTEM OF GEAR TEETH.

SEVERAL readers have referred to the occasional use in our columns of the word "octoid," as descriptive of a system of bevel gear-teeth, and have asked for an explanation of the term. As this system is but little understood, and is often confounded with the involute system, a few words of explanation would seem to be appropriate.

The historical method of treating gear-teeth is to first determine the system of curves forming the outlines of the teeth, and the epicycloidal and involute systems are usually discussed from this standpoint. The rack being a special case of a gear, its profile is a special case of the general system of tooth curves, and by the above system of treatment the rack-tooth curve is the outcome of the general system of curves decided upon at the start, and, as is well known, in the involute system is a straight line. As is also well known, the profile of a gear-tooth may be assumed at random, and a mating or conjugate tooth may be found which will work correctly with the assumed curve, and with all similar conjugates belonging to gears of various sizes. In this way an indefinite number of tooth-curve systems may be originated. For instance, a gear might be made with circular tooth profiles, and mating curves might be found which would not themselves be circles, but which would mesh correctly with the original circular profile, and with each other. This original gear might be of any size, and it might be a rack.

Should such a rack be employed with straight profiles, the resulting conjugate profiles would be involutes, because the involute profile for a rack is a straight line. Again, had the rack a cycloidal outline, the resulting conjugates would conform to the epicycloidal system. This system of originating tooth-curves will be seen to be the reverse of the historical one. In the latter the rack-curve is at the end of the process, and is a development of the general system, while in the former it is at the beginning, and is the base of the system. The Fellows gear-shaper is an example of the newer method applied to spur gear-cutting, a straight-sided rack-tooth forming the starting-point of the system, from which a cutter with conjugate teeth is generated, and which in turn generates conjugate teeth in the gears. With the Fellows machine the resulting curves do not differ from those obtained in the usual way on the involute system, the difference between the Fellows and the older methods being mechanical rather than geometrical.

With bevel gears the analogue of the rack is the crown gear, the tooth profile of which is a special case of the general tooth-curve system, precisely as with a rack, and by assuming the crown tooth profile, various systems of bevel curves may be originated, as with a rack and spur profiles.

Now, while the rack-tooth profile of the involute system is a straight line, the crown-tooth profile of the same system is not, but is curved, as with other bevel teeth, and the adoption of a straight-sided crown-tooth results, therefore, in a new system of tooth-curves, which is called the octoid system. The straight-sided crown-tooth is adopted because, being the starting-point in these systems of construction, it must be easy to originate, and this condition is, of course, best met by the straight-sided tooth.

The name of the octoid system is derived from the fact that the form of the path of the point of contact with complete teeth is a figure-of-8 curve, as shown by the line *a b* in the accompanying Fig. 1, which represents an octoid crown gear. The octoid system was first employed, and in fact invented, by Mr. Hugo Bilgram, all bevel gears cut on his well-known generating machine having such teeth, and the same is true of all generated bevel gears which are originated from a straight-sided crown gear-tooth.

The octoid has been widely confused with the involute tooth, owing to the erroneous assumption that an involute crown gear-tooth has straight sides like a rack-tooth. The first publication of the facts was, we believe, contained in an article by Mr. George B. Grant, published in our columns for October 13, 1890, and since republished in his well-known book, "Odontics."

The difference between the octoid and involute crown gear-tooth can be seen by comparing Figs. 1 and 2, which are reproduced from those published in connection with Mr. Grant's articles. Fig. 1 shows the octoid, and Fig. 2 the spherical involute. With the latter the path of the point of contact is the great circle *a b*.—*American Machinist.*

TRAVELS IN ABYSSINIA.

IN the Section of Geography at the meeting of the British Association, Capt. Wellby gave an account of his recent travels in Abyssinia, in the course of which he said that King Menelek's capital consisted merely of an accumulation of huts, with the Palace or Ghébi of the King planted conspicuously on a small hill. The land in the valley was well watered and good, the climate invigorating, and the grazing all that could be desired. But there was no wood. Wood was brought in daily from a distance of 15 miles, and was comparatively the most expensive article in the market. At the time of his arrival in the capital with Capt. Harrington, King Menelek was about to march north with an army of 70,000 men, and he travelled with the King. While on the march he was struck with the thorough knowledge these so-called "savages" displayed of their own individual duties. One Sunday morning, when all were resting, the King with a lavish hand breakfasted his loyal subjects, governors of provinces, generals, and common soldiers alike. The meal mainly consisted of huge legs of raw, quivering beef, the repast being concluded in a most unexpected manner by glasses being handed round and filled with champagne. It was civilisation washing away barbarism. Though his sojourn in this Christian land was short, he could not help feeling convinced that when the Abyssinians had still further tasted the pleasures and profits of the civilised world, they would adopt more of its ways and customs, and it must be remembered that the Abyssinians had in a way lived independently, untouched by European nations and their inventive power, and thus they were, from our point of view, steeped in the most astonishing ignorance; but for all that there lay in them a mint of pluck, energy, and intelligence which was merely waiting for development. The Abyssinian dominion at the present day extended to a far greater extent south than was generally supposed. Some of the tribes who willingly bore the collar of subjection were apparently contented and well fed, while others, whose spirits were too elevated for subjection, had an opposite existence. Those who relied for food solely on milk and meat were of finer physique than those favoured with cereals as well, while those dependent on fish and vegetables were, as a rule, miserable looking. Furthermore, they dispelled the idea that fish was productive of a plethora of brains. Capt. Wellby said that a couple of days south of the capital they came to the sacred hill of Zagnala, on the summit of which he discovered a lake said to be of unfathomable depth. Looking from the summit of this hill he viewed the distant lake of Zouei, the first of a chain of three lakes connected by running streams. The water of the first he described as good and fresh, of the second as brackish but drinkable, and of the third as highly offensive to the palate. On the banks of the first two lakes were tribes living in a very poor way, but on the third was an independent tribe, which had never, so far as he knew, been visited by any white man. They evidently took him and his Somali companions for an Abyssinian party, and had not darkness come to his assistance he must have fared badly. Other tribes in the district displayed both friendship and hospitality. After crossing a belt of beautiful, though waterless, land, he entered the country of the Walamo, a people credited with the power of transferring the feelings and behaviour of a devil into the body of the stranger. Two theories had been suggested to him of the strange feelings experienced in this country—first, that the body was affected by the water of the district, which was probably impregnated by metals; secondly, as to the mental effects, it had been suggested that, without being aware of it, he was eating his meal before these people under a great mental strain; but the argument was rather beyond him. Further south lay the most picturesque district he had visited. He found hills nearly 11,000ft. high, some clad with slopes of green turf, and others with thick wood. From one of these high-lying camps another chain of beautiful lakes was seen, on the shores of which there existed a mark to commemorate the spot where Sacchi, the friend and doctor of Botego, was killed. Dropping into the plains, he steered for Lake Rudolph, or, more properly, Lake Gallop, where his escort of Abyssinian soldiers left his expedition to their own devices, their place being taken by 30 head of cattle, presents from the Abyssinians. Shortly before this he had come across a tribe called the Asilli. They always asked him for rain, as they entertained the notion that whenever thunder took place a white man was born, and thus the white man must always be able to bring rain. Probably they believed this because they had never seen a white woman. The western shore of Lake Gallop was a pleasant and inviting land, with an abundance of game, both fish, fowl, and meat. The climate was good and the scenery various. At this time the baggage animals were dying at an alarming rate from anthrax, and instead of eating their cattle they turned them into beasts of burden. Some travellers, he was told, adopted the plan of cutting steaks from the living animal, but they had no need to test this economical plan. From the southern end of the lake they struck a westerly course into the unknown before steering north again for the outlying Sudan post of Nasser, on the river Sobat, some 180 miles from its junction with the White Nile. During the journey of over 700 miles they discovered two sources of the Sobat, and came into contact with many more tribes, with all of whom they established a friendly feeling, the most interesting tribe met with being a race of giants. These savages stood in many instances 7ft. high. They wore rings of iron round their arms and necks, sometimes of such a ridiculous height that the head could only be moved slightly to the right or left. The hair hung over the shoulders to the waist, being further lengthened by the addition of a long stick resembling a tail. The end of the hair was turned up and formed a receptacle for knick-knacks. They carried two spears and a sleeping-pillow, and, like most savages, had no desire to stand before the camera.

GENIUS AND HEREDITY.

DOES the first-born have the best of it from the start? According to Prof. Axenfeld (in the *Rivista Moderna di Cultura*), all the men of genius are first-born sons. He says that eminent persons can be also the second or third children of a family, but a fourth, fifth, and sixth child will never be a great light. After a sixth child, the rest may again become men of talent. This is a terrible discovery. The poor fourth, fifth, or sixth sons, as they have no chance of having brains, are not worth giving a high education, and will make very mediocre husbands! Prof. Axenfeld quotes names to prove his theory, all mixed up any way: Luther, Schopenhauer, Francesco d'Assisi, Catherine of Medici, Guizot, Dante, Rafael, Leonardi da Vinci, Perugino, Luigi Gonzaga, St. Benedict, Charlemagne, Alexander the Great, Boccaccio, Confucius, Heine, Goethe, La Bruyère, Ariosto, Campanella, Mohammed, d'Alembert, Shelley, Christine of Sweden, Goldoni, Cantu, Buckle, Buffon, Talleyrand, Milton, Byron, Leopardi, Molière, Carlyle, Rossini were all first-born or only sons. Beethoven, Michael Angelo, Rousseau, Cuvier, Pascal, and Garibaldi were second sons. But there have been other famous men in the world. Cannot somebody produce some comfort for the late-comers in a family?

THE silk industry of China employs, it is estimated, from 4,000,000 to 5,000,000 people.

THE BRITISH ASSOCIATION.

ABSTRACTS OF REPORTS, PAPERS, &c.

Value of Gravity.

A GRAVITY balance invented by Prof. Pollock and Prof. Threlfall, F.R.S., was described by the latter. The apparatus consists essentially of a quartz fibre fixed at its ends and stretched horizontally. The fibre carries at its centre a light wire at right angles to its length, and loaded. The fibre is twisted until the wire is only just in stable equilibrium, under which circumstances a very small change in the value of gravity will cause it to tilt through a measurable angle. The author described the excellent devices by which the instrument has been brought to such perfection as to enable him to detect changes in gravity which amount to less than two-millionths of the whole acceleration of gravity. The instrument is portable, and has been used in a coast survey of Australia, during which it travelled 6,000 miles; since then it has been brought to England, and its sensitiveness is unimpaired. The short pendulums used in the United States Coast Survey gave results accurate to four parts in a million, this being, however, the mean of observations with three such pendulums, and not the record of a single instrument. Prof. Vernon Boys, F.R S., congratulated the author on the new use to which he had put quartz fibres.

The President, Prof. Poynting, said that when the Committee on Gravity Meters was appointed in 1884, they asked for designs for an apparatus to measure changes in gravity amounting to one part in 100,000, and they would have been satisfied with less than this. He was glad to notice the improvement which had taken place since that time. Prof. G. H. Darwin, F.R.S., stated that he would draw attention to Prof. Threlfall's apparatus at the International Geodetic Conference.

Seismology.

The report of the Seismological Committee was presented by Mr. G. J. Symons, F.R.S. It contains details of many observations on earthquakes during the past year from the different stations at which seismographs have been established. A section is devoted to a discussion of the earthquake registers, and is followed by one on varieties of earthquakes and their respective durations. On this subject Prof. Milne remarks: "The shiverings of our world recur on the average every 30 minutes, but the heavy breathing or true ground-swell does not happen more than once a week. Popularly they are both earthquakes, but they differ in their character, in their duration, and probably in their origin, and as they radiate their life, as exhibited at stations further and further remote from their origin, rather than increasing, becomes less." The question of so-called earthquake-echoes is next discussed in detail. An earthquake disturbance as recorded at a station far removed from its origin shows that the main movement has two attendants, one which precedes and the other which follows. The first of these by its characteristics indicates what is to follow, whilst the latter in a very much more pronounced manner will often repeat at definite intervals, but with decreasing intensity, the prominent features of what has passed. Inasmuch as these latter rhythmical but decreasing impulses of the dying earthquake are more likely to result from reflection than from interference they have been provisionally called echoes.

Kite Meteorology.

An account of work done at the Blue Hill Observatory, Massachusetts, by the aid of kites, was given by Mr. A. L. Rotch. The average of the highest points attained by the meteorograph in each of the 35 flights during 1898 was 7,350ft. above the sea, the average of the ten flights during the first four months of 1899 was 7,680ft., and that of the five flights between Feb. 23 and 28 was 10,280ft. The maximum height attained in 1898 was exceeded by 370ft. on Feb. 28 this year, when an altitude of 12,440ft. was reached. The increase of altitude was smaller than in previous years, and this indicated that the extreme height to which the kites could rise was being approached. The features of the Blue-hill practice that enabled great heights to be reached were the use of cellular kites having curved surfaces, giving greater lift, with self-regulating bridles limiting the wind-pressure on each kite, and the attachment of the kites at different points on the wire, whereby their pull was distributed. Some important meteorological results had been obtained during the past year. The value of kites for meteorological observations, as demonstrated at Blue-hill, had led to their trial in the United States and in Europe. The attempt of the United States Weather Bureau to secure each day records with kites a mile above 16 stations was unsuccessful for forecasting on account of light winds, which prevented daily flights at all the stations; but many data were obtained simultaneously in the free air and at the ground. The German and Russian Meteorological Bureaux would employ kites at Hamburg, Berlin, and St. Petersburg; and at Trappes, near Paris, M. L. Teisserenc de Bort has already got records at great heights. It appeared, therefore, that henceforth the equipment of a meteorological observatory should include the kite (and perhaps the captive balloon, for use when wind was lacking), so that automatic records might be obtained at the height of a mile or two in the free air at the same time as observations on the ground.

Standard Thermometry.

The best means of measuring and recording temperature formed the subject of a note by Prof. H. L. Callendar, F.R.S., and in the course of his remarks he said:—The gas thermometer, which had so long been adopted as the theoretical standard, had given results so discordant in the hands of different observers at high temperatures as greatly to retard the progress of research. The arguments in favour of the platinum resistance thermometer as a practical standard given by the speaker in 1886 had since been confirmed and strengthened by the work of many independent observers. The proposals were:—(1) That a particular sample of platinum wire be selected, and platinum resistance thermometers constructed to serve as standards of the platinum scale of temperature. (2) That the scale of temperature deduced from the standard platinum scale by means of a parabolic formula which has been proved to give a very close approximation to the true or thermo-dynamic scale, be recommended for adoption as a practical standard of reference, and be called the British Association scale of temperature. It should be noted that the gas thermometer would still remain the ultimate or theoretical standard, and the exact relation of the British Association scale of temperature. It should be noted that the gas thermometer would still remain the ultimate or theoretical standard, and the exact relation of the British Association scale to the absolute scale would be the subject of future investigation. In the present state of experimental science the difference between the two scales over the greater part of the range was less than the probable errors of measurement with the gas thermometer, and the possible accuracy of measurement with a platinum thermometer, especially at high temperatures, was of a much higher order than with the gas thermometer.

Rearing Sea-Fish.

An account of the experiments at Plymouth made by Mr. Walter Garstang on the artificial rearing of sea-fish was read by that gentleman, who, in the course of his remarks, said that the only successful experiments hitherto had been conducted by Dr. Meyer, of Kiel, who had reared the fry of the Baltic herring, and by Mr. Dannevig, who had reared the fry of the plaice. This summer he himself undertook some experiments with the larvæ of the butterfly-blenny (Blennius ocellaris). The first problem was to determine what volume of water was necessary to healthy development. At first he placed 25 just-hatched larvæ into a two-gallon jar. In the first experiment, however, the water was not fresh, and all the larvæ were dead in five days. Two other similar jars, containing fresh sea-water and the same number of larvæ each, were then placed, one in a window so that the light had full access, and the other in a tank of water maintained at a constant temperature. In the former case, the larvæ were all dead at the end of ten days, and in the latter case the death-rate was smaller, though only one of the larvæ survived to the fifteenth day. It appeared to him that in these experiments the jars had been too crowded, and so, in the next experiment, only 19 larvæ were placed in the jar, which was immersed in water kept at a constant temperature. For more than a week all the larvæ survived; and at the end of twenty days the larvæ were so healthy that they were taken out of the jars and placed in an aquarium with circulating water. There were six or eight of them alive a week ago, and only one had died since he left. A large part of the actual mortality was due moreover to preventible accidents which had no bearing on the conditions of the experiment; but these experiments convinced him that in stagnant water not more than ten larvæ could be reared in two gallons of sea water; and when he put this opinion to the test he found that there was a very slight mortality, and at the present moment he had larvæ five weeks old and in a healthy condition. The success of these later experiments he attributed largely to the fact that he employed "plunger" jars, in which the water at the bottom of the jar was being constantly drawn up to the top. This mechanical stirring of the water in the jars was very necessary in the early period of the cultivation of the fry. There was a very high mortality among the larvæ when placed even in large tanks if the water was not stirred. His investigations showed that it was possible to determine in the laboratory the conditions in which the larvæ of sea-fish might be safely brought through the critical stage of their development. During the coming season he intended to renew his experiments with the larvæ of several food fish.

Report on Water Analysis and Sewage.

An interim report was presented by the committee, consisting of Profs. W. Ramsay (chairman), Dr. Rideal (secretary), Sir W. Crookes, Prof. F. Clowes, Prof. P. F. Frankland, and Prof. R. Boyce, in which it was stated that it is desirable that results of analysis should be expressed in parts per 100,000, except in the case of dissolved gases, when these should be stated as cubic centimètres of gas at 0° C. and 760mm. in one litre of water. This method of recording results is in accordance with that suggested by the committee appointed in 1887 to confer with the committee of the American Association for the Advancement of Science, with a view to forming a uniform system of recording the results of water analysis. [Brit. Assoc. Report, 1889.] The committee suggest that in the case of all nitrogen compounds the results should be expressed as parts of nitrogen over 100,000, including the ammonia expelled on boiling with alkaline permanganate, which should be termed albuminoid nitrogen. The nitrogen will, therefore, be returned as: (1) ammoniacal nitrogen from free and saline ammonia; (2) nitrous nitrogen from nitrites; (3) nitrous nitrogen from nitrates; (4) organic nitrogen, either by Kjeldahl or by combustion, but the process used should be stated; (5) albuminoid nitrogen. The total nitrogen of all kinds will be the sum of the first four determinations. The committee are of opinion that the percentage of nitrogen oxidised—that is, the ratio of 2 and 3 to 1 and 4—gives sometimes a useful measure of the stage of purification of a particular sample. The purification effected by a process will be measured by the amount of oxidised nitrogen as compared with the total amount of nitrogen existing in the crude sewage. In raw sewage and in effluents containing suspended matter it is also desirable to determine how much of the organic nitrogen is present in the suspended matter. In sampling the committee suggest that the bottles should be filled nearly completely with the liquid, only a small air bubble being allowed to remain in the neck of the bottle. The time at which a sample is drawn, as well as the time at which its analysis is begun, should be noted. An effluent should be drawn to correspond as nearly as possible with the original sewage, and both it and the sewage should be taken in quantities proportional to the rate of flow when that varies (e.g., in the emptying of a filter-bed). In order to avoid the multiplication of analyses the attendant at a sewage works (or any other person who draws the samples) might be provided with sets of 12 or 24 stoppered ½ Winchester bottles, one of which should be filled every hour or every two hours, and on the label of each bottle the rate of flow at the time should be written. When the bottles reach the laboratory quantities would be taken from each proportional to these rates of flow and mixed together, by which means a fair average sample for the 24 hours would be obtained. The committee at present are unable to suggest a method of reporting bacterial results, including incubator tests, which is likely to be acceptable to all workers.

Action of Light upon Metallic Silver.

A paper by Col. J. Waterhouse on the "Action of Light upon Metallic Silver" was read by Mr. J. Spiller. It stated that when cut masks are laid on the surface of silver leaf or foil, or on a Daguerreotype plate, and exposed to the sun's rays, a visible image ultimately appears on the metallic surface. The effect is produced more rapidly if the metallic surface has been exposed to mercury vapour or immersed in an acid solution of a ferrous salt mixed with nitrate of silver. Copper and probably other metals are sensitive in the same way.

Electrolytic Solution Pressure.

In a note on this subject Dr. R. A. Lehfeldt discussed the theory of electrolytic solution pressure, in which he stated that, according to Nernst's theory, when a metal is immersed in an electrolyte a minute amount of its goes into solution in the ionic form, giving a positive charge as the liquid as compared with the metal, or ions from the solutions are deposited in metallic form, giving the metal a positive charge according as the osmotic pressure of the ions in solution falls short of or exceeds an amount known as the electrolytic solution pressure. This view had been generally adopted by physical chemists, it being supposed that the amount of metal to be deposited or dissolved was too small to measure. By combining the calculated value of the solution pressures with the known theorems of electrostatics on the tension exerted by electric charges, it might be shown, in the case of zinc at least, that the amount dissolved would be some centigrammes per square centimètre immersed, and could be easily weighed. Hence the theory seemed to break down.

Grants in Aid.

The following grants of money in aid of scientific research have been made by the British Association through the general committee. The asterisk means "re-appointed," and the sums are pounds sterling. In some cases there is sufficient money in hand, and

grants were not made:—MATHEMATICS: *Lord Rayleigh, Electrical Standards (£300 in hand), £25; *Prof. J. W. Judd, Seismological Observations (£9 5s. 4d. in hand), £60; *Prof. G. F. FitzGerald, Radiation in a Magnetic Field, £25; *Prof. A. W. Rücker, Magnetic Force on board Ship, £10; *Prof. H. L. Callendar, Meteorological Observatory, Montreal, £20; *Lord Kelvin, Tables of Mathematical Functions, £75; CHEMISTRY: *Prof. W. N. Hartley, Relation between Absorption Spectra and Constitution of Organic Bodies, £30: *Sir H. E. Roscoe, Wave-length Tables, £5; *Prof. J. E. Reynolds, Electrolytic Quantitative Analysis, £5; Prof. H. A. Miers, Isomorphous Sulphonic Derivatives of Benzene, £20; Mr. F. H. Neville, The Nature of Alloys, £30. GEOLOGY: *Prof. J. Geikie, Photographs of Geological Interest, £10; *Prof. W. B. Dawkins, Remains of Elk in the Isle of Man, £5; *Sir J. W. Dawson, Pleistocene Fauna and Flora in Canada, £10; *Prof. C. Lloyd-Morgan, Ossiferous Caves at Uphill (£8 in hand), £10; Prof. W. W. Watts, Movements of Underground Waters of Craven, £40); Dr. Scharff, Exploration of Irish Caves, £20. ZOOLOGY.—*Prof. W. A. Herdman, Table at the Zoological Station, Naples, £100; *Mr. G. C. Bourne, Table at the Biological Laboratory, Plymouth, £20; *Dr. H. Woodward, Index Generum et Specierum Animalium, £50; *Prof. Newton, Migration of Birds, £15; Prof. E. Ray Lankester, Plankton and Physical Conditions of the English Channel, £40; *Prof. Newton, Zoology of the Sandwich Islands, £100; Mr. A. Sedgwick, Coral Reefs of the Indian Region, £30. GEOGRAPHY: Sir John Murray, Physical and Chemical Constants of Sea Water, £100. ECONOMIC SCIENCE AND STATISTICS: Mr. L. L. Price, Future Dealings in Raw Produce, £5. ANTHROPOLOGY: *Mr. A. J. Evans, Silchester Excavation, £10; *Prof. D. P. Penhallow, Ethnological Survey of Canada, £50; *Prof. E. B. Tylor, New Edition of "Anthropological Notes and Queries," £40; *Mr. C. H. Read, Photographs of Anthropological Interest, *Mr. E. W. Brabrook, Mental and Physical Condition of Children, £5; Mr. C. H. Read, Ethnology of the Malay Peninsula, £25. PHYSIOLOGY: *Prof. E. A. Schäfer, Physiological Effects of Peptone, £20; Prof. E. A. Schäfer, Comparative Histology of Supra-renal Capsules, £20; *Prof. F. Gotch, Comparative Histology of Cerebral Cortex, £5; Prof. F. Gotch, Electrical Changes in Mammalian Nerves, £20; Dr. Starling, Vascular Supply of Secreting Glands, £10. BOTANY: *Prof. J. B. Farmer, Fertilisation in Phæophyceæ, £20. CORRESPONDING SOCIETIES: *Prof. R. Meldola, Preparation of Report, £20. Total, £1,115.

LEVERAGE OF THE LOCOMOTIVE DRIVING-WHEEL—WHY THE LOCOMOTIVE MOVES.*

PLEASE explain why a locomotive moves. It may be simple enough to anyone who knows; but there are several of us mixed up on it. What I mean is, how is the power applied to the wheels during an entire revolution? Take a locomotive when the pin is on the bottom quarter, going ahead. What are the points of the lever in the wheel? Is the fulcrum at the centre of the axle, at the crank-pin, or at the point of contact with the rail? It is easy enough to understand a stationary engine. The front and back cylinder-heads form the resistance for the steam to push the piston; but when you consider a locomotive when the main pin is on the bottom quarter, going ahead, it seems to several of us that the piston forms the resistance, and the front cylinder-head pulls the locomotive along. That would change the point on the driving-wheel at which the power is applied.

In reply to the inquiry of our correspondent we would say that the problem is one that may be better presented by a graphical illustration and somewhat lengthy treatment. For simplicity we will confine our observations to one side only of the engine.

Fig. 1 shows the direction of the force applied by the main rod A on the pin B. As we are concerned only with horizontal forces in the movement of the locomotive along the track, we can resolve, by the law of parallelogram of forces, this oblique or angular force exerted by the main rod into perpendicular and horizontal forces p and h respectively. As p is of no value in this problem, we will omit it, and retain only the horizontal force h, which will henceforth be known as P, the actual horizontal pressure exerted on the pin by the main rod. Thus we will avoid all entanglements with, and need make no further reference to, the angularity of the main rod in dealing with this problem.

Fig. 2 shows the driving-wheel acted upon by P, the force at the pin P_1, the driving-box resistance, and P_2 the force at the point of contact between the wheel and rail. The arrows indicate the direction the forces are acting—viz., P and P_2 are forward, and P_1 is backward. Thus we have a lever of the second class, whose arms are respectively 12in. and 30in., and which is fulcrumed at P_2. The force exerted on the pin, we will say, is 10,000lb. Now we know the two lever-arms and the force P_1, and will proceed to find the two unknown forces P_1 and P_2. At the instant before the wheel starts to revolve there there is an equilibrium of forces about the fulcrum point P_2; i.e., force P, multiplied by its lever-arm (the distance between P and P_2, which is 42in.), is balanced by the opposing force P, multiplied by its lever-arm (the distance between P_1 and P_2, which is 30in.)

This we will state by the equation

$$P_1 \times 30 = P \times 42;$$

or, substituting the known value of P, which is 10,000lb., we have—

$$P_1 \times 30 = 10,000 \times 42;$$

or, multiplying together the terms in the right-hand side of the equation, we have—

$$P_1 \times 30 = 420,000.$$

Now, P_1 is an unknown quantity; but we can find its value, for we know, as the equation states, that 30 times P_1 is equal to 420,000. Therefore P_1

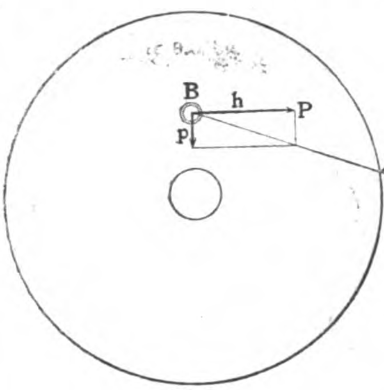


Fig. 1

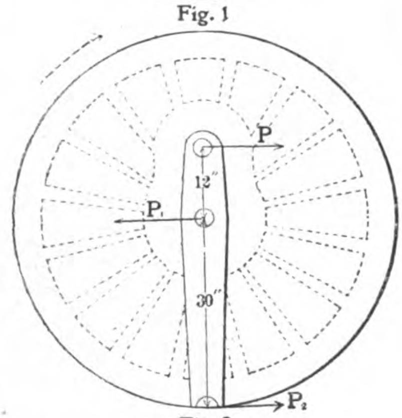


Fig. 2

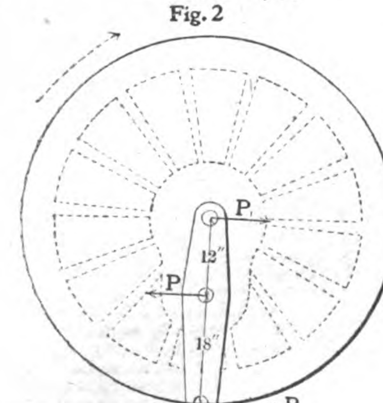


Fig. 3

itself must be equal to one-thirtieth of 420,000, which is 14,000. Now, as we know that the value of P_1 is 14,000, and of P is 10,000, we will put the figures instead of the letters in the equation—

$$P_1 \times 30 = P \times 42,$$

and we will have—

$$14,000 \times 30 = 10,000 \times 42;$$

or, performing the multiplication, we have—

$$420,000 = 420,000.$$

Thus equilibrium is proved.

Now that equilibrium of the forces has been proved, what have we accomplished that is useful? The answer to this question is that we have a proof that at the instant before the wheel begins to revolve, the forward-acting force of 10,000lb. on the pin at the upper end of the lever just balances the backward-acting force of 14,000lb. on the axle at the middle point of the lever. Now that this is proved, another step can be made. We will add enough more steam-pressure to the piston to increase the force on the pin to, say, 10,001, instead of the even 10,000 as before. Now equilibrium is broken (for 10,001 times the lever-arm, 42, equals 420,042, and is greater than 14,000 times 30in., which equals 420,000), and the lever will start to rotate about its fulcrum, P_2, and move in the direction of the greater force, which is to the right. Thus the wheel begins to roll to the right, and the engine moves forward.

Let us return for a moment to the lever held in equilibrium, as shown in Fig. 2, for we have not yet found the value of P_2, the adhesion between the wheel and the rail. To find the value of P_2, we will assume the fulcrum (during this part of the computation) to be at P, the pin. This assumption gives a forward force of P_2 multiplied by a lever-arm of 42in. balancing a backward force, P, multiplied by a lever-arm of 12in. Putting this in the form of an equation, we have—

$$P_2 + 42 = P_1 \times 12.$$

But P_1 has a value of 14,000lb., as proved. Putting this in, we have the equation—

$$P_2 \times 42 = 14,000 \times 12;$$

or,

$$P_2 \times 42 = 168,000.$$

We do not know the value of P_2; but we do know, as the equation states, that 42 times P_2 is equal to 168,000lb. Hence P_2 must be the one forty-second part of 168,000lb, which is 4,000lb. To prove this, and also to prove our right to assume the fulcrum to be at the pin during this part of the computation, the forces directed forward must balance those directed backward—i.e., $P + P_2$ must $= P_1$, or $10,000 + 4,000 = 14,000$. This is done, and is therefore proved.

We will now rotate the wheel ahead one half-revolution, as shown in Fig. 3, which places the pin on the lower quarter. This gives us a lever of the third class, where the force P is applied at the middle point of the lever, and the fulcrum is still at the point of contact between the wheel and the rail. Again, at the instant before the wheel starts to revolve, and the lever to rotate about the fulcrum P_2, the forces pointing to the left multiplied by their lever-arm must equal those pointing to the right multiplied by their lever-arm. Putting this in the form of an equation, we have—

$$P_2 \times 30 = P \times 18.$$

As the pressure at the pin is the same on the lower quarter as on the upper, we can replace the letter P in the equation with 10,000lb., thus—

$$P_1 \times 30 = 10,000 \times 18;$$

or,

$$P_1 \times 30 = 180,000.$$

If 39 times P_1 is equal to 180,000lb., as the equation states, then P_1 itself is equal to one-thirtieth of 180,000lb., which is 6,000lb. Therefore P_1 equals 6,000lb.

Now that we know both the forces P and P_1, we can easily determine P_2; for $P_1 + P_2$ together oppose and hold P in equilibrium. Hence P_2 is the difference between 10,000lb. and 6,000lb. (P and P_1), or 4,000lb. Thus it will be seen that the forces on the pin and the rail above the centres are the same as those on the pin and rail below the centres. One notable difference, however, is the pressure of the axle in the driving-box, which is greater while the pin travels through the half-revolution above the centres than that below. This is true whether the engine be running forward or backward.

Thus we learn that while the pin travels through the upper half-revolution, we have a lever of the second class, which gives the same pressure on the pin and pull on the rail as that had during the revolution through the under half, when the lever is of the third class. The progress of the engine through space should, therefore, be uniform.

Beginning at the back centre, as the engine moves ahead one half-revolution of the driving-wheels, the cylinders, frames, and other fixed parts of the locomotive move forward through space a distance equal to one-half the circumference of the driving-wheels, which is equal to one-half the diameter of the wheel multiplied by 3·1416 (30 × 3·1416), or 94¼in. During this half-revolution the piston pulls away from the back cylinder-head, and, with the second-class leverage in the wheel, pulls the locomotive along. The absolute travel of the piston through space is, therefore, 94¼in. + 24in. (the stroke), or 118¼in.

As the wheel completes the revolution, moving the pin from the forward centre through the lower half-revolution to the back centre, the fixed parts of the locomotive move through 94¼in. more space, making 188½in. in all. The piston, through this half-revolution, now loses 24in., and travels, therefore, but 70¼in. forward. Through this half of the revolution the piston forms the resistance, moving forward more slowly than the cylinder-head, which

* By F. M. NELLIS, in *Locomotive Engineering*, N.Y.

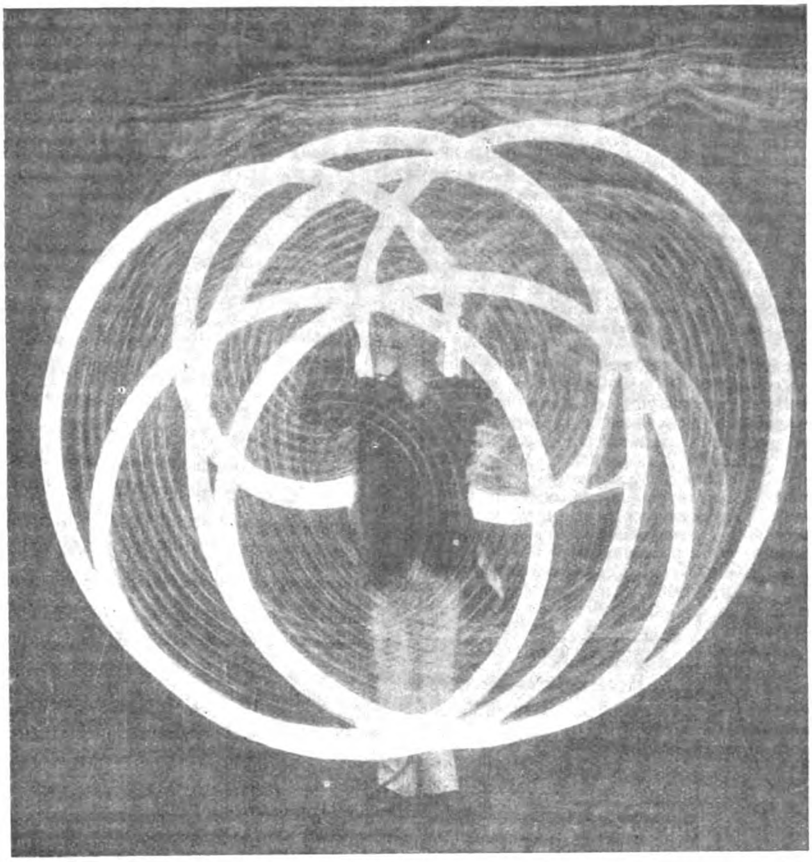
pulls ahead whilst the piston forms the resistance. The pressure on the piston through the lower half-revolution is exerted on the third-class leverage in the wheel.

The only times during the revolution that the piston stands absolutely at rest (in relation with the ground) is at the two dead-centres.

A MARINE ENGINEERS' LABORATORY.

THE Institute of Marine Engineers, that has its "home" in the Romford-road, Stratford, E., has been recently considering the best means of establishing a "laboratory" for the instruction of students, and also for the depositing of the experiences of those engineers who have made many trips over the seas. Mr. G. Halliday read a paper at the last meeting, in the course of which he said that, some years ago, it was the intention of Mr. Macfarlane Gray and Sir John Fortescue Flannery to establish a laboratory in connection with the institute, which would serve as a means of education to the younger members who might be at home or to members who might be at home from abroad. There was a difficulty, he believed, with regard to rooms. About the beginning of this year a small committee, with the best encouragement from the council of the institute, began to make some simple and inexpensive experiments in the rooms of the basement. They were simple experiments, and the making of them did not interfere with any of the other work going on at the same time in the institute. After the first experiments had been successfully carried through others were made, and before the committee almost had time to think where it had got to, it found itself in possession of thirteen sets of apparatus, each set furnishing the means to perform a separate set of experiments. Mr. Halliday read a list of the sets of experiments, and continued: Considerable progress has been made in the direction of furnishing the apparatus for a marine engineers' laboratory. It has only just been made known to the council that so many as thirteen sets of apparatus had been got together. As soon as it became known that so many sets of apparatus had been got together, the question arose what to do with them. How were the sets of apparatus to be arranged so as to be best available and of most use to the members? After the matter had been considered, the council agreed to place at the disposal of the experimental committee three rooms of the institute building. It was a wise idea of the founders of the institute that they should try to create a feeling in the members scattered over the seas that they should consider the building in the Romford-road a kind of shrine. When they returned after many days the feeling would draw them towards it as the Arab is drawn towards his Mecca. To enhance this view the founders made it a rule that each member should give something of his own to the institute, something to which his name would for all time be attached. It has thus come about that engineers, as wanderers in distant parts, when they saw wonderful things, thought of the old place in Romford-road, and brought them home to be seen by the members there. During this year those at home as well as those abroad have directed their energies in a common groove, and have begun to furnish the apparatus for a fully-equipped laboratory. The committee and the younger members, the associates, and the graduates, are devoting time and work to the business, and, with quiet persistence and energy on their part, will soon have something to be seen by members when they come to the place. And the committee would suggest that each member of the institute would of himself put the rule in operation which recommends that each member should present something to the institute during his membership. The work of the marine engineers' laboratory will not cross the work of the laboratories connected with the colleges. Their work is distinct and different. Engineers could not be prepared for the examination certificates of the Board of Trade at the ordinary technical college, because the staff of these colleges are trained in general engineering; they are not specialised for the examinations of the Board of Trade. The kind of experiments which will be made, and the laboratory work taught, will be on questions which are raised in the discussions in the institute, and in conversations with those who are engaged in marine engineering in their every-day life. The laboratory work will be distinct and different from that of other laboratories, and will be specialised accordingly. There is another advantage to the members from the possession of a laboratory. Much could be said of the influence on the mind of making experiments, which give exact knowledge and clear ideas. Much also could be said as to the moral influence which making experiments exerts on the man who makes them. After all, the very existence of this institution is primarily for the improvement of the members, and for raising their status—mental, moral, and social.

WILLOW and poplar corks are now used for champagne bottles by some wine producers.



EFFECTS WITH ELECTRIC LAMPS.

THE following example of the persistence of vision is described by the *Scientific American*:—Mr. George W. Patterson, of Chicago, has favoured us with a photograph of an "electrical spectacular effect," which he produces at entertainments which he gives. The graceful figures of light shown in our engraving are produced by electrically lighted Indian clubs swung in a darkened room. The club is of special construction, and the current is supplied by flexible wires inclosed in a rubber tube. Three series of 8, 3, and 1c.p. coloured lamps are set in sockets in the club at right angles to the centre of the club, which is split lengthwise. At the tip of the club is a 32c.p. lamp. When the clubs are swung at ordinary speeds the effect is very beautiful, an operator behind the scenes manipulating a switchboard turning on and off the lights in the two clubs, which are swung to music. The patterns are almost infinite in their variety, and suggest the engine-turning on our bank bills. Storage batteries furnish the current when the regular incandescent circuit cannot be tapped.

THE "A. B. C." JOURNAL BEARING.

THE purpose of this new bearing, which is manufactured by the Atlantic Brass Company, 192, Broadway, New York, is to provide means for transmitting the load to the journals uniformly throughout the length of the journal, in order to prolong the life of the brass and prevent heating. To accomplish this the load is transmitted from the box to the brass through a "wedge," which has an adjustable contact with the brass, the surfaces of contact being such as to permit the brass to load the journal uniformly, in spite of the tilting and transverse movements of the box.

In the M. C. B. box no provision for self-adjustment is made, and the lives of brasses are often very short, because of a concentration of the load at or near one point. This is sure to occur when the truck-frame tilts even slightly, and its effect is seen in examining M. C. B. brasses, which very seldom wear uniformly throughout their length.

The engravings show the self-adjusting surfaces, which are ingeniously arranged. The brass has a cavity in the centre of its upper face, into which a segment of a sphere on the under side of the wedge fits. The cavity in the brass is slightly elongated, for the purpose of giving an easy adjustment of the wedge and the brass. Other spherical surfaces outside of those at the centre help to carry the load, and, as shown in Fig. 1, they cause the wedge to rise on the top of the brass when subjected to side thrusts, and even under these thrusts the load is carried uniformly to the journal. A projection at the centre of the brass passes into an elongated hole in the wedge and prevents excessive side motion due to emergency thrusts. The spherical surfaces bear such a relation to each other as to cause the weight of the car to be raised by side thrusts, causing a tendency to restore the bearings to their normal condition again afterwards. Such thrusts are resisted and cushioned by the action of the wedge and the box.

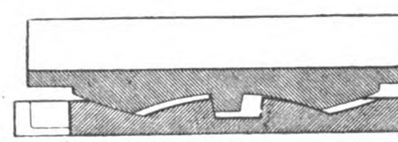


Fig. 1.

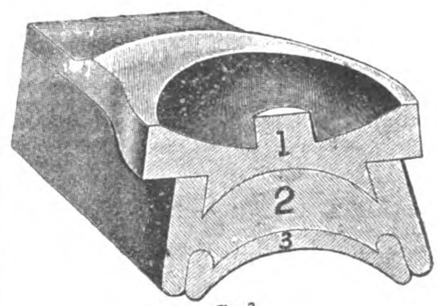


Fig. 3.

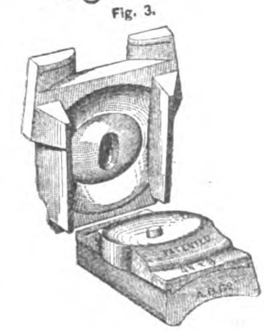


Fig. 2.

A section through the brass is shown in Fig. 3. It is also ingenious, and is made in three parts: 3 is the anti-friction bearing and metal lining; 2 is the bronze backing for the soft metal; and 1 is a cast steel back, which is strong and stiff, and is fused or welded to the bronze part. In earlier forms the

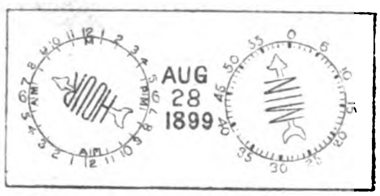
bronze part was riveted to the cast-steel back; but even moderate heating of a bearing made the rivets brittle, and the fusing was devised to overcome that difficulty. The union of the metals when seen in a section of a brass is close, and apparently very strong. The cast-steel back not only strengthens the structure, making it stiffer than if of solid brass, and therefore less likely to break transversely; but it also reduces the cost.

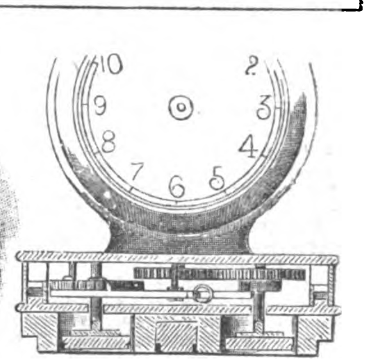
The brass and wedge when used together will fit the M. C. B. box, and the wedge of this adjustable bearing may be used with an M. C. B. brass in the M. C. B. box, so that this bearing will give no trouble on the road whenever a new brass may be required, if an M. C. B. brass is at hand. Experience with these bearings appears to support the claims made for them, and the first cost ought to be much less than that of the ordinary brass. The lubrication of journals ought to be improved by distributing the load uniformly, and it is fair to expect a reduction of train resistance from the smaller amount of friction. It is most important that no change in the boxes is required for these bearings, and also that there is no increase in the number of parts. It is seldom that such a simple device receives the careful study given to this bearing. Some of these bearings have been in constant use in passenger service since November of last year, and are reported to be in excellent condition. Other bearings made on this plan, but with riveted cast-steel backs, have been in constant service since July, 1897.—*American Engineer and Railroad Journal.*

A TIME-STAMP FOR BUSINESS USE.

In many lines of business it is a matter of great importance to record the exact time of acts, operations, or transactions, and to note upon papers and articles of various kinds the time of receipt or departure. A simple stamp by means of which such times can be recorded has been placed upon the market by Samuel H. Hoggson and Company, of 27, Thames-street, New York City, and possesses certain features of construction which are interesting from a mechanical point of view. The time-stamp comprises essentially a watch held in a body supported above a printing base. The printing base is provided with two recessed printing dials. Minute and hour shafts respectively extend within the recesses of the minute and hour dials, and have printing hands normally resting above the dials. By means of gearing the minute and hour shafts are so connected with the watch mechanism that the minute and hour hands of the shafts are made to rotate in unison with the corresponding hands of the watch.

The body of the stamp, in which the watch is carried, is yieldingly supported above the printing base and is movable with the time-printing hands. The parts are so assembled that when the base carrying the dials is pressed against a piece of paper, the printing hands in the dial recesses can be forced into contact with the paper by depressing the body of the stamp. The time thus stamped upon the paper will coincide with the time indicated by the watch. The hour dial, it will be observed, has two series of twelve graduations each. Owing to the arrangement of these graduations, it is unnecessary to provide any changing device to denote the "A.M.," "P.M." and "M." divisions of the twenty-four hours, for it is immediately apparent that the upper half of the dial denotes day and the lower half night. In operation the stamp is pressed upon an inked pad, then upon the article to be marked, a very slight pressure sufficing to insure a legible impression, giving year, month, day, and minute, together with any wording desired around the dials. The stamp is only 4½in. high, and weighs 10oz.—*Scientific American.*





SEPARATION OF THE LENSES IN STEREOSCOPIC WORK.

A correspondent asks us to devote an article to the subject of the adjustment of lenses in stereoscopic work. The reason he gives for his request may be thus stated. In ordering a stereoscopic camera to be made with the lenses so attached to the front that their distance of separation could be varied, he was met by the following pronouncement from the firm of camera-makers with whom he was in communication:—"We note what you say with regard to the adjustment of lenses for different distances, but we are still of opinion that it is more of a theory than of practical value, and this view of the case is also shared by Messrs. ——, to whom we have referred the matter."

We are aware that many firms who, in America and this country, as well as on the Continent, make hand and stand stereoscopic cameras for general use, do not trouble to give an adjustable movement to the lenses, for the obvious reason, of course, that amongst stereoscopic photographers there is very little call for the useful power which this convenience would place in their hands. Nevertheless, amongst the comparatively few persons who have a thorough grasp of the underlying principles of stereography, and the important bearing they have as regards correctness of application to practical ends, the utility of adjustable objectives in binocular work is so great that we may profitably take occasion to point out a few of the many reasons why that power is practically, as well as theoretically, of value.

In binocular vision our appreciation of relief, height, and distance is governed entirely by the power of axial convergence which our eyes possess. If we look at an object which is situated, let us say, at a distance of half a mile, the optic axes are virtually parallel; at any rate, the parallactic angle is so small that no sensation of relief results. In other words, as regards an object situated at the distance named, the two eyes, instead of seeing dissimilar views of it, as in the case of objects situated only a few feet or yards from the observer, virtually perceive them as identical. There is no "seeing round" either the one side or the other of the two similar views which are transmitted to the retina.

What applies to the eyes in the case of this narrowness of parallactic angle applies also to the lenses on the camera front. No relief is seen in distant parts of the binocular photograph; but the comparison does not hold good when we come to objects situated within a few feet or yards of the camera. The eyes, by their powers of accommodation and axial convergence, see those objects in natural relief; but, inasmuch as the lenses situated at a distance, we will suppose, of three inches from centre to centre on the camera front, possess neither the power of accommodation nor that of axial convergence, they impart to those objects, when they are viewed in the prints, an aspect of excessive or rather exaggerated relief. They see too much round the subject. Let the portrait of a person be taken with three-inch separated lenses, four or five feet from the camera, and the effect described will be at once apparent in the stereo-photograph.

It can be seen, therefore, that the need of adjustability in lenses for binocular work is a real, and not an imaginary, one. Suppose one is photographing a vase of flowers, situated a few feet from the camera. In practice, a separation of two inches is sufficient to give natural as opposed to strained relief, which would make the object have a cut-out or model-like appearance. In portraiture a separation of two and a half inches suffices. For interiors and landscape work, three inches should separate the centres, and where, as in the latter class of photography, the nearest prominent object may be hundreds of feet or yards away, a separation of three and a half or even four inches may be adopted.

It all comes to this: the nearer the object to the camera, the less the separation; the more remote the object, the greater the separation. We have known of stereoscopic photographs of objects placed immediately in front of the camera being taken with a separation of only one and a half inches between the lenses. On the other hand, instances may be recalled where, when stereo-photographing distant objects, yards have separated the objectives, and there is the well-known case of the binocular photograph of the moon, taken, so to speak, with the lenses separated many thousands of miles. Here we have the two extremes of the principle brought into force.

It is in the photography of objects placed near the camera that the value of being able to adjust the centres of the lenses chiefly asserts itself. Half an inch in the separation makes all the difference between naturalness or exaggeration of relief. It is the latter defect which offends so many of those who examine stereo-photographs for the first time. In nature, no matter how near an object may be to the eye, we are not conscious of its possessing exaggerated relief. The base-line of the parallactic angle formed by the eyes is approximately two and and a half inches. When, however, a stereograph of the same object, taken under conditions which lengthen the base-line to three or even three and a half inches, is presented to the eyes, it is not difficult to conceive that the mental impression so produced differs vastly from that which is the result of an examination of the original by ordinary vision. In the latter case we have the sense of reality; in the former, the impression of unreality.

We might extend this theme indefinitely. Sufficient, however, has probably been said to show that, when it is desired to take the fullest advantages of the power of making stereographs of objects situated very near the camera as well as those lying in more distant planes, adjustable objectives become something more than a convenience—viz., a necessity.—*British Journal of Photography.*

Of six thousand applications for letters patent for inventions in connection with cycles in 1897, only 2,300 were completed, a much smaller proportion than the average.

On June 1st last, automatic couplers and train brakes had been applied to over 60 per cent. of the freight cars in the United States. Of the 34,787 locomotives owned on June 1st, 32,426, or 93 per cent., are equipped with driving-wheel brakes. There are 211,268 freight-cars out of a total of 1,251,415, or 17 per cent., that are not equipped with automatic couplers; 552,696, or 44 per cent., that are unequipped with train-brakes, and 2,361, or 7 per cent., of the locomotives not equipped with driving-wheel brakes.

Technical Institutions, &c.—At this time the technical institutions and colleges begin their sessions, and we receive the programmes, &c. The City of London College, White-street, Moorfields, is excellently situated for the convenience of students from all parts of London, and the engineering department is under Prof. H. Adams. The Northampton Institute, St. John-street-road, E.C., is educational and social, and is now a polytechnic with classes in all trades, including those generally followed by women. King's College, Strand, London, has a special branch for architecture, building construction, &c., with both day and evening classes. The Borough Polytechnic Institute, St. George's Circus, S.E., has classes in a great variety of subjects, including the arts and practically all trades. The calendar of the famous Birkbeck Literary and Scientific Institution, Bream's-buildings, Chancery-lane, E.C., has also been received, and shows that the "Birkbeck" still holds its premier position as an institution where teaching in all branches can be obtained.

SCIENTIFIC NEWS.

THE meeting of the British Association at Dover seems to have been satisfactory to everybody, and the total attendance, judged by the number of tickets issued, was 1,403—not so many as might have been expected. A "notice" was given that at the meeting of the general committee next year at Bradford Prof. Hartog would bring forward a resolution dealing with the status of women in the Association.

Some papers on the ethnography of the Lake Region of Uganda, which may soon become of special interest, were taken as read, as they are to be published in full in the *Anthropological Journal*. Col. Macdonald's paper dealt with the tribes met with during the progress of the Juba (Macdonald) expedition of 1897-99. It gave details of 30 or 40 native tribes, their language, customs, and traditions, describing regions which were the meeting-places of several great African families—the Bantu, the Negro, the Hamitic, and the Massai or Nuba Fulla. Much information was given regarding their habits and customs, agriculture, marriage rites, religious beliefs, general organisation for war, fighting weapons, and knowledge of working iron, dressing hides, and making pottery, and the history obtained from their own traditions or deduced from those of their neighbours respecting their present and past geographical distribution was fully considered. A curious and interesting point was that all these tribes believed in one Sepreme Being—Ngai—and a future state. In Lieut. Pope-Hennessy's paper it was shown that the author had the opportunity of observing a number of West African tribes in the course of the expedition led by Capt. Lynch from Ibi, on the Benue, into the kingdom of Banchi. There were two roads from Ibi to Banchi, the more usual being by Waze, the shorter by Jibjil and Pongru; but the latter was rendered dangerous to caravans by three tribes of non-Mohammedan raiders—the Wurhu, the Zigori, and the Tangale—who in their native hills had resisted the advance of Fulah conquests. The paper contained many details of these three tribes, together with notes of the Jukos, another Pagan tribe said to have formerly ruled a large empire on the Middle Benue, extending from Banchi to the Allah-Katsena river, but now for the most part fishermen and canoe men in the district round Ibi.

In a memoir containing remarks on that presented by M. Flammarion to the Paris Academy of Sciences, which gave an account of the observations of MM. Antoniadi and Mathieu, of the Perseids of 1899 as observed at Juvisy, M. Bouquet de la Grye expressed the opinion that it would be possible to utilise shooting stars as a means of determining differences of longitude between places unprovided with the telegraph!

The director of the Marine Observatory of San Fernando, Spain, announces that the Minister of Finance has directed that all instruments to be used for the purpose of observing the Eclipse of the Sun on May 27, 1900, are to be admitted free of duty.

We record with deep sorrow the death of Mr. Charles William Bradley, the head of the firm of printers who for so many years have produced this journal. Mr. Bradley, who was in his 62nd year, died at Brighton on Sunday last, and was buried at Hove Cemetery yesterday amid the regrets of many old friends. Mr. Bradley sprang from an old Huguenot family, and his forbears settled in England during the religious persecutions of the seventeenth century, in company with their compatriots, so many of whom were identified with the silk-weaving industries. His early life was one of struggle and self-sacrifice, but he soon found his footing. He determined to be a printer, and, surmounting many difficulties, succeeded in apprenticing himself to the late Mr. Levy, the well-known proprietor of the *Daily Telegraph*. Shortly after the close of his apprenticeship—by which time he had already married—Mr. Bradley started in business for himself, and, in spite of some obstacles, was in no long time successful. In subsequent years the firm was joined by Mr. West, and the present flourishing business solidly built up and extended. In private life Mr. Bradley enjoyed the friendship of all who knew him. His principal recreation was music, and, had he elected to pursue that art in early life, his natural gifts would undoubtedly have secured him a creditable position among its votaries. One of the keenest and shrewdest men in business, he was a very faithful friend, and never missed an opportunity of assisting the less fortunate.

The death is announced of Mr. Edward Case, the "expenditor" of the Level of Romney Marsh, whose system of groyning has done so much in that district, and the success of which made his name well known not only in this country, but abroad, in places where it became necessary to stem the encroachments of the sea. He was at the meeting of the British Association, intending to read his paper on "The Dymchurch Wall and Reclamation of Romney Marsh," but was taken ill, and, returning to his residence at Dymchurch, died rather suddenly on Saturday.

It is stated that the passengers on the Royal Mail steamer *Trinidad* for Bermuda have had a curious experience. When about 360 miles from St. David's Head, Bermuda, an immense aërolite made its appearance, travelling from W.N.W. to E.S.E., and apparently was quite close to the ship. It looked to be a large megaphone (!). One-third of the body, from the base, glowed and sparkled like red-hot iron; the other two-thirds were of a brilliant shimmering green colour. Its path through the air was so well defined that it could be seen for several minutes after the body had disappeared, and it looked as if it had been marked out with whitewash. The aërolite appeared to be so close to the ship that those who saw it thought that when it fell into the sea it would splash the water on to the deck; but it proved to be at a greater distance than it appeared to be, and fell beyond the horizon.

Another Arctic expedition is to set sail this month for an exploration of the Samoyede region, and any other work that can be accomplished. It is the Jeaffreson-Chowne expedition, the leader of which is Mr. J. R. Jeaffreson. The party is to go to Archangel, and, as soon as conditions permit sledge travelling, will proceed to some of the most unknown parts of Siberia. Part of the distance from Archangel will be covered by steamer if the ice is not firm in Kara Straits. The idea of the expedition is not so much to reach the Pole as to explore unknown districts in the Samoyede Peninsula, and observe manners and customs of the natives and make scientific observations. The explorers are taking a large stock of guns and ammunition, as they hope for excellent sport.

The lectures to be delivered on Tuesday evenings during October at the Royal Victoria Hall, Waterloo Bridge-road, will be:—"The Value of Nitrogen," by Prof. Holland Crompton, F.R.S., on Oct. 3; "Liquid Air," by Prof. W. Ramsay, F.R.S., on Oct. 10; "Source and Course of the River Thames," by Dr. C. G. Cullis, on Oct. 17; "Photographs taken in the Dark," by Dr. Russell, F.R.S., on Oct. 24; and "Kamschatka," by Capt. Barrett Hamilton, on Oct. 31.

It is announced that the lighting of the Batignolles tunnel, near Paris, will be done by lines of 10c.p. incandescent electric lamps, placed about a mètre apart on the walls of the tunnel, and ranged at the level of the windows of the trains. Thus if a train has to stop in the tunnel the compartments are lighted from the outside; but economy is studied by making the lighting "automatic," the running of the train over levers or plungers turning on the light.

An interesting antiquarian discovery is reported off the East Coast, at Sandlemere. During the low tides the ebb has been assisted by persistent favourable winds to such an extent that large tracts of coast have been left bare and cleared of shingle, so as to expose the parts for observation, with the result that the habitat of an old-world colony of lake-dwellers has been revealed. The old piles are standing, and the rough-hewn tree-trunks of the platforms are still there, showing the tool-marks and evidences of mortising and jointing. Another colony of lake dwellings is already known to have existed near by; and it would seem from this new discovery that there must have been a considerable number of them in prehistoric times in that district.

A Deal fisherman is reported to have recently landed a lobster weighing not less than 8lb. 2oz. The body is 17½in. long, while the right claw measures 17½in. in length, 5in. in breadth, and 13½in. in circumference. The lobster is said to be a record for Deal.

It is stated that a File-fish (Balistes capriscus) has been landed at Mevagissey and forwarded to the Marine Biological Laboratory Plymouth. According to the descriptive account the "creature" was about 16in. long, 8in. deep, and weighed 2¼lb. It is not unlike a John Dory in form and colour. The last of this species known on the coast of Cornwall was caught in a crab-pot off Portloe, and the late Dr. Couch, of Polperro, sent it to the British Museum in 1865. The fish is known in the Mediterranean, but is scarce there, and was deemed injurious to the pearl fisheries in those waters. The first recorded British example was caught off the coast of Sussex in 1827. Of its habits there is little known more than with its strong teeth it is able to break through the shells of mollusks and eat thom as food.

The following rather extraordinary statement is made in the *Industrial Advocate* (Halifax, N.S.):—A process for making fine wool from the limestone rock found in such inexhaustible quantities in the neighbourhood of Alexandria, Ind., is a recent discovery by C. H. Hall, chemist of the steel works at that place, the claim being that, from a combination of 94 per cent. of the limestone, chemicals, and one of the commonest of minerals, pure wool is obtained as white as snow. It seems that, while making experiments with limestone for his factory, it was found that a certain kind of material, instead of turning to quicklime when subjected to fire, would, when combined with chemicals, turn into lava, and when subjected to another process; this lava could be rendered pliable and handled like molten glass. From this beginning the process was pursued, and a downy wool resulted, with promise of considerable industrial possibilities—that is, such rock wool is represented to be as soft and white as that produced by sheep, and can be manufactured cheaper than sheep can be raised and clipped, is not affected by fire or water, and the supply seems to be almost unlimited.

USEFUL AND SCIENTIFIC NOTES.

THERE are sixteen dockyards along the coast lines of Japan.

THE rapid destruction of the spruce forests of the Eastern States of America may be realised when it is understood that one daily paper used the growth of 22 acres in two days, the wood having been reduced to pulp and then turned into paper.

ON the Royal farms in Prussia some experiments have been carried out with electrically-driven ploughs. The cost of electric ploughing was said to range from £2 6s. to nearly £3 per acre, while the cost of steam ploughing came out at considerably over £4 per acre. These figures are for ploughing heavy soil to a depth of 8in. to 10in. The speed of the plough was about 3ft. per second.

THE coal industry of Western Australia is developing rapidly. With the deepening of the mines a better quality of fuel is being mined, with the result that it is not only being used largely for domestic, mining, and railway purposes, but also by local steamship companies. This coal, it is said, is likely to be of very considerable value. It burns somewhat quickly, giving out much heat and leaving a small percentage of ash. An authority reporting on it says that, although it cannot be put into the first class, there can be no doubt that it will prove a valuable fuel. As a steam raiser it is greatly to be preferred to many other coals of better composition which produce much smoke.

The Permissible Rise in Temperature in Electrical Apparatus. — The committee on standardisation of generators, motors, and transformers, appointed by the American Institute of Electrical Engineers, have reported with regard to the permissible rise in temperature of electrical apparatus. The standard temperature and pressure selected for reference are respectively 77° Fahr. and 29·92in. of mercury. If the room temperature during the test differs from 77° Fahr., the observed rise of temperature should be corrected by nine-tenths per cent. for each degree Fahr. to make up for increased copper resistance. A full-load run of from six to eighteen hours is recommended before making temperature tests, but this can be shortened if the machines are heated up by overloading them. The rise of temperatures of conductors should, it is recommended, always be measured by their increase of resistance. The increase for copper is taken at seven-tenths per cent. per degree Fahr. With this method the maximum rise allowable is given at about 90° Fahr. The other parts whose temperature is measured by thermometers are allowed somewhat more, with the exception of the bearings, where 104° Fahr. is the final maximum.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

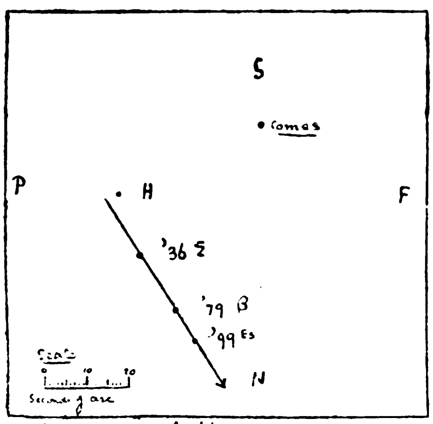
"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

α LYRÆ—ε LYRÆ—A NEW STAR OF TYPE IV.—THE NEW EDITION OF ARGELANDER'S ATLAS.

[42873.]—IN answer to Mr. Ellison's request, I looked up α Lyræ on Sept. 2 and Sept. 4, and failed to find any *comes* nearer than the well-known 10·5 magnitude. The pair is an optical one, and the little *comes* is rapidly being left behind. I ran the micrometer wires over it, and got—

P = 162·8°. D = 54·3″. 1899·67.

The following diagram shows the motion of the large star since H's time, whose distance would



Motion of Vega

seem to have been too small. I do not know the date of H's measure.

While showing ε Lyræ to a friend the other evening I noticed a star fainter than the *debilissima*, and careful attention revealed two others. They were all seen in moonlight, and I have run the micrometer wires over them roughly, all except No. 5, and made the inclosed drawing to scale, with

ε¹ and ε² Lyrae

the exception of the close pairs, whose distance is exaggerated. I have had so little experience with the micrometer, and my apparatus is so rough, that it is hardly worth giving the individual measures. Nos. 1 and 2 are the *debilissima*. The following are my estimations of the magnitudes to-night:—

No. 1 ...... 11·5	No. 4 ...... 13·5
No. 2 ...... 12·0	No. 5 ...... 14·0
No. 3 ...... 13·0	

May I say how glad I am to see that the interest in these old-fashioned objects is reviving in your columns? Now and again when I can spare a little time for star-gazing from the regular routine work, it is a great pleasure to look up old friends that one has never seen for years. Years ago there was much correspondence over ε Lyræ in these columns, but I do not remember if these faint stars were ever laid down in a diagram. I hope some of your readers may look them up and report what they can do with them. A younger and keener eye may perhaps catch other faint points; but I have laid down all I can actually feel certain about.

Stars of Type IV. within the reach of my instrument that have not already been detected are now very rare. On Aug. 11 I, however, swept up one which has hitherto escaped detection. It is B.D. + 53° 2736 21h. 49m. 56s., Decl. + 53° 49′ for 1855, mag. 9·0. I made it 8·6 Aug. 11, and Sept. 14, 8·7. Its magnitude is given in the Harvard zones:—

1874, Oct, 22 .... 8·7
1883, Oct. 11 .... 9·2

It is curious that it has escaped detection so far, if it is not, like so many of this class, variable.

Is it generally known among your readers that the great Atlas of the Heavens of Argelander has just been republished at Bonn? I mention it because for stellar work it is simply invaluable.

T. E. Espin.

Tow Law, R.S.O., Co. Durham, Sept. 14.

METEOR.

[42874.]—A BRIGHT meteor was seen here at 9.55 p.m. on Saturday, Sept. 16. In the bright moonlight it appeared about four times as bright as Jupiter. It came from the direction of Capella and passed through ζ Herculis. It was remarkable for the great length of its path (about 80°), which it traversed at a great rate of speed. It left a short streak.

St. Alban's. **G. S. H.**

THE COMET AND THE DELUGE.

[42875.]—MR. F. H. WENHAM is quite mistaken about the Deluge story being invented by believers in a flat earth (letter 42851, p. 136). No universal flood on a flat earth was conceivable. It required mountain barriers to confine the water, and the only way Noah or any animals could be saved was by moving to those mountains. The device of a floating ark really implied a globular earth. I do not mean that either Noah or the writer in Genesis knew the earth to be globular. But the story (if invented) was invented by those knowing quite as well as Newton or Halley its roundness. On no flat earth could it be half so easy to construct an ark as to escape to hills not flooded.

Another common mistake is that Genesis implies no beasts to have been saved but in the ark. But in chap. ix. 10, God makes a covenant with mankind and the animals, from those that leave the ark *to every beast of the earth.* The rainbow, which probably Noah's family had never seen before, having dwelt in rainless Upper Egypt, was made a sign of this covenant. The cataracts of rain had swept off all vegetation, uprooted all timber, and left bare hills only. The best illustration left of their violence is the way they filled bone-caves with the bodies of most discordant beasts, hyenas, wolves, and bears, with sheep, and occasionally human bones. These caves have been found in every European country, and in Asiatic, African, and those of both Americas. But the cataracts having lasted only six days (according to Hasisadra's account), it was quite possible for many of those creatures that clung to the drifting timbers and landed to find food. In less than six months a young olive sapling yielded a leaf to the dove. But saving of men in another week from the catastrophe, as Hasisadra implies, was quite impossible. Genesis implies all wild nature, vegetable and animal, away from Armenia, to have had nearly a twelvemonth's start of Noah and his cattle. These were taken in November from the hottest parts of the old world, and having grounded, they were hoisted up above the clouds, to pass the summer imprisoned till the next November, in the coldest climate of this renewed and warmer world.

It is astounding to think of Samuel Graham Wilson living 15 years at Tabriz as a missionary, leaving the timbers Nouri had found, as *deceiving* somebody. Whence on earth does he suppose them brought to the snow, 15,000ft. above sea-level? What was he a missionary of? Seemingly of Prof. Bonney's creed, or the anticatastrophist Lyell, before he tumbled down and broke his neck.

In quoting the missionary Wilson (p. 39), I was quite aware that his first story about Mount Ararat was a blunder. I only meant to refer to Nouri's in 1892. It is not clear to me that the statements in Psalm cxiv. quoted by "F.R.A.S." in p. 133, are mere poetry. The Psalm describes the earthquakes that accompanied the exit of the Israelites from Egypt, when there was an eruption of Sinai, and as Psalm xcvii. says, "The hills melted like wax at the presence of the Lord." All this may be "statements of physical fact." Again in p. 134, answering query 96601, surely an eye at sea-level can see hills 60 or 70 miles distant, if they are high enough. They must be 2,400ft. to be seen at 60 miles, or 3,267ft. at 70 miles.

E. L. Garbett.

THE DELUGE.

[42876.]—REFERRING to the criticisms passed upon my letter of August 11, contained in your two following numbers, I would firstly say that it is inconceivable that heathen nations can have been influenced by Christian missionaries to believe and narrate the story of the Great Flood, and sometimes of the Fall of Man that preceded it, without being influenced by them also to believe and narrate something about the Saviour Christ and His doctrine. Yet there is the tradition running all round and all over the world among nations and tribes that show no traces of Christian doctrines or observances, or of Jewish ones either, or even of those grafted on Judaism by Mohammed.

I omitted in my former letter to say that when I asked Mrs. Isabella Bird Bishop, who has spent thirty years of her life in travelling over Asia in all directions, whether she had personally come across legends of the Flood among Asiatic people, her answer was: "They all have it." And similarly, when, in 1896, I told Mr. J. Owen Dorsey, who the year before had presided over the Anthropological section of the American Association, and has written learnedly upon divers Red Indian tongues, that I had just read in verse the Ojibway legend of Nanabusha, who restored the dry land and its inhabitants, both men and brutes, after all had been swept away by a flood, he said in reply: "I meet with the same story among all the Indian tribes."

Now, Humboldt records in his book upon the Orinoco that the traditions of the Deluge existed among the Tamanacs and Maypures and many other tribes in that region, although upon careful search (as I have read in the said volume) he could find no fossil-bearing strata that could have given origin to the tale, and these tribes, as he tells us, claimed descent from one man and one woman who were saved on the top of the mountain called *Tamanzcu.*

Again, Pastor Böressen in 1876 was giving an account to a Free Church folk of Aberdeen of his mission in company with two other evangelists to the Santals (an Indian hill tribe), begun ten years before, when they had never heard a word of the Gospel, and were cut off by language and manners from all intercourse with Europeans, and I heard him tell two primitive traditions of this people. Their first parents, said they, were placed in a most beautiful garden by the spirit of good; but the spirit of evil came and tempted them to partake of a forbidden drink. They yielded, and were punished by being driven from the lovely garden to dwell in the outside world. Time went on, and men became very numerous, but also great sinners. The spirit of good in anger destroyed all but seven men and seven women, who escaped in a boat, and became *the progenitors of the Santals.* Again, Hugh Miller, the eminent geologist ("Test. of Rocks," p. 288), among other legends of the Flood, quotes one from the Scandinavian Eddas as follows:—On the death of the great giant Ymir, whose flesh and bones form the rocks and soils of the earth, and who was slain by the early gods, his blood, which now constituted the ocean, rushed so copiously out of his wounds, that *all the old race* of the lesser giants, his offspring, were drowned in the flood which it occasioned *save one;* and he, by *escaping on board his bark with his wife,* outlived the deluge.

Now, in the first story, the fact that those Brazilian tribes give the name of the mountain of refuge as identical with one of their own names shows that they could not have borrowed the story from a Christian or Jewish source; and so, too, the fact that the Santals declare themselves to be the descendants of the saved pair proves that the tradition is a native primæval one. And, taking the three legends together, unaccompanied as they are by the least trace of the distinctive tenets or ceremonies of either Christians or Hebrews, and prevailing among nations far removed by language and space for long ages from both, the common pith of each legend must have been handed down from a time when Brazilians, Santals, and Norsemen all dwelt together. But this is a time of which the Bible alone succinctly tells us, as part of a consecutive history (though it is borne out also by the cuneiform tablets) when all men were in Shinar and Mesopotamia. And how, even then, could they have communicated the tradition of the Deluge to one another, unless the Bible record (borne out by the tablets again) is true—that then all men spoke the same language? And is it conceivable that this is true, and yet that the story of the event which the Bible just previously records is untrue?

For this, we should have to suppose that after punishing men for their sin by confounding their languages, and sending them forth as different nations over the earth, the Creator at the same time caused each nation to treasure up a lying tale of a previous transaction of His with the children of men.

The supposition needs only to be stated in order to be scouted. The facts stand thus: The Hebrews alone possess a consecutive history, giving many genealogies and dates, interspersed with not a few events, from the Creation of Man down to the founding of their own nation, and onwards, in the course of which (with the date after the Creation of its beginning and end duly assigned) comes a succinct account of the Flood; but legends preserved by a host of nations all over the globe (possibly by all nations if due inquiry had been made) preserve the main features of this account, and some of them—as the Babylonian and Brahmin one, for instance—many features besides. The conclusion in every reasonable mind, therefore, should be that the story contained in the Hebrew scriptures is true, even if we were not assured of the fact, as we are, by its being used as a moral warning and example both by the Apostles and by the Divine Saviour himself. All scientific facts, therefore, which now seem to conflict with it must ultimately be found to harmonise with it, and in your own columns I, for one, am indebted to Mr. Leonard Kelly for his summary of facts that confirm the solemn story, as well as for pointing out that Noah had not to collect all the animals small and great which he stowed in the Ark, but that God planted an impulse in them to "come" to him. (Gen. vi. 20.)

The objections to a universal deluge—that is, to one covering the whole globe—are strong, but, I do not think, invincible. For instance, as regards the number of species carried representatively by twos, and now and then by fourteens, we must remember that birds and clumsy beasts, such as monkeys, squirrels, racoons, and opossums, would have occupied little lateral space, for cages could have been found for them no less than 20ft. high between any two of Noah's decks, and perches duly ranged about and all the way up the cages, just as in zoological gardens nowadays. And, again, the species, though numerous, may have been far less so than now. An Eskimo dog is not distinguished from the wolf, with which it freely plays when out of harness, as I have heard an Arctic explorer, Mr. Stupart, tell the Canadian Institute. At Winnipeg, the chief warder of the prison, who so wisely preserved a remnant of the bisons a few years back, found that they freely interbred with domestic cows and bulls: and the experiments now being conducted by Prof. Cossar Ewart in Edinburgh tend to show that the domestic horse and the zebra had a common ancestor since the creation of man (*Westminster Gazette*, July 18, 1899).

But, after all, the safest course to take is that of Hugh Miller's, and hold that the Deluge extended no further than the settlements of men. This does no violence to the language of Holy Writ; for why should the statements of Genesis vii. 21 and 19 (R.V.), "All flesh died that moved upon the earth," and "All the high mountains that were under the whole heaven were covered," be more comprehensive than those of Genesis xli. 57, "All countries came into Egypt" to buy corn, because the famine was sore in all the earth, and of Deuteronomy ii. 25, "This day will I begin to put the dread of thee and the fear of thee upon the peoples that are under the whole heaven"; or of Acts ii. 5, "There were dwelling at Jerusalem devout men from every nation under heaven?" And considering that three hundred million Chinamen were content up to the beginning of this century to dwell without emigration inside the bounds of China, why should the habitats of the human race before the Flood, who probably after 2,000 years of growth were less numerous than the Chinese after 4,000, have been more extensive than Russia and Turkestan united, where Hugh Miller places them, a territory several times as large as China?

He points out that around the Caspian Sea are "vast plains white with salt, and charged with sea-shells"; while the shells also "abound in an outer region, which includes the vast desert of Khiva," and I would add, on the authority of Sir William Dawson, in his "Meeting Place of Geology and History," that shells have been found on the surface of the Pamir Mountains up to a height of 15,000ft. The first-named geologist also points out that this whole region lies low, while some of it is completely beneath the level of the ocean, and therefore it would be the more easily depressed to a point where the ocean would completely cover it. The flowing in of the waves along the river valley would indeed be a "breaking up of the fountains of the great deep."

The geographical description given of Eden in the Bible and on the Babylonian tablets compels one, however, to add Turkey in Asia at least to the antediluvian settlement of men; but otherwise the great geologist's theory seems without a flaw. And if in the present century we have seen thousands of square miles at a time in the estuary of the Indus in 1819, and in western Java in 1883, drop low beneath the waters, and have observed a vast region like Scandinavia year by year rising on one side and sinking on the other, what is there contrary to reason in believing that at one time the Almighty, because of the sin and ingratitude of His creatures, caused the whole vast region we have named to subside for forty days in succession, concentrating all His rainstorms upon it at the same time, until all the mountains within it were covered with a watery waste?

Mr. Dormer talks slightingly of the attempt made to prove an affinity between the cuneiform letters and the Chinese. I therefore repeat more succinctly that Prof. Lacouperie showed to the Philological Society of England, when I was present about seven years ago, some fifty letters of the cuneiform and as many of the Chinese alphabet before this was made ideographic, and the resemblance was very striking. It does not militate against this connection that the Chinese carried with them neither of the Babylonian languages, the Altaic, Accadian, or the Semitic Sumerian (an Aryan language no one but Mr. Dormer has hitherto credited them with). The Bible tells us that all nations once lived around Babylon before the confusion of tongues; and the Babylonians, who have themselves a tradition of this confusion, say, on the other hand (as I have shown), that books were always known to mankind; therefore it is well-nigh certain that this cuneiform writing existed before the confusion of tongues, and that the Mongols and Chinese—the sons of Magog—took it away with them when they migrated to the east.

But Mr. Dormer, who is very fluent in the language of contempt for others, is himself rather prone to tumble into pitfalls, for I notice that in the same letter he talks of the "philanthropic partnership scheme" ascribed by Mr. Garbett to "Rameses the Great and his much beflogged fellaheen"; whereas Mr. Garbett ascribed the partnership to an Egyptian sovereign who, by any reckoning, reigned at least 150 years before Rameses the Great—the Pharaoh who welcomed Joseph's brethren, not the one who first oppressed the multitude of their descendants.

However zoology and geology may appear to be against the universal deluge, I by no means agree with Mr. Dormer that either anthropology, philology, or archæology is against either a partial or a universal deluge. Archæology, as embodied in the traditions of the people of the world, is all in favour of it. Philology shows savage nations, like those of North America (in the teeth of Dean Farrar's absurd theories), to be possessed of languages utterly different from those of the literary nations, yet extraordinarily rich in expressiveness and grammatically synthetic. How came this about, unless their ancestors at Babel were endowed with a fresh and perfectly formed language?

Again, as regards anthropology, the table of nations and their parentage given in Genesis x. wonderfully tallies with ancient ethnography. Take two instances only. Genesis x. tells us that Japhet, one of the very few human beings who had survived from a previous age, had a son called Javan, by whose children "the isles of the Gentiles were divided." The Greeks, on the other hand, tell that their earliest human ancestor was Japetos, a son of Heaven and Earth; while Homer commonly calls the rank and file of the Greeks either Argeioi (Latin, Argivi) or Jaones (with the digamma, Javones). [Compare Smith's "Classical Dictionary" and Gladstone's "Treatise on Homer," pp. 102 and 103.]

Again, the same Bible record states that Ham (in Hebrew Kham) was the father of Mizraim, or the Egyptians as well as of many other African peoples (compare with Chap. I. 11). The Egyptians, on the other hand, worshipped a god called Kham; they had a very ancient city called Khemmis, and they called their country Khemi. And now in modern times the Matabele have a river called Kami, and a tribe called Kamm; while there is no commoner name among the Kaffirs than Khama, which has been rendered so illustrious by a Bechuana chief. (See Chambers's "Cyclopædia," Smith's "Class. Dictionary," &c.) **Martin Luther Rouse.**

THE MOSAICAL DAY.

[42877.]—"F.R.A.S." seems to imply that I invented it all, simply because he is not acquainted with the subject. What he calls "wild nonsense" is a rescript from M. Delambre's work on "Ancient Astronomy," in addition to recent translations of Assyrian tablets. My deductions as to the possibility of Moses applying this Cosmic Day in his record, is, I think, worthy of consideration; to suppose that each successive creation occupied 24 hours is "nonsense" indeed.

73, Clarence-road, Clapton. **J. D. Hardy.**

THE DAYS OF CREATION.

[42878.]—THE earth rotates on her axis in 24 hours *now*; but the "evening and the morning" were not always of the present length. The friction of tides is constantly lengthening the day, and as this has been the case from the beginning, Prof. Darwin proves that, when the moon originated, the day and night were about three hours, and the month the same. Both day and month have lengthened, and the ratio between them became rather greater than we find it now. The number of days in a month is now diminishing, the day lengthening rather faster than the month.

The days of creation in Genesis are very long periods, as everyone must have seen, before St. Augustine or even the New Testament. The order of the words "evening and morning" showed this; because "evening and morning" do not begin and end in a day, but a night. A recent translation I have seen, in these terms: "and there were evenings and mornings one day." Afterward, "There were evenings and mornings a second day." And so on up to "a sixth day." The phrase occurs only six times, for there is no such statement about the seventh day, because that is incomplete. We are still in the seventh day, which began by Noah's flood. In the seventh creative day, God rests or desists from His creative works, and is refreshed.

Light being created, times of light were distinguished from those of darkness and called days, the dark intervals being nights. Now we find the earth as a whole is no darker at one time than at another; but she is liable to encounter comets, which, when falling, must darken her entirely. Are not these, then, the nights between days of creation?

The Hindoos reckon days of Brahma of something like 432,000 years divided by comparatively very short nights. The days of creation may have been such periods, not equal, but marked off by comet-falls. The statement in Genesis is that "evenings and mornings" have endured through all these periods. The new world that appeared in the Andromeda nebula in 1884, if it rotates, must have evenings and mornings just like our earth, although it has no sun. Every part has day when turned towards the central nebula, night when turned away. It is in the exact condition that Genesis describes our world in the three first creative days, before the sun or moon existed.

Sept. 23. **E. L. Garbett.**

THE NO. 666.

[42879.]—IN reply to "E. L. G." (p. 140, 42370), the passage referred to, in Daniel viii. 25, is "He . . . . by peace shall destroy many." In the "Teacher's" Bible, and several others which I have consulted, the margin gives *prosperity* as an alternative reading for *peace*. Is not the same "Beast" referred to? **Glatton.**

THE ORIGIN OF SPECIES—SIR MICHAEL FOSTER'S ADDRESS.

[42880.]—I WOULD remind Mr. Garbett (42815 p. 115) that Darwin's "Origin of Species" is not nearly so absurd as the fabulous story he is trying to bolster up—"The Deluge."

Assuming (42869, p. 140) that "the first man, the first ox, or the first of any new species originated. . . from a virgin," we have still to ask, Whence the virgin? I presume the virgin is of the same species she is to originate.

It is an astounding piece of information that Mr. Garbett has given us in stating that the *sun is younger than the earth*. Of course, this miserable, third-rate planet was created first and the rest of the universe afterwards. I can give Mr. Garbett some more information like this: (1) There are mountains on the moon; (2) Neptune is the furthest planet from the sun yet discovered; (3)—— But enough. I will write seriously, although it is hard to take Mr. Garbett so.

It is not certain that the earth is the densest planet. More probably the moon is. Therefore, theorising from Mr. Garbett's standpoint, the moon is the oldest. It is understood, of course, that we are dealing with the Solar System only. There are probably immense dark stars distributed through space, beside which the earth is a mere satellite (which she is, of the sun). Few people who have seen a variable star can doubt this. It would be interesting to have Mr. Garbett's views on the Nebular Theory.

Because a star in the Andromeda nebula blazed out suddenly, and then disappeared in six months, does not prove that it cooled down in that time. I consider it highly improbable that a star can cool down in six months, or six thousand months if you like.

Erratum: In No. 42840, line four from bottom, read "faintest" for "greatest."

Earlsfield, S.W. **Silverplume.**

THE VITALITY OF SEED — VISUAL CONCEPTS—PARTHENOGENESIS.

[42881.]—I AM obliged by "F.R.A.S.'s" assurance that no wheat from mummies has germinated. As the vitality of seeds is very variable, it would be of interest to know the greatest age at which such a proceeding has occurred. I believe legumes have been shown to retain their vitality longest, and it is well known that willow seed is very short-lived.

One sometimes idly speculates on the possible influence of the vitreous humour of the eye in connection with conceptions due to vision. Sight, of course, results from the action of light on the retina, the other contents of the eye-ball merely rendering objects perceptible. It is curious that the jelly-like vitreous humour, firmly compressed by the orbital muscles, bears a certain resemblance to the conception of ether.

Theories supported by ill-invented "facts" and abuse of eminent scientific men simply provoke laughter. The slangwhanging of Darwin and Lyell with boomerang epithets that only harm Mr. Garbett is very suitable sauce for his hash of science. As to letter 42869, the possibility of a woman bearing a child whilst retaining a deceptive virginity has nothing in common with the production of young without male assistance, which occurs in aphides, crustaceans, and other lowly forms of life. If Mr. Garbett had troubled to read Chapter XIV. of Darwin's "Origin of Species," he might have become aware that parthenogenesis has not been discovered "since Darwin's time." As a matter of fact it was observed in 1701 in the silk-moth, and in 1745 Bonnet described the successive generations of the virgin aphides; indeed, Owen's work on the subject appeared a decade before the "Origin." There being no record, I believe, of any new animal or vegetable species produced parthenogenetically, this notion provokes the same derision as those concerning the age of the sun, watery comets, *et id genus omne*. It tempts one to echo the plaint of Sterne's abbess: "Oh! virginity—inity—inity!"

J. Dormer.

CAPITAL AND INTEREST.

[42882.]—I AM still at a loss with regard to Mr. Garbett and his ευπορια. He evidently knows more about Demetrius than I do—or, I think, than Luke did. As to the relations between Demetrius and his workmen, in fact, Mr. Garbett is my sole source of information; but I think it very unlikely that the writer of the Book of Revelation had this passage of the Acts of the Apostles in his mind when writing, and, in fact, it is not improbable that the Acts of the Apostles was written subsequently to the Book of Revelation.

I have not read Mr. Ruskin's views on the subject, and I cannot promise to read them. With regard to the relative merits of our system of land tenure and the Metayer system, I should think that Carlyle did not follow them far enough to ascertain experimentally that one led to heaven and the other to hell; and, in fact, there would be a difficulty in transporting the land to either locality, or in carrying any system of land tenure without it. But the Metayer system appears to lead to more poverty than the system of fixed rents. What, however, are we to do in Ireland in order to avoid worshipping the Beast? The rents are fixed by the Court at a figure of which both landlord and tent may disapprove; and even if both parties asked to have the rent fixed as a share of the produce, the court would not do it.

Mr. Garbett tells me that the servants in the parables of the Pounds and the Talents were not employers of labour, though they were traders. I have had a good deal to do with traders, and in almost all instances I found that they were employers of labour—a remarkable fact being the frequency with which they raised the salaries of their servants when about to go into bankruptcy. Does Mr. Garbett keep a servant-girl? If so, is her salary fixed on the partnership principle?

With regard to the National Debt, I do not see why, if we execute some great work (say the construction of a railway) which is certain to benefit our successors, should we bear the whole cost of it and leave it as a present to them?

Might I suggest, as a possible explanation of Ahaz's dial, that the dial was badly constructed, or that the ground sank? **W. H. S. Monck.**

DOWN "CORNISHMAN," G.W.R.

[42883.]—As a companion to the up "Devonian" run on p. 15, I send a log of a run I took in the down "Cornishman" (summer part) running from London to Exeter without a stop. Unfortunately, since the train was rather heavy (one of the eight corridor coaches being a dining car), a stop was made at Taunton for a pilot engine (No. 1366) up the Wellington bank, and again at Whitehall sidings—the summit—to take off the pilot. In spite of these delays, costing $10\frac{1}{2}$ minutes, the arrival in Exeter was not more than four minutes late, for which the driver (Westbury) and the fireman both deserve praise.

To obviate the necessity for the pilot stops, the company have lately been using the large four-coupled "Barrington" class on this train. I give below a somewhat detailed account of the run:—

DOWN "CORNISHMAN."

London to Exeter, August 21st, 1899:—

Engine: 7ft. $8\frac{1}{2}$in. single bogie "Lord of the Isles," No. 3046.

Train: Seven corridor "eights" and one dining-car "eight" equal 180 tons behind the tender.

Weather: Fine, dry, and hot—calm.

Stations.	Miles.	Chains.	Booked Times. h. m.	Actual Times. h. m. s.	Speeds.
Paddington	0	0	10 30	10 30 20	—
Westbourne Park	1	22	—	10 33 41	22·8
West London Junction	2	66	—	10 36 1	39·9
Acton	4	19	—	10 37 54	45·0
Ealing	5	58	—	10 39 41	50 0
West Ealing	6	42	—	10 40 36	52·4
Hanwell	7	28	—	10 41 33	52·1
Southall	9	6	10 42	10 43 29	53·5
Hayes	10	74	—	10 45 30	55 0
West Drayton	13	18	—	10 47 55	57·1
Iver Siding	15	3	—	10 49 47	58·2
Langley	16	18	—	10 50 59	59·4
Slough	18	36	10 52	10 53 11	60·7
Burnham Beeches	20	37	—	10 55 40	60·7
Taplow..............	22	36	—	10 57 10	59·5
Maidenhead..........	24	21	10 58	10 58 59	59·9
Waltham Siding......	26	30	—	11 1 4	60·8
Ruscombe Siding	29	40	—	11 4 18	58·0
Twyford	31	3	—	11 5 54	57·7
Sonning Siding	34	11	—	11 9 8	57·5
Reading	36	0	11 10	11 11 45	42·7
Reading, West, Junc..	37	0	—	11 13 49	29 0
Scours-lane Junction..	37	60	—	11 14 55	40 9
Tilehurst	38	53	—	11 16 7	45·6
Pangbourne..........	41	44	—	11 19 32	50·7
Goring	44	66	—	11 23 3	55·3
Cholsey..............	48	37	—	11 27 2	54·8
Moreton Cutting......	50	66	—	11 29 32	56·7
Didcot	53	9	11 29	11 31 55	57·6
Steventon............	56	42	—	11 35 43	53 9
Wantage-road	60	32	—	11 40 4	53·7
Challow	63	71	—	11 43 53	54·8
Uffington............	66	42	—	11 46 52	53·0
Knighton Crossing....	69	0	—	11 49 36	54·3
Shrivenham..........	71	44	—	11 52 22	55 3
Marston Crossing	74	14	—	11 55 13	55 3
Highworth Junction ..	76	28	—	11 57 34	55·5
Swindon	77	22	11 55	11 58 38	52·0
Hay Lane............	79	62	—	12 1 15	57·3
Wootton Bassett......	82	70	—	12 4 20	60 4
Wootton Incline......	85	22	—	12 6 35	64·0
Dauntsey	87	59	—	12 8 42	69·8
Christian Malford	89	72	—	12 10 33	70·1
Langley Crossing	92	53	—	12 13 3	66·3
Chippenham	93	76	12 14	12 14 25	56·5
Thingley Junction....	96	10	—	12 17 10	47·5
Corsham	98	26	—	12 19 58	47·1
Box Tunnel, East	99	3	—	12 20 55	45·0
Box	101	71	—	12 23 41	61·8
Farleigh Down Siding	102	79	—	12 24 43	63·8
Bathampton	104	48	—	12 26 36	51·4
Bath	106	70	12 29	12 30 3	39·6
Westmoreland West ..	107	46	—	12 31 12	36·5
Tiverton	108	29	—	12 32 19	42·3
Tiverton Tunnel......	109	31	—	12 33 44	43·4
Saltford	111	27	—	12 36 14	46·8
Keynsham	113	59	—	12 39 6	50·2
St. Anne's Park	116	59	—	12 42 35	51·0
Bristol East Depot....	116	77	12 41	12 42 56	45·0
Marsh Junction	117	66	12 44	12 44 43	29·0
Pylle Hill Junction ..	118	57	12 47	12 46 25	31·3
Bedminster	119	32	—	12 47 35	35·4
Malago Vale	119	63	—	12 48 10	39·9
Portishead Junction ..	120	27	—	12 48 58	41·3
South Liberty Siding..	121	3	—	12 49 55	44·2
Flax Bourton	124	22	—	12 54 3	47·0
Nailsea	126	34	—	12 56 13	59 5
Yatton	130	28	—	12 59 46	66·3
Puxton	133	77	—	1 3 13	62·8
Worle Junction	135	13	—	1 4 28	57·6
Uphill Junction	138	5	1 9	1 7 18	61·4
Bleadon	138	49	—	1 7 50	61·9
Brent Knoll..........	142	44	—	1 11 55	57·9
Highbridge	145	24	1 17	1 14 52	55·9
Pottery Siding	148	12	—	1 17 54	56·4
Dunhall	149	6	—	1 19 5	46·9
Bridgwater	151	48	1 24	1 21 50	55·1
Fordgate	154	16	—	1 24 49	52·3
Durston	157	30	—	1 28 23	53·4
Creech Junction......	160	59	—	1 32 15	52·2
Taunton	163	13	1 36	1 35 35	43·7
				1 38 20	—
Norton Fitzwarren ..	165	14	—	1 42 19	30·3
Victory Siding	166	10	—	1 43 26	51·0
Beambridge Crossing..	167	31	—	1 45 0	48·4
Poole Siding	169	0	—	1 47 4	46[illegible]
Wellington	170	19	1 45	1 48 50	42·0
Whitehall Tunnel Siding	174	1	1 51	1 55 10	35·8
				1 56 20	—
Burlescombe	174	59	—	1 58 37	19·1
Sampford Siding......	176	79	—	2 1 8	53·6
Tiverton Junction	179	5	1 57	2 2 58	67·9
Cullompton..........	181	32	—	2 5 2	67·8
Bradninch	185	44	—	2 8 38	69·2
Silverton	186	62	—	2 9 42	68·9
Stoke Cannon	190	41	—	2 13 8	65·3
Cowley Bridge Junc....	192	52	—	2 15 8	63·1
Exeter (St. David's) ..	193	75	2 13	2 17 0	41·4

Delays: Slowed through Bathampton and stopped at Taunton $2\frac{3}{4}$min., and at Whiteball $1\frac{1}{6}$min., besides the booked checks past Reading, Didcot, Chippenham, Bath, and Bristol; time lost = 24 minutes.

Actual time for journey, 226min. 40sec.; speed = 51·4m.h. Running time for journey, 222min. 45sec.; speed = 52·3m.h. Net time for journey, 202min. 40sec.; speed = 57·4m.h.

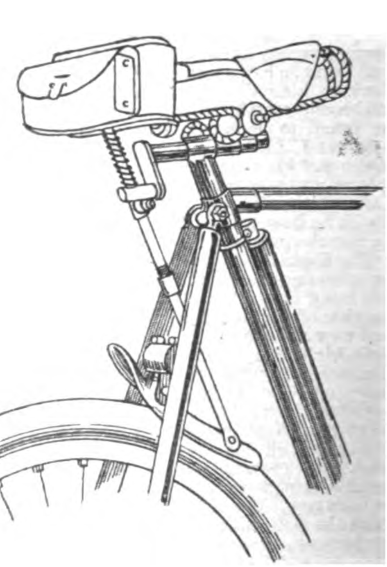
Flying average: Southall to Cowley Bridge Jn., 183 miles 46 chains, in 187m. 39s. (nett time); speed = 58·7 miles an hour.

Maximum speed: 72 miles an hour through Dauntsey.

Ealing, W. **O. R. Walkey.**

BICYCLE BRAKE.

[42884.]—IN last number of MECHANIC, at p. 124, is an illustration of a bicycle brake, called Cole's. There appears to me to be considerable merit in the idea, but it has one defect which may be easily



remedied, and I venture to inclose tracing, showing the improved position of the brake, going with the travel of the tire instead of against it, as well as giving a neater appearance, and making it easier to fit mudguard. **H. J. Burton.**

Southfield End, Uxbridge-road, Hanwell.

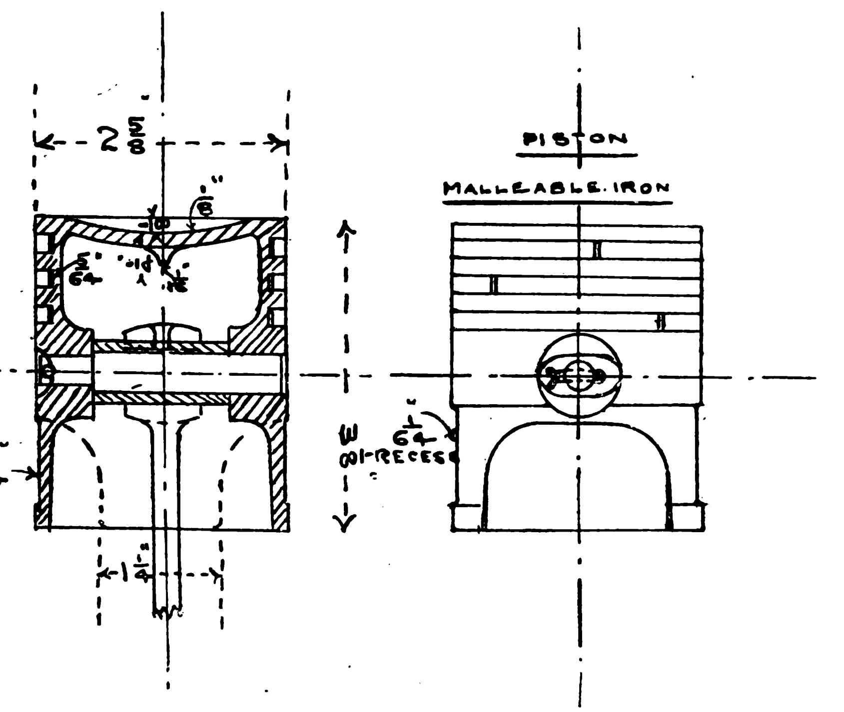
MOTOR-CYCLES.

[42885.]—As the former letter of mine on "Ariel Motors" has been replied to by so eminent an authority and expert as Mr. Chas. Sangster (p. 138), I think there are one or two questions raised in his letter to which an answer is needed.

The public will be gainers for the knowledge imparted by these discussions, and will, no doubt, make use of it when picking out a motor at the next show. Still, "when doctors disagree, who shall decide?" Every mechanical work brought out nowadays is fully commented upon by writers to the various technical journals, and good and bad points impartially reviewed. Readers have the option that they can hear both sides, and believe neither if they are so inclined. Perhaps I can convince even Mr. Sangster that some of the points I have criticised may be improved upon. "Every inventor is apt to look upon his goose as a swan," and therefore must prepare some time or other to find it thought otherwise. He replied to a former letter of mine on "Dion Motor," which was copied from "E. M." by the *Auto-Motor Journal*, and will, no doubt, remember all that was mentioned in that article.

I have looked up all particulars I possibly could about each motor I have so far described, and have gleaned further information from careful inquiry, and am therefore in a position to substantiate any statement I may make. I take the Dion as a standard figuratively, as it is so well known, and therefore serves as an object of comparison. As regards motor in front of back axle, I will obtain some particulars for you of them, and forward to address you have given; but you need not go so far as France. I may tell you twelve months before a single Ariel tricycle was made, Accles, Ltd., of Perry Bar, had one running on road with engine in front. This was illustrated in *Auto-Car* of Aug. 26.

The bearings I find, roughly speaking, contain 9sq.in. in the Dion, 9·6 only in Ariel; whereas proportions of latter engine being much larger, and a greater pressure on piston (which, I believe, is the guiding factor in designing all parts), the length of bearings should also be greater. Increasing the diameter to gain surface area is not good practice mechanically, as friction is greater with the larger



diameter and shorter bearing, which is not so well adapted to retain oil under pressure.

True, the bearings are ⅛in. closer between inside than Dion, but this cuts down width of the most vital bearing—viz., the big end of the connecting-rod; here you may look for squeak and trouble after hard running. Top or crosshead bearing in piston is, I find, even less in length than Dion; whereas it might be made ¼in. longer with beneficial results.

See sketch of piston sent last week for further improvements, which, if any good, adopt; if any objections, shall be pleased to hear of same. "Valve foot being inaccessible"! I maintain I am correct; if, for instance, foot comes off rod, or the latter breaks at lower end of guide bush, as I have known them to do, what advantage is bush then, as you must perforce take engine out and get it apart to recover broken piece.—Q. E. D. As regards Mr. Stocks's breakdown, I will quote a remark made by Lincoln, who said, "You may fool all the people for a time, or part of the people all the time, but you cannot expect to fool all the people all the time." I *know* what happened, and should advise the fitting of a split taper pin, as used on loco. work, in lieu of plain taper pin, through sparking cam. This would prevent any danger of spindle working through into crank case, and allowing head to get sheared off by the crank.

This crank, by the way, seemed to me a most expensive, complicated affair as compared with simple arrangement of Dion. Look at expense of making or repairing which would face an unfortunate rider. Might I suggest you could simplify it, using wheel on one side similar to Dion, making crank-pin and taper to fit wheel, also do away with pinion screwed on, and place on taper. If engine got jammed, look at pleasant "biz" of dropping it right down till pinion was out of gear before you could unscrew it, and what is to hold engine from turning while unscrewing pinion? It's sure to happen as soon as a few get on road; that would condemn design right away.

You will wonder how I am so familiar with internal economy of engine; but I have been allowed to see one taken apart, and took particular notice of all good and bad points for future reference. I regret I am going away for awhile, and cannot go further into the matter with you, both from personal and business reasons, though I am not in the motor-tricycle business, but speak and write from a rider's point of view, as an ardent rider myself. A two-speed gear is necessary, and I hope to give readers sketch of one when I can get time. There are no hills in Midlands of any great length or steep gradient; so don't base your estimates of way tricycle behaves on these roads.

I am right about furious driving, for, in papers lying before me, I find both yourself and Mr. Stocks largely figuring in police reports, in which they give what must be to you most gratifying and eloquent descriptions as to speed you were travelling.

All the clutches I have seen so far on motors, with one exception, possess the great fault that they are too small in diameter, and not properly constructed, being usually two cast-iron cones with long taper. For a tricycle they should be nearly 1ft. diameter, the inner cone having a bearing only about ⅝in. wide, composed of strips of leather on edge, working against outer cone of cast iron. I am aware it is a difficult matter to fit one calling for something better than mere copying in the designing; the greatest difficulty is to avoid the oil getting on it in excess;—if this was attended to clutch would give no trouble at all. I have lately seen one similar to one I describe that has been in use daily for months past, that is highly praised by owner. Now I have given you an idea of what is really wanted on road, and I feel sure you will take the criticism in the spirit it is given, for, as you know, the lookers-on often see the most of the game. One thing I strongly recommend you to adopt is magneto-ignition. I can speak from experience that it licks batteries into the proverbial cocked-hat.

Monty.

[42886.]—SKETCH shows an improvement for small motor pistons that have been designed since complaints against not getting sufficient oil on top bush, also to save weight. It may be useful to those engaged in following present articles. It is of malleable iron cut down to thinnest possible dimensions. The top, being dished for strength, also allows oil to run to point of small inverted cone, which must be cast on in one, not screwed in. Sides of piston cut away to save weight, which it does considerably. It wears very well in actual work, and gives no trouble, cast-iron rings being used. It may be further lightened by using two rings only, which would cause less side friction, but would not keep tight so long. The top bush is of manganese bronze, which I have since adopted on every bearing of engine, being far superior to steel or anything else I have tried so far; engine gives better results, and there is less liability to seize. In fitting bronze bushes they must be left a trifle slacker than if steel was used, owing to rapid expansion under heat. The split cottar shown to hold crosshead pin in prevents any danger of same working out, and scoring cylinder; it is far superior to method of having screwed pin to secure it.

Monty.

AERIAL LOCOMOTION.

[42887.]—I HAVE to inform "Eureka," in reference to his letter (42864), that which he takes as confusing in my former letter arises from a printer's error. Instead of "3H.P. per 100lb.," it should have been "3H.P. per 100lb. raised" (read one hundred pounds). This amount of power related to the free flight of an aërial screw, and was recorded because the force could be easily computed. I stated in my essay of 1866 that the result was only approximate: it is enormously in excess of the real power required to sustain a weight on a wing surface, which force may be moderate, judging from the flight of the largest and heaviest birds. A screw when first spun off, has its vanes suitably adjusted for a high speed. As this diminishes, so does the power required to sustain increase, for it is a condition in flight that the higher the speed the greater the economy in power. If a flying machine was to be made with the idea of acquiring a low speed, say of four or five miles per hour, not by any command of motive power applied, either by flapping wings or vertically-acting screw-blades, would it be possible to keep it sustained. The absolute condition of continued flight must be rapid horizontal progress through the air: then we can get nearly a solid support, on the inertia of a large extent of aërial mass. I believe that every construction of a machine for flight has been deficient in stability, and this has been the main cause of failure. I once made a model that would glide steadily away to a distance of twenty yards, or more, without capsizing. I requested an aëronaut to take it up in his next balloon ascent, and then set it free, in order to ascertain how far it would travel away. It kept its equilibrium for a short distance, and then suddenly tripped and turned rapidly over till it reached the earth. Some compensation for stability was needed. We see how readily a bird can adjust itself. A tumbler pigeon, for mere frolic, will turn a series of somersaults in the air, and if a carrier pigeon is thrown with the tail first or legs upwards, this makes no difference, the bird feels the air and rights itself instantly.

F. H. Wenham.

THE CONQUEST OF THE AIR.

[42888.]—IN reply to "Eureka," letter 42864, p. 139, it would obviously facilitate a more favourable reply if he gave a more definite description of the size or weight, if not a fuller description, of his models. Models by the score have flown before this, but at the same time they do not conclusively show that the problem of aviation is solved. For instance, a boy's kite is a model of the aëroplane, and Prof. Langley's experiments with his aërodrome, in which a small model flew nearly a mile until the power was exhausted, whilst instructive, are to the trained mind quite inadequate sources of logical proof. For small experimental models, electricity is undoubtedly far preferable where lightness is essential.

E. Wilson.

MICRATOMIC ETHER.

[42889.]—IN reply to W. Howse (42825), yes, the pitch of sound is analogous to the colour of light, both being the effect of the number of vibrations in a given time set up in their respective media.

I presume the question is asked in order to show a likeness between a material medium and the ether. There are many others; for instance, sound can be refracted and reflected, it exhibits the phenomenon of interference, and its rate of propagation is subject to the same laws (with regard to the elasticity and density of the medium) as that of light.

In fact, I believe the only supposed point of difference is in the matter of "polarisation," and I cannot find any record of what experiments have been carried out to prove this: hence my letter of inquiry, which I trust some reader will be able to answer.

R. A. Kennedy.

METALS MADE PLIABLE BY TAURIC ACID.

[42890.]—THE following statements I found in an American paper (dealing with science according to its title); but I cannot find any further information, so appeal to readers of the "E.M." The article reads:—

Another discovery is claimed that, if true, bids fair to give as important results in the world of science as any that has been made in many years. It is the result of experiments carried on by Theodore Olan, a Swedish chemist at Washington, and, like many others, it was found by the merest accident.

Mr. Olan's discovery consists in finding a new agent which will soften steel, gold, silver, and many other metals, making them soft, pliable, and ductile as a piece of putty, and quite as easily and safely handled. He has named the new chemical agent tauric acid, because it is obtained from tauric moss, a peculiar lichen, or fungus, which grows upon rocks and roots of trees very generally in the country, but it has never before been the subject of chemical investigation. The new acid has been tested by many eminent chemists in the country, who pronounced Mr. Olan's discovery to be one of the wonders of the world of chemistry, and it is believed that it has a great and important future before it in the arts and sciences. It is remarkable that the discoverer has given it gratuitously to the world.

Mr. Olan gives the processes that led to the results reached by saying that while making some experiments with tauric moss in his laboratory he found the bottom of the metal dish he was using became soft. At first he supposed the dish had been partially decomposed by other acids, but upon investigation he proved this was not the case, and fully satisfied himself that the change was caused by tauric acid, and this led him to making experiments which fully verified his opinion. He says: "By placing gold, silver, steel, aluminium, or lead in this acid I found they became soft as dough, so that they might be worked with the hands into any shape or form. Although steel softens readily when placed in a vessel containing tauric acid, strange to say, the acid has no effect upon iron. Tauric acid will be of great value to jewellers in making designs in precious metals. Designs may be moulded or

beaten to the required shape without heat being at all."

The process of making the acid is very simple and inexpensive. Mr. Olan describes it as follows: "My plan for bringing out the acid from the tauric moss is to put in a deep vessel a layer of chloride of lime, then a layer of tauric moss, to the depth of 2in., and then a layer of chloride of potash of about the same thickness. This is saturated with water until the lime is slaked away. After the fire has gone out of the lime the liquid is drawn off. After this, creosote of tar is added until a saturated solution results. The solution is precipitated with a solution of sulphuric acid, one part in ten. After precipitation the supernatant liquid is decanted, and the residue is found to consist of pure tauric acid."

Can any American reader tell me what is this wonderful moss, or is it another joke? **Wideo.**

IMPROVEMENT IN ROTARY ENGINES.

[42891.]—IN this week's issue (p. 131) is a section and elevation of an "Improved Rotary Engine," but it, as with the twin steamer and the roller steamer, so prominently brings to my mind the astonishing fact that as the cycle of years roll on modern men repeat the same work which earlier men have found to end in failure.

As long ago as when the screw steamer *Archimedes* was lying in the East India Docks, a Counsel named Brenton had an identical type of rotary engine (except on that the two pistons were connected together) in a screw steam launch, and with this steam-launch and rotary engine I made a series of trials of several forms of screw-propeller. To change the several forms of propeller, the stern of the launch was lifted out of the water with suitable gear attached to the yard-arm of the *Archimedes*.

Then following this Mr. Wimshurst adopted a similar engine for the s.s. *Novelty*, the little difference being that it had four pistons, instead of the two used by Brenton, and now shown in your plan. With this rotary type of engine the s.s. *Novelty* made her first commercial voyage.

It would take too much of your space to explain all the causes of failure in both of these engines; but Mr. Wimshurst soon after patented a somewhat similar type of engine having six pistons. This engine was fitted in the s.s. *Zingaree*, and one day I was on board her when she beat the p.s. *Meteor* upon the run from Gravesend to Blackwall.

Your readers may therefore suppose there is abundant reason for inquiry before they become infatuated with the modern design. **J. W.**

VASO-DILATORS.

[42892.]—IT has been known for perhaps some ten or twelve years that nitro-glycerine causes rapid dilatation of the arteries, and, therefore, usually gives prompt relief against the heart-strain of angina pectoris. This effect soon passes away, and the liability to the heart-pain then returns. To Prof. Bradbury, of Cambridge, it seemed likely that among a certain group of nitrate compounds, beginning with methyl nitrate, and passing through nitro-glycerine to erythrol tetra-nitrate and mannitol hexa-nitrate, we might find some one having a longer vaso-dilating effect, and on undertaking experiments which were detailed in the *British Medical Journal* of Nov. 16, 1895, p. 1213, he found, in erythrol tetra-nitrate especially, such a compound as he was searching for, its action lasting for four or five hours. What a boon this is to those who would otherwise be roused from sleep in the night by this agonising suffering cannot be told. It has occurred to me that the same knowledge of organic chemistry which led Prof. Bradbury to experiment with this particular series of nitrates may indicate other groups, among which there may be substances capable of causing still more prolonged vessel-dilatation than the erythrol tetranitrate. Can any chemist kindly say what is the prospect of there being such? Are there other lines or series of nitrate or nitrate compounds, many or few, along which substances acting in the same way, and even preferably, may be hopefully looked for? I ask in great ignorance of organic chemistry, and the question can evidently be answered only by those whose knowledge is of an advanced kind.

A word also would be acceptable as to the process by which erythrol tetra-nitrate is prepared, and why the charge made for it is so very high.

L. C.

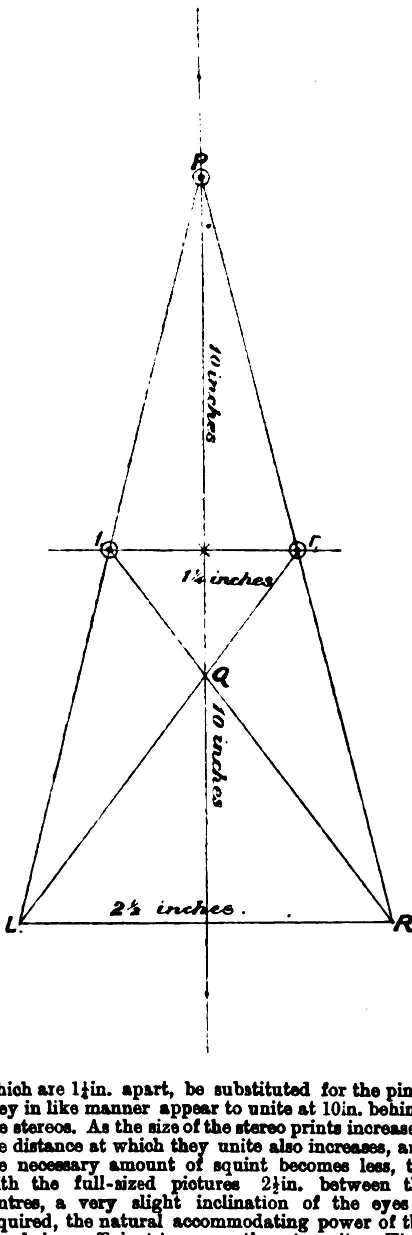
THE STEREOSCOPE.

[42893.]—THE method of uniting stereoscopic pictures mentioned by "R. S. D." in his letter, by looking at the left-hand picture with the right eye, and *vice versâ*, gives, as he says, pseudoscopic effects, unless the pictures are mounted especially for the purpose, the right-hand half of the slide being changed to the left.

A print from a binocular camera negative gives the pictures in this position. It is, however, quite possible to see ordinary stereo slides in the way I mentioned without squinting outwards, as he suggests. The diagram annexed will show this to be the case.

I have for the sake of clearness given an exaggerated width in proportion to the lengths, as it will have to be copied on a smaller scale for publication. Supposing R and L to be the position of the eyes, *r*, *d*, *l*, two pins stuck upright and a third pin stuck in at P, it is evident that looking with the right eye the pin *r* will appear to cover the pin P, and looking with the left eye the pin *l* will do the same.

On looking with both eyes, slightly squinting, the heads of the pins will appear to unite at that point, and if small stereoscopic pictures, the centres of



which are 1¼in. apart, be substituted for the pins, they in like manner appear to unite at 10in. behind the stereos. As the size of the stereo prints increases, the distance at which they unite also increases, and the necessary amount of squint becomes less, till with the full-sized pictures 2½in. between the centres, a very slight inclination of the eyes is required, the natural accommodating power of the eyes being sufficient to cause them to unite. They seem, in fact, to coalesce without effort.

Pictures taken with the lenses of the camera the same distance apart as the eyes give the least trouble to unite, as one sees the pictures under the same aspect as the objects they depict.

I have shown at Q in the diagram the effect of uniting the pictures in the way mentioned by "R. S. D." It will be seen that the amount of squint requisite is greatly in excess of the way I described, and more trying to the eyes.

I know that some people find a difficulty in uniting the pictures; but, on the other hand, many do so quite easily. I have photographed and mounted a very great number of stereos during the last forty years by the method described, and have never found any trouble in doing so. I recently looked at the stereoscopic pictures in the *Royal Magazine* without a stereoscope, and, with one exception, had no difficulty. Some of them were excellent—much better than I should have thought possible from mechanical printing.

Lavant. **L. Paxton.**

HEAT AND GASES—MICRATOMIC ETHER.

[42894.]—I FEAR that, owing to the brevity of my previous letter (42817), I have not pointed out with sufficient clearness the exact fallacy in the formula which Mr. Tanton deduces. Using his notation, we have—

$$M = V r^n \text{ and } r = 1 + a,$$

$$\therefore \quad M = V (1 + a)^n.$$

Now, the correct formula, using the same notation, is

$$M = V (1 + a n).$$

It is obvious that, as in Mr. Tanton's formula the expression $(1 + a)$ is raised to the nth power, and in the correct formula the term a is multiplied by n, the first formula will give results in excess of the truth. Let me point out that the correct formula is nothing more than the algebraic expression of Charles' law.

The proof of the accepted formula is given perfectly correctly in "W. B. M. M.'s" letter (42819, p. 115), if we take into account the obvious slip of $V t = V (1 + a t)$ for $V_t = V (1 + a t)$, where V_t represents the volume at $t°$ C., and V that at 0° C.

Mr. Tanton's criticism of Mr. Webb's letter (42818) is perfectly justified. It must be remembered that the equation given above only holds with absolute exactness for a "perfect gas"—i.e., one that obeys Boyle's law, and for which R in the equation $P V = R T$, and γ, or the ratio of the two specific heats, are really constant. All gases diverge from Boyle's law to a greater or less extent, the differences decreasing with decreasing pressure. Small irregularities also become apparent as the temperature falls. Both these deviations become more marked the nearer the gas approaches its liquefying point.

I do not think that the coefficient of expansion of any gas has been determined for each degree between 0° and 100° C. The variations within these limits would be excessively small. It being still vacation, I have no great reference library with me; but all Regnault's results I am acquainted with are the mean values between 0° and 100° C., or some such range of temperature. They vary from ·0036613 in the case of hydrogen to ·0039028 in the case of sulphur dioxide. If we were acquainted with any substance which even within a limited range of temperature behaved exactly as a perfect gas, it would be quite easy and also correct to extend its indications by extrapolation, and thus to determine with accuracy the absolute zero, from which we could reckon an absolute scale of temperature.

This would, of course, be independent of the peculiarities of any thermometric substance whatever. As it is, one particular substance is chosen as the standard, and all other thermometric substances standardised by comparison with it. Nitrogen gas is perhaps the most suitable; but it is evident that the more this standard substance departs from the behaviour of a perfect gas, as regards expansion by heat, the more inherently vitiated will our observations of temperature be. However, fortunately for us, nitrogen or hydrogen departs so little from the behaviour of a perfect gas, within wide ranges of temperature and pressure, that these errors vanish almost entirely.

Lord Kelvin has succeeded in determining the "absolute freezing point of water" by a thermodynamic method, and finds it to be 273·14. According to the indications of the gas thermometers, it is 273° C. The difference is trifling. Mr. Tanton seems to find some difficulty in arriving at the physical interpretation of the term "absolute zero." It is safe to look on it as a point where all motion of the molecules and atoms ceases; and, consequently, as a temperature below which we cannot go.

I am afraid I do not quite see the meaning of Mr. Tanton's penultimate paragraph (letter 42872). If he would kindly explain his difficulty, I might possibly be able to help him. In conclusion, let me recommend Preston's "Theory of Heat" to Mr. Tanton. He will find it very interesting reading; it requires, however, an elementary knowledge of the calculus in a few places. The price is, unfortunately, rather high.

With regard to "Lucretian's" remarks (letter 42871), he is quite right in saying "I scarcely think 'J. M. W.' imagines the ether to be mere motion," for I have always carefully avoided crediting the ether with any specific structure. There is, however, a great deal to be said for the idea that matter is merely motion of the ether—i.e, for the vortex atom theory. This theory I recommend to "Lucretian's" close attention; I am sure he will find its study profitable and instructive, and afterwards he will not speak so disparagingly of it as he does in his letter of last week.

Trin. Coll. Oxon. **J. M. W.**

THE MISTAKES OF AUTHORITIES—A HINDRANCE TO PROGRESS — THE AURORA.

[42895.]—SCIENTIFIC literature contains examples of theories that were once venerated as orthodox explanations of natural phenomena in the scientific ranks, which have since been ruthlessly shattered by the criticisms and influence of modern research.

The introduction of a rival theory to supersede one that has been sanctioned by custom is usually regarded as an unwelcome intrusion in the camp of

prejudice, and is destined to face opposition, sometimes acrimoniously conducted, in passing through the various debatable positions, until common sense prevails over objections more sentimental than sensible, and it eventually becomes accepted as an established principle in the scientific canon.

Similarly prejudicial opposition operates now, and has operated during the past half-century, as an obstacle in the formation of a correct apprehension, or an unbiased judgment of the evidence elicited in a class of phenomena of a quasi-astronomical character, whose hypotheses are founded on mistakes and sustained by misapplied facts. These references comprise the faulty methods employed in dealing with the Aurora Borealis, Zodiacal Light and Band, the Gegenschein, and certain aspects of meteoric phenomena.

In examining the methods of investigation adopted in the first of these subjects, it will be noticed that no preliminary attempt is made to ascertain the nature of the phenomenon to be investigated—whether the luminous objects forming the aërial picture are material or spectral, whether the proposed problem is possible or impossible; but without any justification the requisite conditions for treating it as possible, and the objects as concrete bodies, are assumed, then submitted to comparison with similar objects seen elsewhere, and upon their supposed identity computations are based, in the vain endeavour to reach tangible results, a difficulty further increased by the unscientific method of selecting the facts to suit the assumptions and rejecting the rest. Necessarily, the results obtained by the adoption of such unsound principles are extremely divergent and worthless, whilst the publicity given to them, without comment, in periodicals devoted to exact science, gives them a fictitious importance tending to their perpetuation rather than their solution. An example of this kind is furnished in the monthly notices of the Royal Astronomical Society, Vol. LVII. p. 73, and is by no means an isolated instance of errors possibly sanctioned by that learned body, whose decisions and dicta in such matters are generally supposed to be unquestionable. In *Nature*, Vol. V. p. 422, Mr. Backhouse recommends "some rules to be attended to" in recording observations appertaining to this subject, and directs attention to the necessity of noting the astronomical positions of these luminosities as particulars of paramount importance; whilst discouraging the notification of the position of the radiant point of the streamers "because it is of no value in determining their height, for it is merely an apparent phenomenon." What effect this unfortunate advice has had in delaying the solution of the question, it is impossible to say; but certain it is that the omission of such an indispensable factor from the records vitiates their utility, whilst the retention of the rest serves very little purpose.

The requisite observations and the method of dealing with them to prove the fallacy of the current ideas in relation to this subject are collected and discussed in the ENGLISH MECHANIC for April and May, 1894.

The conclusions there arrived at have recently been confirmed by Prof. Cleveland Abbe, in a paper read before the American Philosophical and Physical Society, who states that "the aurora, like the lightning, may be entirely confined to the lowest stratum of the atmosphere. That its origin must be placed at or below the level of the clouds within a few thousand feet of the ground, and that the assumption that the observed beams have an individual existence is negatived, and that the observers do not see the same object."

An impartial scrutiny of the observations, studied with the view of obtaining all the information derivable from them, is calculated to produce many facts which will materially assist in placing the question on a philosophical basis conducive to its solution.

There are sufficient already in hand to show that it is in the domain of experimental physics that this desirable result may be accomplished. It seems fairly deducible, for instance, that the beams are semi-luminous hollow cylinders, resting on bases some 150 yards in diameter, thickly studded over a surface three or four miles in diameter, with cyclonic movement from east to west round a centre, constituting an auroral system. The arch, which shows no perspective effects, connects two terminal points, separated by the diameter of the magnetic field, a connection which is sometimes established by moving objects taking the same course when the arch is absent. A display seen from various places is due to the multiplicity of such systems, apparently traversing the country from east to west simultaneously; the rate of progression along certain lines of force was noted in one instance at 9¾° of longitude in 2¼ hours.

The conditions of visibility are among the mysteries connected with this peculiar light, whose power of penetration is of a very limited kind, analogous to light reflected from films or thin plates, and may be due to the action of the vertical currents on the mechanical structure of the cylinders, the tint being observed to change with their change of position relatively to the observer situated in the plane of reflection, their visibility being, apparently, within narrow limits in direction and distance.

Birmingham, Sept. 24. **W. H. Wood.**

USEFUL AND SCIENTIFIC NOTES.

A GAS and Allied Trades Exhibition will open on December 31, 1899, at the Royal Aquarium, Westminster, London, and terminate on January 23, 1900.

OBSERVATIONS have been taken of the rise of temperature at different depths in a mine at Bendigo. At 454ft. the rise was 1° Fahr. for each 110ft.; at 1,294ft. it was 1° for each 182ft.; at 1,750ft., 1° for each 173ft.; at 2,295ft., 1° for each 152ft.; at 2,701ft., 1° for each 137ft.; at 3,110ft., 1° for each 110ft.; at 3,250ft., 1° for each 111ft.; the mean result being 1° for each 137ft. in depth. The mine in question was through Silurian rock.

AN American firm of locomotive builders ascertains the weights on locomotive wheels by means of an apparatus whereby the weight on each pair of wheels is measured by a separate scale. The scales used are portable, being mounted on small truck-wheels. Each scale is capable of registering a weight of 60,000lb. They are about 7ft. 6in. long by 2ft. 6in. wide. All locomotives are weighed with a full tank, and the gauges three-quarters full.

COKE is to be used as a locomotive fuel on the Boston and Maine Railroad, says an American contemporary. The locomotives using coke are to be fitted with water-grates. About a dozen have now been changed, and it is expected to have 100 locomotives ready to use coke by the end of the year. Besides the saving of smoke, it is expected that the coke will prove advantageous in reducing the number of fires caused by locomotives; and, owing to the low price of coke hereabouts as compared with coal, should prove much more economical.

PROF. MOSSO has been recently experimenting on smoke prevention in a long tunnel not far from Genoa, through which some 200 trains pass a day. Two methods were tried:—First, large steel cylinders, 5ft. by 2ft., were filled with air at 750lb. pressure, and placed in a locomotive tender. The air was allowed to escape in the tunnel, with the object of blowing out the smoke. The second method was with compressed oxygen, which was supplied to the furnaces of the engines with the idea of improving the combustion. Both methods are reported to have been successful.

Cost of Railway Working.—The Board of Trade report on the working of the railways of the United Kingdom points out that the average expenditure per train mile has been increased by over one penny in two years, and that the expenditure cannot be expected to diminish much during the next year or two. Before 1890 the total expenditure of the companies per train mile stood for some years at about 2s. 6d., whereas from 1891 to 1897 it was about 2s. 8d. Last year it was 2s. 9½d. The number of third-class passengers in 1885 was about 603¾ millions, while last year it had risen to over 963¼ millions. This is a total increase of 359½ millions in the thirteen years, or on an average about 27¾ millions annually.

The "Ivernia."—The new steamer built for the Cunard "carrying" line was successfully launched on Sept. 20. The vessel is the fourth largest in the world, being about 400 tons smaller than the *Kaiser Wilhelm der Grosse*. Among British steamers there is only one larger, the recently built *Oceanic*. The *Ivernia*, which was christened by the Countess of Ravensworth, is intended for the company's line between Liverpool and Boston, and is designed mainly for the carriage of cargo, third-class passengers, and cattle, although a few first and second-class passengers will be carried. Stalls will be fitted for about 800 head of cattle and 80 horses. The leading particulars of the vessel are:—Length over all, 600ft.; length between perpendicular, 580ft.; beam, extreme, 64ft. 6in.; depth, moulded to upper deck, 41ft. 6in.; depth, moulded to shelter deck, 49ft. 6in.; gross tonnage, about 13,900 tons; speed, on trial, 16½ knots. There are four complete steel decks—lower, main, upper, and shelter; also a steel orlop deck from the boiler room forward to the stem, and a bridge deck 280ft. long above the shelter deck. The space between the orlop and lower decks forward is insulated for carrying chilled beef. Three large refrigerating engines are fitted in a house on the upper deck, and also a smaller one for the ship's own stores. The whole of the space forward of the engine-room on the main deck is utilised for the accommodation of the third-class passengers. On the same deck aft are the stalls for the cattle. These stalls will be fitted on the latest approved principle to pass the American cattle regulations. On the upper deck at the forward end is a clear covered promenade for the third-class passengers. It is expected that the vessel will take up her station on the Liverpool and Boston service early next year.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96439.]—**Quadratic.**—Solutions to this are not satisfactory; all partake of the guess and trial method. As for that of H. T. Burgess, any little boy can reduce it to a bi-quadratic, which is not re present question. The way I took is as follows, but was not satisfied, and thought to get a better from some of our readers. Mr. H. C. Donnithorne says, rather airily, that if he spent half an hour he could, by quadratics, find a in $a^2 - x - 3 = 0$. 'Tis a pity his half-hours are so precious.

$$\sqrt{x+3} + \frac{\sqrt{x-2}}{\sqrt{x+3}} = \frac{11}{3}$$

Let— $$m = \sqrt{x+3}$$

Then— $$m + \frac{\sqrt{m^2 - 5}}{m} = \frac{11}{3}.$$

$$11m - 3m^2 = \sqrt{9m^2 - 45}.$$

As $9m^2 - 45$ is a square number, we can take its square root, which is $3m - 3$, and remainder is $18m - 54 = 0$, from either of which we have $m = 3$ and $m^2 = x + 3$. Therefore $x = 6$. ONTARIO.

[96452.]—**Meal-Powder.**—When I was a boy, I made fireworks of all sorts, from crackers to shells, and even yet I do something in that way now and again. For a long time the most unpleasant part of the work was the grinding of the meal-powder. At last, however, I found an old disused coffee-mill. Into this I put the big-grained powder (quarry-powder, we used to call it), and a few turns of the handle brought it out as fine as snuff. I ground stones weight of powder in this way, and there is not the slightest danger. The mill will not get hot if it is not turned too quickly. These mills have usually a means of regulating the degree of fineness. Run the powder first through so that the grains are only crushed, then tighten the machine and grind a second time. Charcoal may be ground in the same way. POWDER.

[96503.]—**Shire.**—The use of the suffix "shire" seems to be purely arbitrary. If the meridian of Canterbury is taken (that is the mother city, the real metropolis of this country), all the shires lie west; but, so far as I know, no one has been able to explain why "shire" should be added to the names of counties. On the east side of England there is Lincolnshire, Yorkshire, Cambridgeshire, Hertfordshire, but on the west there is Cornwall, for example. The term "shire" seems to be used in a very arbitrary manner, for while it is generally applied to the Scotch counties, it is very rarely appended (if ever) to the Irish counties. I have looked up this matter, and cannot find any definite information at all, nor why there should be, amongst others, such a term as "Hallamshire." TOPOS.

[96555.]—**Equations.**—Mr. Harding is quite right; the reply given by Mr. Burgess cannot be called a solution of the problem; it is impossible to say how he has hit upon "the answer," as there is nothing in the equations to justify him in saying "we may assume" x to be so and so. In the three equations here reproduced—

$$\left.\begin{aligned} \text{(i)}\ \tfrac{2}{3}x^2 + \tfrac{8}{5}yz &= 6\tfrac{3}{4} \\ \text{(ii)}\ \tfrac{8}{5}y^2 + \tfrac{5}{7}xz &= 7\tfrac{1}{2} \\ \text{(iii)}\ \tfrac{5}{7}z^2 + \tfrac{7}{9}xy &= 11\tfrac{2}{3} \end{aligned}\right\}$$

It will be noticed that the coefficient $\frac{8}{5}$ occurs both in (i) and (ii), also that the coefficient $\frac{5}{7}$ occurs both in (ii) and (iii). Now eliminate $\frac{8}{5}$ between (i) and (ii), and the same for $\frac{5}{7}$ between (ii) and (iii), and we get two equations; it will be found that x^2y appears in both of these equations; eliminate this, and we get the equation—

$$\tfrac{81}{8}y - \tfrac{425}{28}z - 15x = \tfrac{87}{35}y^2z - \tfrac{15}{14}xz^2$$

Now, I want to get rid of the z's except the term involving z alone. From I., we have—

$$yz = \tfrac{45}{4} - \tfrac{10}{9}z^2,$$

and from (iii.)—

$$z^2 = \tfrac{42}{5} - \tfrac{49}{45}xy.$$

Substituting these and reducing, we get—

$$z = \tfrac{9}{16}y + \tfrac{14}{9}x - \tfrac{182}{945}x^2y,$$

and from (i.)—

$$z = \frac{\tfrac{45}{4} - \tfrac{10}{9}z^2}{y}$$

Equating these, we get an equation from which y can be found in terms of x, or x in terms of y by solving a quadratic equation. Taking the former, I find on solving the quadratic—

$$y = \frac{\sqrt{\left(\tfrac{3644}{1701}z^4 - \tfrac{57713}{4462}x^2 + \tfrac{81}{8}\right)} - \tfrac{7}{8}x}{\tfrac{9}{16} - \tfrac{182}{945}x^2}$$

Now, in order that this equation may hold good, the terms under the radical sign must form a square

number: otherwise we should have an inexact number = an exact one, which is impossible. Then, confining our attention to the radical term, we may equate the terms under that sign to $\frac{m^2}{n^2}$, m and n being the whole numbers. And it will be seen that any number, either whole or fractional, can be represented by $\frac{m}{n}$ where m and n are whole numbers. Now bring the terms under the radical sign to a common denominator, and write it in this form:—

$$\frac{x^2}{3402}\left(728\,x^2 - 8715 + \frac{34445{\cdot}25}{x^2}\right) = \frac{m^2}{n^2}.$$

Now we have to make x^2 = a square number, which will make the left hand of the equation of the form $\frac{m^2}{n^2}$. To do this, it is necessary that x^2 should divide 34445·25 exactly without a remainder. The only square values of x^2 which will do this are $x^2 = {\cdot}25$ and $x^2 = 2{\cdot}25$. The latter makes the last term 15,309. With this value of x^2, the whole expression after reduction reduces to $\frac{49}{9} = \frac{m^2}{n^2}$, which is the square of $\frac{7}{3}$. Substitute $\frac{7}{3}$ for the radical term and put $x^2 = 2{\cdot}25$ or $x = 1{\cdot}5$, and we get $y = 2{\cdot}5$; then from the other given equations $z = 3{\cdot}5$.

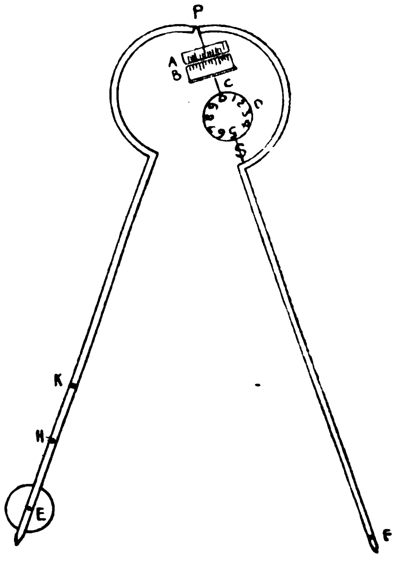
Bath. M.I.C.E.

[96555.]—**Equations.**—As Mr. Harding has had the kindness to mention my name in this connection, I can only say that the direct solution is beyond me. The elimination gives rise to an equation of the eighth degree in the remaining unknown, and some works on algebra say that it has been "conclusively proved" that any general solution of equations of a higher degree than the fourth is "impossible." Personally, I fail to see how any negative can be "conclusively" proved, as the possibilities of a science are infinite.

Oystermouth. SCORPIO.

[96556.]—**Oil and Gas-Engines.**—Thanks to "965" for correction—my mistake. Theoretically you are right; but if you fit a pressure-gauge on a tee-piece so that you can use side outlet for relief-cock, you will find compression actual—generally comes out somewhat higher. Fit a cock also between gauge and engine if running, as it plays havoc with any steam gauge, which should never be subjected to sudden violent shocks. Turn engine sharply by hand and watch gauge. MONTY.

[96587.]—**Speed Indicator.**—(1) Yes, the principle is that of a centrifugal governor. The centrifugal force of the rotating spindle causes a needle to indicate upon a dial graduated to give direct readings in miles per hour. I have seen another form containing a watch movement. On pressing a stud the movement is wound up and the hand set to zero. On releasing the stud the indicator starts counting revolutions, and continues so for 60 seconds. When the watch movement throws the mechanism out of gear, the diameter of the wheel being known, a simple calculation gives the speed. (2) I inclose a rough sketch of a planimeter drawn somewhat



out of proportion in order to render the working parts clear. A, fixed vernier; B, wheel; C, worm gear actuating disc D; S, spindle; E, fixed point; F, tracing point; P, hinge. The total revolutions are read on the disc D, the tenths on the wheel itself, and the hundredths on the vernier. The weight E which anchors the fixed point may be placed at different positions, as shown at H and K, thus enabling the ratio between the two arms to be varied, in order to simplify the reduction of the readings when working to different scales. The theory of the instrument depends upon the fact that while the free end traces out the area of any closed figure the hinged end oscillates to and fro along a curve, but traces no area. If "Scorpio" can refer to "Williamson's Integral Calculus," or "Minchin's Uniplanar Kinematics," he will find the theory of the instrument fully elaborated. As a matter of fact, the planimeter is simply a mechanical integrator. There are several different forms of the instrument. The form I have sketched, with which I am practically conversant, is that commonly used by civil engineers for checking areas and similar calculations. A more elaborate form is used by naval architects in calculating metacentres, displacements, &c., which measures the moments of inertia of areas. W. J. G. F.

[96615.]—**Brown Boot-Polish.**—Yellow wax 1oz., palm-oil 1oz., oil turpentine 3oz., oil mirbane 15 drops. Make into paste. Colour may be heightened by judicious use of butter, colouring made from annatto. Russet leather shoe polish: yellow wax 2oz., linseed oil 3oz., oil turpentine 10oz. Dissolve by means of a water bath in closed vessel, and add hard yellow soap, finely shaved, 1½oz. Dissolve soap in 14oz. of water, add solution to solution of yellow wax and flax-seed oil formed in first instance. A nice russet brown colour may be imparted by incorporating about three grains of Bismarck brown to each ounce of polish. Oil turpentine 10oz., yellow wax 5oz., soap ½oz., boiling water 10oz. Dissolve wax in the turpentine by aid of water bath, and soap in the boiling water. Mix and stir until cold and smooth. Soft soap 1oz., linseed oil, raw, 1½oz., annatto 4oz., yellow wax 1½oz., gum turpentine 4oz., water 4oz. Dissolve soap in water, and add annatto. Melt wax in linseed oil and turpentine, and gradually add the soap solution, stirring till cold. All these articles should be easy to get. REGENT'S PARK.

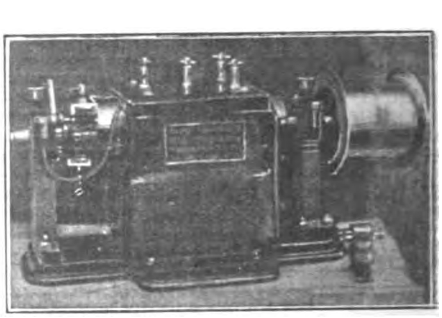
[96619.]—**Electric Organ.**—Thanks to "Diapason" for reply. I should still like to connect American-organ keyboard with that of pipe-organ by electricity, if he will kindly give a few hints how to manage it. In a rough way I had previously connected the keys with laths, but found the leverage too great to play easily. With regard to the pitch, the pipe-organ has its own bellows, and can be weighted according to pressure required. Would "Diapason" also state publisher and price of work referred to. J. S. Z.

[96624.]—**Etching Ground.**—White wax 30, gum mastic 30, asphaltum, 15. White wax 30, gum mastic 15, asphaltum 15. White wax 60, gum mastic 30, asphaltum, 60. White wax 3, black pitch 1, asphaltum 4, rosin, 1. Callot's ground: Linseed-oil varnish, mastic, heat until wax is melted, filter, apply with brush, and heat plate until varnish stops smoking. White wax 2, black and Burgundy pitch each ½, add by degrees powdered asphaltum 2, boil till a drop taken out on a plate will break when cold by being bent double two or three times, pour into warm water, and make into balls. Soft: Soft linseed-oil 4, gum benzoin and white wax each ½, boil to two-thirds. REGENT'S PARK.

[96628.]—**German Yeast.**—As you live so far away, perhaps an inspection of W. Jago, on Bread-making, who is a consulting specialist in London on the subject. The publishers are Simpkin, Marshall, and Co., Ltd., London. He informs us that compressed yeasts from France, Holland, and Germany are not successfully made except on a large scale, and cannot be imitated by small bakers; mostly distillers yeast working chiefly for spirit, largely used for perfumery, &c. However, if you care to try your hand, this is what he gives. Have not written all, as you may suppose. Malt and rye taken together, mashed at a convenient temperature to transform into maltose. Mash allowed to stand in tubs at temperature most suitable for lactic acid or about 35° C. Lactic acid germs on skin of malt rapidly develop and marked acidulation ensues, perhaps 1·5 per cent. of acid. Mash is then cooled by immersion therein of cooling coils of copper tube, through which cold water passes. When at desired temperature, without filtering of the grains (husky fibre of grain used), pitching yeast is added, fermentation allowed to proceed for 10 to 14 hours, according to temperature. Next the raw grain, principally maize, first cooked by high-pressure steam in special steam-cooking vessel (cuiseur) until thorough gelatinisation has been produced. From this vessel cooked maize passes into saccharification tun, there mashed, first with rye; afterwards malt is added, and saccharification continued until the hydrolysis of the carbohydrates to maltose is as complete as possible. The finished wort passes to refrigerators; then conveyed to fermentation vats and pitching ferments added. Air is drawn through the wort by mechanical means until, or found, necessary. Grains in mash rise to surface and act as non-conductor of heat. In three or four hours after pitching the carbon dioxide forces itself up in a sort of cauliflower head through the grounds and bursts or breaks. Fermentation is allowed to continue from 10 to 12 hours from commencement, and then the yeast is skimmed off with a long lath and lay up whole of yeast at one end of vat and then ladle it off in scoops into wooden gutter for conveyance away for washing and purification. Skimming is practically carried on for 12 hours. The skimmed yeast first mixed with water; then passed through a series of mechanical sieves to separate the grains. Yeast then washed by decantation two or three times, and then sifted through finer sieves, &c. REGENT'S PARK.

[96629.]—**Linoleum Polish.**—A paste of beeswax and turpentine, made by melting the wax and stirring in the turps, afterwards stirring carefully in a pot on a kitchen-stove, answers well. Take care not to let the turps catch fire. It is used cold. GLATTON.

[96630.]—**Fifty-Volt Overtype.**—I inclose a photo., of one of our drum-armature shunt-wound overtype dynamos, that perhaps our Editor, with



his usual willingness to oblige, will insert. Subjoined are the principal dimensions:—Armature, built up of 4in. punchings, 3⅝in. long and 4in. diam. before winding. Shaft 2ft. long, 1¼in. diam., turned down to 1in. where it enters bearings. Base of dynamo 23in. long by 13¾in. at widest portion, 1¾in. thick. Field-magnet cores 8in. wide, 1in. thick, by 6¼in. high. Pole-pieces 3⅞in. high, 9⅞in. long, 7¼in. across the tunnel, which is bored out to take the wound armature to about 4¼in. diameter. Armature to be wound with 3lb. No. 18 in 24 sections of 5·625 yards each. Field-magnets to be wound with 10lb. No. 22 d.c.c. on each limb, connected up in shunt. Output at 1,800 revs. per minute 20 ampères, 50 to 55 volts. Will light easily from fifteen to twenty 50v. 16c.p. lamps, or two arcs taking 8 ampères each in parallel. S. BOTTONE.

[96631.]—**The Eight Queens Problem.**—There is nothing "vague" about this problem, as stated by "Q. R." To arrange the eight queens in this manner is an old puzzle, well known to most chess-players, and the fact that the eight queens command the whole board has no bearing on the question. Examined analytically the problem is resolved into the following arithmetical puzzle:—Place the first eight natural numbers in such an order that the inequality $a_m \sim a_n \neq m \sim n$ shall hold generally, where a_m and a_n denote the mth and nth numbers in order. Such an arrangement is 7, 5, 3, 1, 6, 8, 2, 4. If we place immediately to the left of each number the figure representing its place in order, we get 17, 25, 33, 41, 56, 68, 72, 84, and these are the eight squares on which the queens are to stand, expressed in Kieseritsky's notation (where 11, 12, 13 . . . 18 represent the squares of the first rank, 21, 22, 23 . . . 28 those of the second rank, and so on). In the common English notation the above solution gives the squares Q R 7, Q Kt 5, Q B 3, Q sq., K 6, K B 8, K Kt 2, K R 4. The problem, as quoted by "Q. R.," requires *the number of different solutions*, and in giving an answer to this question we must first decide what we shall call a different solution. In general, any arrangement of the pieces can be presented in eight different aspects. We may turn the board on either of its sides, or upside down, thus giving four different views, and each of these may be duplicated by reflection in a looking-glass. I am not aware of any published solution to the above arithmetical problem, and have been forced to consider it *de novo*. The analysis is much too long and complicated for publication here, but the result, which "Q. R." may take as correct, is as follows:—If we consider the eight aspects mentioned above as *different* aspects, then there are 92 arrangements which satisfy the required conditions. If, on the other hand, we do not consider them as different, there are only 12 satisfactory arrangements. The reason why the first value is not eight times the second is that one of the latter 12 arrangements is semi-symmetrical, and can only be shown in four different ways. Of the twelve solutions, six belong to one family, and can be converted one into another by equal displacements; the other six are monads. C. P.

[96631.]—**The Eight Queens Problem.**—This interesting problem is a particular case of the more general one—viz., to place n queens on a board of

n^2 cells, so that none can take any other. In 1874 Dr. Günther suggested a method of solution by means of determinants. Thus, if we take 64 cells we can obtain the possible positions by expanding the determinant—

$$\begin{matrix} h_1 & g_2 & f_3 & e_4 & d_5 & c_6 & b_7 & a_8 \\ k_2 & h_3 & g_4 & f_5 & e_6 & d_7 & c_8 & b_9 \\ l_3 & k_4 & h_5 & g_6 & f_7 & e_8 & d_9 & c_{10} \\ m_4 & l_5 & k_6 & h_7 & g_8 & f_9 & e_{10} & d_{11} \\ n_5 & m_6 & l_7 & k_8 & h_9 & g_{10} & f_{11} & e_{12} \\ o_6 & n_7 & m_8 & l_9 & k_{10} & h_{11} & g_{12} & f_{13} \\ p_7 & o_8 & n_9 & m_{10} & l_{11} & k_{12} & h_{13} & g_{14} \\ q_8 & p_9 & o_{10} & n_{11} & m_{12} & l_{13} & k_{14} & h_{15} \end{matrix}$$

Each symbol representing the corresponding cell of the board. Now pick out each term in which neither the same letter nor the same number appears more than once. Each such term gives a solution. There are 92 such terms in the above determinant, and "Q. R." may like to find them for himself; for his benefit, however, let him remember that there are |8 or 40,320 terms to investigate. Dr. Glaisher (*Phil. Mag.* Dec. 1874, pp. 457-467) has shown how to shorten the process by deducing the solutions for a board of n^2 cells from one of $(n-1)^2$ cells. In this way he finds twelve fundamental solutions given by—

4 6 1 5 2 8 3 7, 6 1 5 2 8 3 7 4, 3 5 8 4 1 7 2 6,
6 8 4 1 7 2 6 3, 7 2 6 3 1 4 8 5, 5 7 2 6 3 1 4 8,
3 5 2 8 1 7 4 6, 1 6 8 3 7 4 2 5, 4 8 1 5 7 2 6 3,
5 1 4 6 8 2 7 3, 4 2 7 5 1 8 6 3, 5 1 8 6 3 7 2 4.

In these the 1st, 2nd, 3rd, &c., digit represents the number in the 1st, 2nd, 3rd, &c., column of a queen. For futher information on this subject the reader is referred to *Phil. Mag.* 1874, as above, and to a short article on pp. 85-88 of that excellent little book "Mathematical Recreations and Problems," by W. W. R. Ball (Macmillan), guaranteed to cure inventors of perpetual motion machines, lunar non-rotationists, &c. J. T. G.

[96635.]—**Solder.**—The inquiry was for a solder more fusible than tinman's solder. Five of tin to one of lead is a low-melting solder, or one of tin to one of bismuth melts nearly 100° lower. It is a general rule, the lower the melting-point the weaker the solder, but soft-solder is much stronger than is generally supposed, especially if the joint is well fitted and the layer of solder very thin. Don't mind "Regent's Park's" answers. He once gave one for brass-coloured solder to use with copper bit. I spent several hours in testing, thinking it was possible that "R. P." had made a discovery, though I should have known better. I would willingly give £5 for recipe for brass-coloured soft-solder.

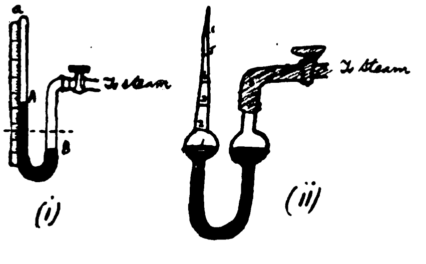
West Didsbury. M. COLE.

[96636.]—**Accumulator.**—Page 142, last sentence, for "two parts of water" read ten parts of water to one of sulphuric acid. W. J. G. F.

[96648.]—**Mercury Gauge.**—I remember experimenting some years ago with a patented gauge consisting of a glass tube filled partly with fluid and partly with air, the latter being near the closed end of tube. Steam pressure forced more of the liquid up the tube, compressing the air. Equal divisions were obtained by varying the section of the tube. I did not think it satisfactory, as the amount of air required adjustment from time to time. The fluid used was water, but mercury would be better, as it would not absorb the air.

GLATTON.

[96648.]—**Mercury Gauge.**—The simplest form of such a gauge is shown in Fig. 1, and consists simply of a bent U-tube, with its longer limb, A, closed at one end. In this tube is a quantity of mercury, A B, which thus shuts off from all communication with the external air the air A *a* in the



longer closed limb of the tube. The gauge is so made that when the pressure on the mercury at B is equal to that of the atmosphere, the mercury is at the same level in both limbs of tube. If the pressure be increased, the mercury in B will be forced into A, thus causing the air in A to be compressed, as shown by the rise of the mercury in A. Equilibrium will be established when the pressure in A, together with that exerted by a column of mercury whose lift is the difference between the levels of the mercury, equals the pressure on B. It will be seen that decreasing rises in the mercury in A will correspond to equal rises in pressure at B. Hence for very high pressures the accuracy and sensibility of the instrument are not very great. This difficulty is overcome in some instruments by making the tube A conical. Thus, when the mercury rises in A, increasing changes in length of the mercury column correspond to equal changes in volume and pressure. (See Fig. II.) Such instruments are in practice graduated empirically by subjecting to varying pressures and comparing with a standard mercury column or pressure gauge. Unless access can be had to a standard gauge and compressed air or steam to act on, both so as to graduate gauge by experiment, I think the manufacture should not be attempted, as, although the distances on the scale for equal increments of pressure can be determined by calculation, the formula is fairly complicated and the chances of error, owing to differences in volume of different lengths of tube, &c., are not a few. The glass tube, of course, should be stout steam and water-gauge tubing, such as is used on boilers for water-gauges, and should be without flaws. J. BENNETT.

[96656.]—**Bookbinding.**—By all means take the books to a printer, and have them cut by machine. I have done my own bookbinding for 30 years, and never could cut edges to give good appearance. In gold lettering you can use ordinary-type, which need not be very hot. You can usually buy for 4d. or 6d. at the bookstalls most beautiful specimens of binding—of course, the worse for wear, but good as specimens to copy from.

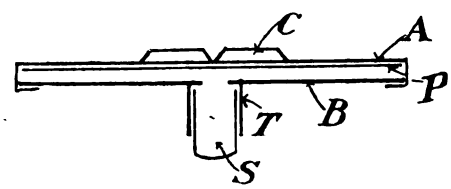
West Didsbury. M. COLE.

[96658.]—**Rheumatism.**—I have been suffering from what the doctor calls gouty neuritis since June, and, getting tired of taking salicylate of soda, unusual exercise, and the other things recommended, I began three weeks ago to take Bishop's citrate of lithia, as recommended by "Edwards," on p. 72. The results are most encouraging; the pain has practically gone, and so has the crackling of one of my hip-joints, which I experienced when getting up in the morning. GLATTON.

[96660.]—**Ringing Anvil.**—A lump of wood stuck on the horn reduces the noise, but is in the way.

West Didsbury. M. COLE.

[96661.]—**Regulating Capsules for Incubators.**—I have two incubators—one on the atmospheric principle, which is regulated by what is called a J-tube regulator; and the other machine is on the hydro principle, regulated by the capsule-regulator. I have used the machine on the atmospheric principle which is regulated with the J-tube, and find the regulator to work very well. The other machine, with the capsule-regulator, I have not yet worked, so cannot say how it works with use. I got mine made at a tinner's from my instructions, which are as follows:—In Fig. 1, to



A, Top plate; B, bottom plate; C, metal ring soldered in centre of top plate; T, tube to pour ether in; S, plug to fit tube; P, sheet of blotting-paper.

make it clear, I give a section of the capsule. The upper plate, marked A, should be 2½in. square and No. 33 gauge, and the lower plate, B, 2in. square, and rather stronger—say No. 30 gauge. A small round metal plate, C, about ⅝in. diameter, is countersunk in the centre; the lifting-rod works into this countersunk hole. This metal plate is soldered into the top plate marked A (Fig. 1) in the centre, thus spreading the weight over the whole plate. In the centre of the bottom plate B (Fig. 1) solder a very small piece of brass tube, T (Fig. 1), and turn a brass plug to fit tightly in it, which is afterwards sweated or soldered in (see S, Fig. 1). Now, to commence putting the capsule together. Have both the plates perfectly flat, then bend the edges of the top plate A over the bottom plate B, and solder round, and be sure to put a 2in. square of clean blotting-paper, P, between the two plates. Now fill the tube with ether (prepared for the purpose), which is made of sulphuric ether 2 parts, methylated spirit 1 part. Allow it to soak into the blotting-paper until it will soak no more. Then sweat or solder in the brass plug S (Fig. 1). The capsule is then complete, and I think the various plates, &c., will be understood from the vertical drawing of the same. The capsules are generally made of thin sheet brass to the sizes given above, though I had mine made of thin sheet steel; but, of course, cannot tell how it will work until I have given it a trial. I trust the information will be found useful by your correspondent, "Poultry Breeder," and I might just say that a good book on the subject is "Incubators: How to Use and Make Them," published by Carvell and Co., Ludgate Hill, London, E.C., price 1s. 2d. I have, I may say, from the instructions therein, made the two incubators as above, and here he will find all information required, though I shall be pleased to answer any further questions if desired to do so. The specially-prepared ether for the capsules can be obtained from incubator makers at about 6d. per small bottle. I find I have not any left, or would have sent you a bottle in care of the Editor. W. H. B.

[96661.]—**Incubator Capsules.**—Get some thin sheet-brass, cut out two discs 2⅞in. and 3in. diam., and harden well by planishing with hammer on smooth block (a flat-iron will do), hammering slightly more in the middle to raise same about $\frac{1}{16}$in. or so. Now clean and tin each round about ⅛in. from edge. Place same together and solder round with the exception of about ⅛in., allowing solder to lap over edge of top plate. This forms shell which, when compressed, should spring and cockle. Pour about 20 drops of sulphuric ether in a saucer, compress shell, forcing the air out between the plates; apply unsoldered part to ether and release, and the ether is sucked up or, rather, forced between the plates. Close up, keep capsule cool with a piece of wet rag on the other side to prevent ether from evaporating, and solder up remaining ⅛in. This will boil and lift at 98°, but by weighting lever boiling-point is raised easily to 108°. If a higher temperature is required on capsule, owing to position of capsule and tank, a mixture of alcohol (rectified spirits) one part and S. ether three parts can be used. You will find this gives a good result if directions are carried out. SOCIALIST BRUM.

[96662.]—**Thunderstorm.**—It probably makes little or no difference whether the coat of the man or animal be wet or dry. Animal bodies are good conductors of the electricity of high potential difference of which lightning is an example. The hair, wool, or fur of animals, however, are protective, being in varying degrees insulators; but when wet, water being a good conductor, they to some extent lose their protective or insulating properties. This rule also, of course, applies to woollen clothes worn by man. Clothes of cotton or vegetable material are conductors of electricity even when dry. Men, therefore, or other animals, are more likely, *cæteris paribus*, to be struck by lightning when their clothes or skins are wet. However, this wet condition generally implies that it is raining, and when this is the case there is less likelihood of an object being struck, for the electrified clouds are being dissipated, falling harmlessly as rain to the earth, and the damp air affords an easier path for any high electrical discharge from cloud to cloud, or from cloud to earth. Trees are good conductors of electricity, some kinds being better than others. This is owing perhaps to the large number of points which their leaves or branches present; and it is therefore obviously, as well as notoriously, dangerous to stand under a tree during a thunderstorm. It is said to be safer, however, to stand near a tree, at a distance from the trunk equal to the height of the tree, than in an open field. These statements are perhaps mostly founded on theory; but since the Russian, Prof. Richmann, of St. Petersburg, was killed by the lightning which he had drawn for experimental purposes from a "thunder" cloud, comparatively few people seem to have practically investigated the subject. H. E. SEYMOUR.

[96662.]—**Thunderstorm.**—I remember, at a lecture at the Royal Institution, seeing a waterproof boot exhibited which had been torn to pieces by a lightning flash, which had passed over the wet parts of the wearer without injuring him. I cannot find this mentioned in the *Proceedings* however. Prof. Lodge's experiments showed that, dry or wet, it is dangerous to stand near a tree in a thunderstorm. A horse (and probably cows and bullocks) is killed very easily by an electric shock. An electric-tram cable, if it it falls on a horse's head, will generally kill. What would be merely a severe shock to a man will kill a horse. In this week's *Engineering*, p. 338, a new method of experimentally imitating ball lightning is described, which is interesting. GLATTON.

[96666.]—**To J. Dormer.**—Your paper does not seem sufficiently sized. Try treating it with gelatine solution before applying iron. J. D.

[96669.]—**Mercury's Mass.**—In Ball's "Elements of Astronomy," 1883 edition, four determinations of this are quoted:—

A.D. 1841	Encke	$\frac{1}{4865751}$	of the sun's mass.
„ 1861	Leverrier	$\frac{1}{5310000}$	„ „ „
„ 1861	„	$\frac{1}{3580000}$	„ „ „
„ 1876	Von Asten	$\frac{1}{7636440}$	„ „ „

Probably there are later estimates. GLATTON.

[96671.]—**Solvent for Gum.**—Benzine, chloroform, ether, or petroleum ether are solvents.
REGENT'S PARK.

[96673.]—**Aluminium.**—As this is now only about 15d. per pound in the ingot, it is not worth while to go to much expense about it. To reduce to fine powder machinery is required. Send it to a board school to put in their cabinet of specimens.
West Didsbury. M. COLE.

[96677.] — **Voltage.** — It is quite immaterial whether the source of current be a dynamo or a battery. The softer the iron of the rod the more powerful will be the magnetisation. The size of wire will depend entirely upon what current you use, the result will depend upon the number of ampère-turns—i.e., 10 ampères going once round the rod will produce the same effect as 1 ampère going ten times round. You may, therefore, use a small current with high voltage to force it through the resistance of many turns of wire, or a large current with small voltage going round comparatively few turns. W. J. G. F.

[96677.] — **Voltage.**—The question as to the gauge of copper wire best adapted to wind an electro-magnet is decided by a knowledge of the current in ampères required to magnetically saturate the iron. Remembering that the "free" magnetism which can be evoked is dependent upon sectional area of poles (independent of length), and on the number of ampère turns, and also that the limit of useful magnetising force is reached when the ampères (or ampère turns) flowing round the iron amount to about 14,000 per square inch of section, there will be no difficulty in calculating out the best winding, provided the E.M.F. and internal resistance of the proposed source of current is also known. An example is here given. Suppose we have an iron rod of 1⅛in. diam. (equal very nearly to 1in. square sectional area), we should require to cause to flow around that 14,000 ampères. Such a large current is not practical, so we will use ampère turns instead, and content ourselves with six ampères. Now 6)14,000(2,333 very nearly, so that if we can wind our rod with 2,333 turns of a wire that will safely carry six ampères, we shall get the desired magnetising force. No. 16 copper wire meets the requirements. Hence, if we wind our rod with about 2,333 turns of No. 16d.c.c., we shall do very well. No. 16 lies 14 turns to the inch, so that we can wind 168 turns on a rod 12in. long: $14 \times 168 = 2{,}352$, so that 14 layers will give us the desired number of ampère turns. As the average length of each turn is about 5⅛in., so the total length of wire needed is 12,042in., or, say, 335 yards, or 14lb. very nearly. Now the resistance of No. 16 copper wire is 0·2 to the pound, so that the total resistance of our coils is 2·8 ohm. To push six ampères through this resistance, we should require a battery, dynamo, &c., capable of giving at least 16·8 volt, since 2·8)16·8(6. But since there is no battery or dynamo that has *no* internal resistance, allowance must be made for this. Supposing we used accumulator cells, each giving two volts, with an internal resistance of 0·04 ohm each, then ten such cells in series, when coupled to the electro-magnet, would give us $\frac{20}{2\cdot8 + \cdot4}$ 6·21 ampères. From this it is evident that a dynamo giving 18 to 20 volts, with an internal resistance not exceeding 0·4 ohm, would answer equally well in this case. S. BOTTONE.

[96678.]—**Spark Coil.**—If you have not put the condenser in connection with the contact-breaker of the coil you can form no criterion of the behaviour of the coil. Try it again, with the condenser properly connected, and with a good battery, capable of giving about eight volts and six or eight ampères. (Four freshly-charged accumulator cells are the most satisfactory for this purpose.) If the nine sections do not give at least ¾in. spark under these circumstances, there must be something radically wrong in the insulation.
S. BOTTONE.

[96678.]—**Spark Coil.**—If the insulation and connections are right, one would expect much more than $\frac{1}{16}$in. spark from 1lb. of wire. Querist does not mention the break. If not already tried, a mercury break might be found to improve results; a bit of platinum wire dipped by hand in the mercury does for a test. The core and primary are, however, in my opinion, too small for 6lb. of secondary. Judging from the dimensions of noted coils given in a table which I published in "E. M.," No. 797, the core might be 1¼in. to 1⅜in. diameter by 15in. to 18in. long, and primary three layers of No. 12 to 14. The present core and primary might suit for 3 to 4lb. secondary No. 36, and give 3in. to 4in. spark.
Belfast. J. BROWN.

[96678.]—**Spark Coil.**—The reason for your coil not working seems to be that you didn't connect up the condenser. A 6in. spark coil without a condenser will give barely 1in. spark. Are you sure that the sections are properly connected up? You should be able to get 5in. spark or more from this coil. W. E. G.

[96680.]—**Temperature.**—If Perkins's "Arktos" refrigerator is still on the market, it would perhaps suit. A few pipes, partly filled with ammonia, led round the room like heating pipes, are practically all it consists of. A fire has to be lit about once a day in a fireplace where part of the pipe is coiled. No other attention wanted, I believe. GLATTON.

[96683.] — **Cycle Motors.** — Endurance motor seems a crude adaptation of oil-engine taken from gas-engine practice. It is English make and design, and Early English at that, though they may run well enough; but look to me more in keeping with a wheelbarrow or hand-truck than a tricycle. You cannot do better than follow on lines described by writer; but make your inlet valve pipes and gauze in carburator half as large again. It is a great deal easier to choke a high-speed oil-engine than people are generally aware of. I do not like in writer's design the sunk nuts on flywheels. Any special work like that is bad in practice. Otherwise, all would-be makers are indebted to him. MONTY.

[96686.]—**Cycle Motor.**—You can pump petrol in if you wish. Pennington used to run his in by gravity three or four years ago; and they worked well; but I believe had a tendency to choke up near small inlet into cylinder. I do not think he uses it on his present engine, from which you can draw your own conclusions. MONTY.

[96687.] — **Black Straw Hat Polish.** — "Milliner" will find nothing better than black sealing-wax dissolved in methylated spirit. Some things that are used for black straw are intolerable—they either have a horrible smell which is never got rid of, or in the least rain they become clammy, and come off on the hand. Sealing-wax and methylated spirit are free from any objection. M.

[96688.] — **Oil Engine.** — You do not say if yours is a stationary engine or not. Electric ignition will enable you to fire at best point and therefore get better results! Certainly you would get better results from petrol than common paraffin with less objectionable smell, and no tarry deposit in cylinder and vaporiser. Power is merely a question of speed; compare difference between yours and one described. You can easily test the brake H.P. before and after alteration. Double the speed of your present engine if you want more power. MONTY.

[96690.]—**Dynamo.**—To MR. BOTTONE.—Premising that at 65v. pressure you will not be able to draw a large current from so small a dynamo, I should advise you to wind the armature with about 130 yards, or, say, a little over 1½lb. of No. 20 d.c.c. in not less than 16 sections, and the field-magnets with about 10lb. No. 22 d.c.c. If the iron of the F.M.'s is soft and of good magnetic permeability, you would probably get better results by using as much as 13lb. of No. 22; but if the iron is at all hard the machine would possibly not "build" with so much wire on the fields. Using wire of the above gauges, which correspond to 0 89mm. and 0·75mm. respectively, you may reasonably expect to get four ampères at 65 volts when driving the machine at about 2,500 revs. per minute.
S. BOTTONE.

[96691.]—**Acetylene Gas**—The statement that this gas can be made at a cost of 2s. 6d. per 1,000c.ft. is ridiculous. Calcium carbide cannot at present be bought by consumers at a lower figure than 20s. a cwt., to which must be added the cost of its carriage. A pound of good carbide is supposed to give 5c.ft. of acetylene; but the querist may consider himself lucky if he can get carbide to give 4c.ft. in practice, and at this rate his 1,000c.ft. would cost over £2, without taking into account cost of carriage. One has not the least faith in the statements made in the catalogues of people connected with the acetylene business if one has had experience in the matter. Under the most favourable circumstances, the amount of light would work out thus:—112lb. $CaC_2 \times$ 4c.ft. = 448c.ft. = 60 candle-power for 448 hours, or 448c.ft. × 60c.p. = 26,760 candle-power for one hour. The acetylene light is a brilliant one, and could not be beaten; but I should say that coal-gas at 3s. 9d. per 1,000 with incandescent mantles (with fair care) would be a great deal cheaper. FIAT LUX.

[96692.]—**Liquid Nitrogen.**—The querist asks a question, and assumes that liquid nitrogen would be above its critical temperature, and "therefore must be in gaseous state." How can nitrogen or other "gas" be in a gaseous state when it is under such a pressure as compels it to be liquid? It appears to me that this is an examination question, and should be left alone by readers of the "E. M." Some of these examination questions are useful no doubt, because they test the real knowledge of the students, and some candidates have the courage to write against them that they are incomprehensible, others, perhaps more daring still, write "silly."
JUSTUS.

[96693.]—**Colouring White Metal.**—What does for brass will probably do. If so, as a lacquer dissolve dammar 2 parts in oil turpentine 4, add to solution siccative 1 and boiled linseed-oil 2. By adding gamboge, dragon's blood, and Syrian asphaltum, red or brown-yellow to golden tones given; or ruby shellac 10, copaiba 3, siccative linseed-oil 3. Melt together when cold, dissolve mass in 100 to 150 of spirits of wine, according to desired consistence. Or dissolve fused copal 1 in oil turpentine 2 to 3. Black (amber) varnish for metals: melt amber chips in iron vessel, and same quantity by weight of best asphaltum in second vessel; heat both resins till they evolve heavy vapours. Then add to each resin half its quantity of boiling linseed-oil of the resins originally used; stir oil roughly into resins, then combine both fluids. Heat the article first, and apply varnish in hot state in very thin layer. Copal may be used instead of amber, but not so durable. Brown and every shad to black: water 1 pint, nitrate iron 5dr.; water 1 pint, perchloride iron, 5dr. Brown and every shade to red: water 1 pint, nitrate iron 16dr., hyposulphite of soda 16dr.; water 1 pint, hyposulphite of soda 16dr., nitric acid 1dr. Brownish red: water 1 pint, nitrate copper 1dr., oxalic acid 1dr., nitric acid 3dr. Yellow to red: water 1 pint, tersulphide arsenic 30gr., pearlash solution 6dr. Blue: water 1 pint, hyposulphite soda 20dr. Steel grey: water 1 pint, muriate arsenic 1oz. Black: water 1 pint, permuriate iron, 2 pints, muriate arsenic 10oz. REGENT'S PARK.

[96694.]—**Circular Saw.**—"R. T." could buy a small horse-gear, such as farmers use for chaff-cutting, &c., for about £8, and an intermediate gear for increasing the speed, and with pulley for belt for about another £5; or, if very high speed is not required, could drive direct from gear with a rod and universal couplings. But only a small saw could be driven by a donkey, and even horses soon get sick of these contrivances and require continually prodding to keep them at it, so that the proverbially stubborn donkey would probably refuse to go at all in a short time, and then no amount of ill-treatment, however barbarous, would make him (or her). OPTICAL L.

[96696.]—**Cycle Motor.**—I would advise "Fiat Lux" not to attach a motor to his bike; $\frac{1}{10}$H.P. would be useless, it wouldn't drive the machine along the level, even without a rider. A suitable motor and accumulators would be very heavy, and oil-motor bikes are no good except for side-slipping, which they do rather well. GIBSON.

[96697.]—**Lime-Water.**—Take some well and newly-burnt limestone, and pour water over it as long as the stone seems to absorb, and allow it to stand; if not breaking down freely, sprinkle a little more water over it. A small quantity is best done in a vessel, such as an old cask, so that it can be covered with a board or bag. After being slaked, add about 1lb. of it to every 10 gallons of cold water, then stir, and allow to settle. The clear liquor is what is used for dyeing. Lime-water attracts carbonic acid from the air, which tends to weaken solution. Or, take 2oz. of lime, 2 quarts of distilled water. Slake lime with a little of the water, pour on the remainder of water, and stir them together; then immediately cover the vessel, and let it rest four hours. Keep the solution with the undissolved lime in glass-stoppered bottles, and when wanted for use pour off the clear liquor—anti-acid, of course. REGENT'S PARK.

[96699.]—**Purification of Well.**—The "slightly reddish colour" may be due to iron; but there is one thing certain: if there is any reason to suspect the purity of the water it should not be used until certified to be free from contamination. I must have consumed some quarts of water from Aldgate pump, the late pump in Cornhill, near the Royal Exchange, and also from that in Postern-row, Tower-hill; but they have all been condemned, and I should not wonder if the water companies somehow managed to get the water from the well in the Bank of England condemned. That will probably be a tough job; but the charge for water on the Bank would be a nice little sum. The breweries in London use water from wells—deep ones, in the chalk. S. R.

[96700.]—**Shaving.**—Very few put the razor into hot water. My father did so, and I am the youngest of thirteen children, and in my 80th year; but none of his sons ever used hot water for the razor, although we all used hot water to soak the beard.
G. A. H.

[96702.] — **Glue.** — The addition of a little glycerine tends to prevent cracking, making it elastic. REGENT'S PARK.

[96703.]—**Cycle Chain.**—One of the leading cycle papers a few weeks ago advised a correspondent to take off his chain, soak it in paraffin and then boil it in Russian tallow. After letting it cool in the tallow, wipe off the superfluous grease, and it will then run 700 or 800 miles "without further lubrication." I have tried this for some 200 miles with excellent results, as it runs now as smoothly as when first put back. I have also rubbed it occasionally with "grapholine." It keeps beautifully clean in contrast to the nasty mess made by oil in dusty weather.
Oystermouth. SCRIPIO.

[96703.]—**Cycle Chain.**—The noise is probably due to chain or hub gear-wheel, or both, being worn out of pitch. The only remedy is a new chain or gear-wheel, as the case may be.

N. E. E. S.

[96703.]—**Cycle Chain.**—Take chain off, put it in an old pot, cover it with cold water, put a handful of common soda in, and boil hard for about fifteen minutes. Take chain out whilst boiling, and it will dry in a few seconds. (Don't wait until the water gets cold). Then rub all dirt off with dry rag. Now thoroughly clean chain wheels, and put chain on. Next put a good drop of oil on chain, and run it round so as to thoroughly work oil between blocks and rivets. Wipe all oil off outside of chain, so that no oil will get on teeth of chain wheels, and put some good blacklead on, or, better still, some dry lubricant (which is obtainable at any cycle shop), and keep chain well lubricated with it.

Syrl.

[96704.]—**Ivory Polish.** — Putty-powder and water, by rubber made of old hat. Or, set in turner's wheel, take rushes and pumicestone powder and water, and rub till smooth; then heat by turning it over piece of linen or sheepskin, and when hot rub it with a little whiting diluted with olive-oil; then rub with a little dry whiting, and finally with a soft piece of white rag.

Regent's Park.

[96706.]—**Cutting up Slate.**—After getting perfectly level surface on slate, coating of colour of shade required is applied. Slab baked in oven at 130° to 250° Fahr. for 12 to 48 hours according to size. The colours floated on to the surface of a cistern of water over which they float naturally into shapes of streaks of colour seen in marble. The slate with its black ground (tar varnish is used with good effect) burnt in is dipped into surface of water and receives thin coat of colour. It again goes into oven, and when hardened a coating of enamel is applied. Another baking to harden the enamel. The slab is then pumiced to get level surface. Baked again, once more pumiced, and then goes into oven with pumice wet on surface. If necessary this last operation is repeated. Slab ready for polishing. As regards cutting, have you heard of De Winton's patent hydraulic feed circular saw, driven by pulley and belt arrangement for independent travel by hydraulic pressure to table carrying slab to be sawn. Table connected on underside by a bracket and nut to the piston-rod head of hydraulic cylinder, bolted underneath table to framing. Supply pipe leads to both ends of cylinder from valve-box with pressure of 60lb. to square inch, &c., &c. Fast or slow movement, according to thickness or hardness of slate, quick return of table obtained. Small quantity of water to work feed; 3in. main pipe enough for twelve pairs of saws. Feed very steady, and prevents slate being jagged, saw forced, as is sometimes the case with chain or rack feed. See Powis Bale on "Slate and Stone Cutting."

Regent's Park.

[96708.]—**D.Sc. Degree.**—To Mr. Bottone.—Nearly all the Italian universities are absolutely free to students, *id est*, no fee is required for admission to the classes and lectures. But fees are demanded for entrance to the examinations themselves, and no diplomas are granted unless the candidate has thus entered himself and passed the exams.

S. Bottone.

[96709.]—**Hovis Bread.**—1. Quantities: 3½lb. Hovis flour, 1oz. of compressed yeast, such as D.C.L. (dissolved in two tablespoonfuls of warm water), 1 quart water (about as warm as the hand can bear it); use no salt. 2. Method: Take about three parts of the flour and mix it thoroughly with the water, then pour in the yeast and mix again—this time using also the remainder of the flour. 3. Baking: Let it rise 20 to 40 minutes, and bake rather longer than ordinary bread (say 15 to 20 minutes longer). 4. Caution: Do not attempt to knead or mould it in the ordinary way (it will not be firm enough for these operations to be possible); but put it in the tins direct from the mixing.

The Hovis-Bread Flour Co., Ltd.
Hovis Flour Mills, Macclesfield.

[96709.]—**Hovis Bread.**—Take, say, 14lb. Hovis flour, 4oz. compressed distilled yeast, one gallon of water; break down yeast in 4oz. of water. Take temperature of Hovis flour, say 50° Fahr. water must be 130° Fahr., or if it is 70° Fahr. water must be 110° Fahr., the two added always making 180° Fahr. Dough should be 90° to 95° Fahr.; mix 10lb. or two-thirds of meal with the gallon of water till it is a very smooth batter; stir in the dissolved yeast, complete the mixing with remaining 4lb. of flour, weigh off and tin immediately. It will require from 20min. to 40min. proof (according to temperature of bakehouse, &c.) and should be thoroughly well baked, say 10min. or 15min. more than white bread. Use no salt. Dough should be thin and somewhat unpleasantly sticky; no other flour to be used but Hovis flour, not even for dusting, &c., &c. See "Jago" on "Bread-Making."

Regent's Park.

[96713.]—**Test for Arsenic.**—Scrape off the paper as much of the colour as you can. Boil this in a test tube with pure hydrochloric acid. Now divide this into two portions in separate test-tubes. In the first place a strip of clean bright copper, and boil up for a few minutes. If arsenic be present the copper will become covered with a grey metallic deposit. In the second add a few drops of ammonia nitrate of silver. The presence of arsenic will be shown by the production of a yellow precipitate. There is yet another test, which is extremely delicate, but which requires special apparatus and a little dexterity. It consists in placing the acid solution in a well-corked bottle, fitted with a tube drawn out to a fine aperture. A few pieces of pure zinc are then placed in the bottle, which is to be immediately corked. A little of the gas is allowed to escape from the tubes, so as to avoid explosion. The issuing gas is ignited, and a piece of clean white porcelain (such as a broken plate) lowered upon the flame. A *brilliant* metallic stain will be produced on the porcelain if arsenic be present.

S. Bottone.

[96713.]—**Test for Arsenic.**—Heat a piece of glass tube and draw it out to make a jet. Insert the tube through the cork of a medicine-bottle, with the jet outside. Place in bottle a little pure zinc, sulphuric acid, and water. Light the hydrogen gas which is evolved at the jet. Inserting a cool surface, as a china cup, in the flame, will cause a black mirror to be formed on it if arsenic be present in the bottle. If no mirror be formed, place some scraps of paper in the bottle, and notice if then formed. This arsenic mirror is soluble in sodium hypochlorite almost immediately; if not, it is due to antimony.

Clara.

[96713.]—**Test for Arsenic.**—Take fragment of the paper and put it into a solution of ammonia. If arsenic be present the liquid will assume a bluish colour. For further test, pour a little of the ammoniacal solution on crystals of nitrate of silver, and arsenic, if present, will leave a yellow deposit on crystals.

Regent's Park.

[96714.]—**Electrophorus for Wireless Telegraphy.**—Yes; an electrophorus answers perfectly well, with one proviso, and that is that you have some device for producing a "surging wave." The neatest way to do this is to make a small Leyden jar with a ½oz. medicine phial, and fasten this bodily to the shield or cover of the electrophorus, and take the sparks from the knob of this little jar with a brass ball.

S. Bottone.

[96716.]—**Solenoid.**—To Mr. Bottone.—The iron would now carry less than before boring, because the magnetic force is a function of the superficial area of pole-piece. The rod would not travel up the iron cylinder at all, because the said iron cylinder would shield it almost entirely from the magnetic lines set up by the solenoidal wires.

S. Bottone.

[96717.]—**Shaving Cream.**—Veal suet, 60; lard, 20; cocoa-nut oil, 20; potash lye, 36°, 50. Melt grease in kettle or jacket with double bottom heated by steam, kettle of tinned copper, or by means of a steam jacket. Divide alkali into two parts, and dilute one with water to mark 21°, and place it so that it will run gently into melted grease. When grease is about 112° Fahr., turn on the lye, keep stirring, and regulate the temperature below 100°. In about two hours soap will begin to form, and will separate in grains, then add the other portion of lye at 36°, and continue the constant stirring until it becomes too stiff to work, when remove the fire, and beat it, while cooling, into as smooth a mass as possible, when cover the pan or remove it into any suitable wooden vessel. The pearly appearance has to be given by beating in small portions in marble mortar or by running it rapidly through the stone rollers of the mill. To make almond cream, perfume with oil of bitter almonds and a little bergamot. To make rose cream, colour with fine French vermilion of proportion of a drachm to 1lb. of cream, and perfume with oil of roses and rhodium. To make ambrosial, colour with tincture of archil and perfume with tinctures of ambergris and musk, oil of cloves and bergamot. The colours are mixed at the time of milling or rubbing in the mortar.

Regent's Park.

[96718.] — **Bonetti-Wimshurst.** — I do not suppose P. H. Calcis will find any description of such machine, for Mr. Wimshurst at the very early stage showed the sectorless machine at several of the prominent institutions; but, as they are practically not self-exciting, he has never recommended them. The best machine for all purposes should have from 10 to 20 sectors upon each glass. So fitted, the machine is freely self-exciting in any atmosphere.

I. W.

[96719.]—**Gauging Tanks.**—How does this suit? The capacity of a cylinder in imperial gallons = the square of the diameter × the length (all in inches) × ·0028325; for U.S. gallons, × ·0032. Or if the terms are in feet, × 4·9 or 4·89469 for imperial gallons; for U.S. gallons, × 5⅞.

Regent's Park.

[96720.]—**Hotel Problem.**—The two visitors who pay £2 3s. 4d. each per week pay 6d. each less than the weekly average of the whole number. But if any large proportion of the 34 visitors pay three guineas each per week, or anything approaching that sum, it is certain that those who pay no more than the general average of £2 3s. 10d., and necessarily all below it, must fail to yield any profit to the hotel.

A. E. P.

[96721.]—**Launch.** — Your neighbours in the States are very prominent with steam (by spirit) launches. Very well illustrated in C. P. Kunhardt's "Steam Yachts, &c.," published by Forest and Stream Co., New York, 1887. Nothing to prevent making if you have the skill; but otherwise cheaper to buy of firms like Colt Co., at Hartford, Conn.

Regent's Park.

USEFUL AND SCIENTIFIC NOTES.

The popularity of the "penny-in-the-slot" gas-meters is increasing in Sydney, the number in use at present being over 3,000.

Birmingham is about to experiment with the bacteriological treatment of sewage, and the Drainage Board have authorised the expenditure of £1,000 in the construction of experimental beds. Works are now in course of construction at Saltley.

A firm in America is said to be turning out large quantities of paper tiles which are used for roofing. They are reported to be hard and tough, and the glazing appears to be of the nature of Japanese lac. They are said to be exceedingly cheap, and can be fashioned in any colour or shape to suit the purchaser.

Loss Through Smoke.—Someone has calculated that the "smoke nuisance in London" represents a loss of four or five millions of pounds per annum in London alone, and no man can estimate the human suffering it entails by shutting out the invigorating sunshine and by poisoning the air we breathe. The article concludes with a suggestion that the appointment of a Royal Commission to investigate the question should be urged on the Government; but it is not quite clear whether pounds weight or pounds sterling represents the loss, and, of course, there is no suggestion as to a remedy.

At an auction held recently at Torquay one of the lots put up was a very curious clock, made in 1635. Besides chiming on 37 large bells, tuned by semitones, and consequently extending to three octaves, it can be played upon by means of an "organ keyboard." The whole is inclosed in a handsome walnut pedestal case, with dial, over 10ft. high in all. The original cost is said to have been £200, but £73 10s. was the price it fetched under the auctioneer's hammer.

Insect-Trapping Orchids.—"The Story of the Orchids" is a theme on which the Rev. Alexander S. Wilson, M.A., B.Sc., discourses in the September issue of *Knowledge*. "One of the Australian orchids, *Pterostylis longifolia*, has a sensitive labellum which acts as a spring trap. When an insect alights it instantly flaps up, and the unwary visitor is entrapped in the flower. There is only one opening above by which escape is possible, and, as happens in Cypripedium, the stigma and anther are encountered on the way out. An irritable labellum also occurs in species of Megaclinium, Bolbophyllum, Drakea, and others. In the vanilla orchid, the pods of which supply the well-known flavouring, an arrangement of hairs, somewhat resembling the mouse-trap hairs of the birthwort, induces visitors to enter and depart in the manner most favourable to cross-fertilisation."

The Social Instinct in Protoplasts.—Sir Edward Fry still continues to advance curious facts about the mycetozoa in *Knowledge*, and in the current issue he says: "The life-history of all these Acrasieæ presents many very curious points. It seems to bring before us the fact that separate protoplasts, without ever uniting into a plasmodium or ever becoming part of a single organism, may nevertheless acquire as it were the social instinct, and live for the good not of themselves but of the whole organism, and for that purpose may submit to a division of labour; for whilst some of the protoplasts assume the function of only supporting their fellows, the others avail themselves of the support, raise themselves from the level of their original surface, and devote themselves to the function of reproduction. And, moreover, certain aberrant and sessile forms of the *Dictyostelium* seem to show that this elevation of a portion of the protoplasm is not necessary to reproduction, though it may well be that the greater exposure to the ripening influences of the atmosphere and the sun may render it beneficial to the organism, and so more than compensate for the withdrawing from the function of reproduction of a certain part of the protoplasm, and applying it to the purposes of support alone."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96329. Physical Exerciser, p. 515.
96338. Kachin, 515.
96339. Benz Carburetter, 515.
96343. Artificial Rain, 515.
96345. Studs, 515.
96349. Lathe, 515.

96463. Hovis Bread, p. 22.
96472. Soret's Fluorescent Eyepiece, 22.
96473. Hand-Camera Shutter, 22.
96475. Reflector, 22.
96477. Old Coins, 22.
96480. Preserving Flying Fish, 22.
96485. Humane, 22.
96486. Loune's Vacuum Engine, 22.
96487. Torpedo Boat Destroyer, 22.
96490. Lantern Query, 22.
96496. Canary Complaints, 22.
96498. Boat, 22.
96500. Inspector of Weights and Measures, 22.

QUERIES.

[96722.]—**The Preservation of Indiarubber.**—I recently had a conversation with a scientific acquaintance on this subject, with special reference to cycle tires. He said that, especially in the case of a machine being laid by for the winter, the best thing is to smother the tires with flowers of sulphur, which he had experimentally proved to be a valuable preservative. This is contrary to all I had previously heard. But my friend's scientific attainments were such that I could not lightly dispute his opinion. Thousands of "ours" must be interested in this question. Will some of our chemical friends give their experience?—CH. ROBINSON.

[96723.]—**Electrical.**—Will Mr. Bottone advise on the following case? I have a dynamo of 45 amps. and 110 volts, compound wound, which at present lights nothing but incandescent lamps. On one section of the circuit I wish to place two or three arc lamps in place of six incandescent lamps. Can I do this with present wiring, which is capable of carrying 12 amps.? And, if so, what lamps would be best to use, and how fixed, so as to retain a few incandescent lamps on the same circuit?—S.

[96724.]—**Oil-Engine Castings.**—To THE BOGEY MAN.—Will you kindly give a few hints on fitting up a set of castings of 1½H.P. oil-engine? If so, please say what is necessary to be done to the castings to complete them, or what would be the probable cost of having them done by a maker?—ROBUR.

[96725.] — **Geometrical Progression.** — Five numbers are in geometrical progression, their sum is 62, and the sum of their squares is 1364.—CANADA.

[96726.]—**Induction Coil.**—Will Mr. Bottone please give me a little information on the above? I have a ⅝in. charcoal iron core, 6in. long, and, when wound, I want to get the longest spark possible. Must I wind the primary directly next the core, and then insulate for secondary? Kindly give sizes of wires, and also thickness of insulation. I have heard something about winding the secondary in sections. Is it advisable, and will Mr. Bottone kindly explain? The size of a suitable condenser and the manner of connecting will much oblige?—LUCIO.

[96727.]—**Elementary Optics.** — If the rays of light from an object, after passing through a lens, proceed in diverging straight lines, why cannot the reversed image of an object, as viewed on the focussing-screen of a camera, be seen with equal distinctness at all distances? Why is it necessary, after adjusting the distance from lens to screen to get the size of picture, to have to make another alteration, frequently quite minute, to get perfect sharpness?—W. A. G.

[96728.]—**Gold.**—W. Howse speaks of the difference between Australian and Californian golds as atomic, and not molecular? What differences are there between golds from different sources?—W. A. G.

[96729.]—**Grindstone.**—What pressure will a grindstone bear without breaking, running at n revolutions per minute, and doing its ordinary work of grinding castings, &c., the tensile strength of the stone being s pounds per square inch?—GRIT.

[96730.]—**Curl in Photo. Films.**—Will any reader kindly tell me how to take the curl out of photo. films, as they always seem to curl up after developing?—CURLY.

[96731.]—**Power of Boiler.**—Can any of our engineering friends say what power can be got from a boiler, size as follows?—12in. diam., length over all 28in., tubes are 19in. long, copper 130 in the boiler, size of tube ⅜in. The boiler is tested 330lb. I propose having a 3 by 5 engine. Would it drive a larger one, speed 600?—MOTOR CAR.

[96732.]—**Paint.**—Could some readers of the "E. M." give an idea how to mix house paint, as I am told the paint bought already mixed has very little white-lead in, and has no lasting power. Is there any book published on this subject?—POOR MAN.

[96733.]—**Gas and Oil-Engines.**—Why is the trunk form of piston always used in gas and oil-engines? Why cannot a double-action cylinder, as used in steam-engines be employed so as to obtain an impulse every revolution, instead of every alternate one?—J. E. L.

[96734.]—**Nerve in Tooth.**—Can any reader say what the dentists use for killing the nerve in a tooth previous to stopping it? I refer to a brown, rather bitter, substance. Is any patent preparation recommended?—NEW CENTURY.

[96735.]—**White Paint.**—Will some reader give me good recipe for white paint? I have whitelead, turpentine, and dryers, and wish to paint my glasshouses inside and out.—ANXIOUS.

[96736.]—**Crystoleum Painting.**—Would a reader kindly tell me what the three mediums used in crystoleum painting are composed of, and exact proportions, so that I can make? One of them is adhesia, another is called a preservative, and the other is clearine.—F. E. A.

[96737.]—**Chemical Balances.**—Can any reader tell me how to make a pair of chemical balances? Or would any of your readers possessed of such give me a rough drawing, showing dimensions and details of knife-edges and other important parts? A drawing of one half only would be necessary, as the other is an exact duplicate.—G. E. O.

[96738.] — **Gas - Heating Soldering - Iron.**— Wanted, the best and simplest design of fitting up the above, connected by rubber tubing and portable?—BUNSON.

[96739.]—**Electrical Contrivance for Deaf Person.**—Will Mr. Bottone or some other reader kindly give me some hints about an electrical contrivance which will enable a partially deaf person to hear a minister preach from the pulpit?—IMPROVER.

[96740.]—**Efficiency of Small Gas-Engines.**—Can any reader tell me whether small gas-engines of 3in. bore and smaller have the efficiency of larger ones? Kindly give figures.—IMPROVER.

[96741.]—**Heating Room by Electricity.**—I should be glad to know how to heat a room by electricity. What is the most economical way? Whose method would you propose to adopt, supposing I have all the necessary arrangements for making electricity?—JOHN BOWDEN.

[96742.]—**Bore of Cylinder.**—Could you tell me what bore I should want for a double cylinder to give 2H.P., as I am making a motor-car? Also, how to find horse-power of a gas-engine, and whether the horse-power of an oil-engine is found in the same way?—F. MAUBY.

[96743.]—**Wimshurst.**—Will Mr. Bottone tell me if it would be of any advantage or otherwise in making a Wimshurst to have the sectors on both sides of the plates, and have them connected with a fine wire through a hole drilled through the plate?—NOVICE.

[96744.]—**Celluloid.**—I should be extremely obliged for information with regard to the repairing of celluloid articles, if it is possible to mend them, and how?—E. C.

[96745.]—**Flagstaff Problem.** — A person at a distance A from a tower which stands on a horizontal plane observes that the angle of elevation A of its highest point is the complement of that of a flagstaff on the top of it. Show that the length of the flagstaff is 2A . cot 2A? If the distance of the person from the tower is unknown, and if, when he recedes a distance c, the angle of elevation of the tower is half of what it was before, show that the length of the flagstaff is c cosec. a cos. 2 a?—PUZZLED.

[96746.]—**Grammaphone.**—As my grammaphone has not been as distinct as usual, I examined the diaphragm and found that part of the glue which attaches the point-holder to the diaphragm has fallen away. Please say if that is the cause of lack of precision. I would like to know what kind of glue is used. Is the diaphragm mica or celluloid, and is Berliner a German or American? How can an amateur take records? I have made records of my own voice in the graphophone, but find the high notes very bad and shrill, as if the trumpet of the receiver vibrated sympathetically with certain high notes; but the graphophone records are wax, while the grammaphone records are ebonite, and must have been taken when soft, and, therefore, warm, or could a soft surface be made by soaking in acetone of bisulphide of carbon for a short time?—IKOS.

[96747.]—**Retouching Negatives.**—Which is the best instrument for scraping negatives, so as to reduce the density of small portions. Some hints on the best manner of using it will also oblige.—MINYAM.

[96748.]—**Boilers for Motor-Cars.**—In connection with letter 42793, on p. 90, Sept. 8: (1) What H.P. will this boiler give? (2) Please give me dimensions of one big enough for a ¾H.P. engine at 45lb. steam pressure? (3) What ought the section of the boiler to be? I mean a ¾H.P. engine, not 3-4 cyl.—ALLEN ROBERT CRANE.

[96749.]—**Electro - Magnets in Series.**—I have two electro-magnets wound as nearly alike as possible in series. One draws its armature up with a bang, the other scarcely moves. Why is this, and what is the remedy? I use with them two largest size Leclanché cells.—SUBSCRIBER SINCE 1866.

[96750.]—**Spring Tides.** — The moon being full at x o'clock, how soon after will the highest tide take place? How much time will elapse from x to (1) commencement of the flow; (2) high water; (3) cessation of the ebb? What direction of wind would reinforce the tide the more? Position, lat. 53° 5′ N.; long. 4° 23′ W. Any information as to the *modus operandi* of arriving at the answer will greatly oblige.—DAFYDD JONES.

[96751.]—**Diving.**—Will any reader please inform me to what distance a diver is able to see clearly under the surface of the sea, and whether the use of a powerful electric light would increase the distance?—ENQUIRER.

[96752.]—**Motor-Carriage.**—I am making up two separate 1¾ cycle motors, instead of fitting these to two cycles. My intention is to fit both motors to one small four-wheeled carriage to carry two. Could any of our readers tell me if the two engines should be made up on one crankshaft, and should the cranks be set at right angles, or opposite, for self-starting? Shall I require two separate ignition batteries and two carburettors to supply the two cylinders, or could this be done with one? Shall I need an extra flywheel in addition to the four usual motor discs? What kind of gear should I adopt; tooth-wheels the same as in the cycle, or what arrangement would be best? The writer would be grateful for an illustration of the underneath of a two-cylinder motor-carriage, or any information as to construction thereof.—G. A. H.

[96753.]—**Acceleration.**—A train starting out of a station is made to move with a uniform acceleration of 25 kilomètres per hour. What is its velocity in kilometres per hour after it has gone a distance of 18 kilomètres?—H. H. W. P.

[96754.]—**Problem.**—A winner of a prize has a certain sum to spend on books. The unbound books are of equal value, and binding costs 6s. per volume. If he gets none of them bound, he will be able to purchase ten more volumes than if all were bound, but only four more if half of them be bound. What is the value of the prize, and how many books could he procure on each supposition?—H. H. W. P.

[96755.]—**Lamp for Firing Tube-Motor.**—To "MONTY."—Will you kindly further explain? Is the burner to be fixed vertically or horizontally? What is the use of the loose pan? How is the oil vaporised, as I do not see a coil of tube for it to pass through? Is the nipple screwed over the central pin?—INVESTIGATOR.

[96756.]—**Ornamental Blocks.**—I am preparing ornamental blocks by pasting together several pieces of tissue-paper covered with a piece of silk cloth, and by pressing the same under an engraved metal plate for embossing the design on the cloth. The silk cloth, becoming wet with the paste, loses its lustre. Will any reader please inform me of a suitable colour or composition, which, when applied to the embossed surface, will regain the lustre?—ENQUIRER.

[96757.]—**French Polishing.**—Will any reader kindly inform me of the maker of a powder used in the finishing-off in French polishing, to do away, as I understand, with the usual process of spiriting off? I have on several occasions heard of the fine finish and the lasting properties of this powder, and should like to test its merits. I should be glad of any information from an experienced polisher who has tried it.—RUBBER.

[96758.]—**Sharpening Files.**—I find the following method given to sharpen-up worn files; but I am told by an expert that the only economical process is to use the sand-blast. These are the directions, and they do seem rather funny:—"First clean the file thoroughly from all dirt that may be clinging to it, then dip it into a mixture of one part nitric acid, three parts sulphuric acid, and seven parts water. How long you are to keep it in this strong mixture must be regulated according to the extent the file has been worn and the finings (?) of the teeth; the time may vary from five seconds to five minutes. When you take it out wash it in water; next dip it in milk of lime, wash the lime away, and dry it; and, when dry, rub it over with a mixture of equal parts olive oil and turpentine, and, lastly, brush it over with powdered coke." I think the usual file-card and a few seconds under the sand-blast would prove more effectual. What do experienced readers say?—E. F. P.

[96759.]—**Bikes and Prams.**—I see by an account in the papers that some "judgment" has been given that bikes must not be wheeled on the footpath or sidewalks; but perambulators may. Can anyone tell me where to find the law on the subject?—ROTA.

[96760.]—**Model Loco.**—Will someone kindly give me the following dimensions below for a ⅛-scale model four-coupled bogie loco. (express)? Loco.: (1) Sizes of wheels, (2) sizes of cylinders, (3) sizes of boiler barrel and tubes, (4) size of outside firebox, (5) size of inside firebox, (6) lengths of side frames and thickness, (7) rail gauge. I have three companies' engines to choose from (1) 4-c. 73, Caledonian No. 721; (2) 4-c. 73, N.B.R. No. 729; (3) 4-c. 73, L. and S.W.R. No. 593. Which do you think would make the finest model for working?—J. BAIRD.

[96761.]—**Ginger-Beer Plant.**—Can any reader tell me what is really the scientific name of the "ginger-beer plant," or is it different from the vinegar plant? Does it make ginger-beer without putting ginger into the sugar? Is it anything more than Saccharomyces Mycoderma? The "books" seem to copy from one another, and in a well-known work I find it stated that "the ginger-beer plant is in reality a heterogeneous mixture of various Torulæ and bacteria, some of which appear to occur together constantly in nature." Where can I find definite information, or is it a Mrs. Harris?—ZINGIB.

[96762.]—**Dry Cell.**—Will some reader say if they have tried a dry cell named "Electrogene Dry Cell," stated to give 2·8 volts, to work in the greatest heat and under freezing point? This, if true, should be good news. Comes from Berlin, I think.—DRY CELL.

[96763.]—**Salicin.**—What is the chemical composition of salicin, and what changes does it undergo in passing through the body?—RANDAL.

[96764.]—**Charging Accumulators.**—I am using small electric lamps with my 5in. telescope, and should be much obliged if Mr. Avery would advise me how to re-charge the accumulators? Should not mind buying a dynamo if that would enable me to manage it.—E. WELDON, Tunbridge Wells.

[96765.]—**Bagatelle.**—(1) What is the limit (distance) from the bottom of the board where the balls may be placed for striking? (2) In finishing a game, if a player gets, say, three more than he requires, what is to be done?—BAGATELLE.

[96766.]—**New Lawson Biunial Saturator.**—Will someone who has used the new Lawson biunial saturator say if it is a success, and if one can dissolve quite easily with it, and if the lime that is supposed to be turned off goes quite dead, or at least red?—OPTICAL L.

[96767.]—**Wireless Telegraphy.**—To MR. BOTTONE.—I wish to connect up two houses a mile and a half apart with wireless telegraphy, and should be glad to know if it can be done with two Wimshurst machines with 18in. plates and Leyden jars, and also if the coherer and relay as recommended by you, the coherer consisting of 1½in. length of ⅛in. triblet tubing filled with nickel filings? The transmitter consists of three brass balls (2¼in. and 1·2in. in the centre). I should be glad to know what length of spark is necessary between each of the balls, and also how many dry batteries are needed for the relay circuit? I have a ⅛in. copper wire at one end, and a ³⁄₁₆in. at the other, 40ft. high. Are these sufficient?—A. L. M.

[96768.]—**Ironmould in Copper.**—Would anyone kindly tell me if anything can be done to my cast-iron washing copper? It ironmoulds the clothes when boiling them. Could it be coated with anything to make a permanent job of it?—A NEW SUBSCRIBER.

[96769.]—**Search-Light.**—Would some reader kindly give sketch, with dimensions, of an electric lamp for search-light to take about 20 or 25 amps. at 50 volts, or more if required? I have an 18in. concave reflector fitted into an 18in. by 24in. light steel tube. What I want is the simplest mechanism for lamp, as I will make it myself. I mean it to be hand-fed?—D. S. G.

[96770.]—**Flow of Water from Cistern.**—I would like the opinion of some fellow correspondent on the following subject:—A cistern of, say, 5ft. by 4ft., and 3ft. deep, full of water, is emptied through a hole in the bottom of the cistern; depth of discharge hole equals thickness of tank bottom. If a pipe, say, 10ft. long, of equal sectional area, be fixed to hole underneath, the tank would be emptied sooner. How does this come about?—NIMROD.

[96771.]—**Wall-Papering.**—I want to paper a wooden partition, and shall be thankful for any hints as to the best method of doing so. There are chinks in places between the boards, and I fear the paper will tear at those places. Will it improve matters if I paste strips of calico or canvas over the chinks?—PAPER.

[96772.]—**Probability.**—If I toss up a coin nine times in succession, the chances are 511 to 1 against their all being heads. Now, if I throw 512 groups of nine tosses each, what is the probability (1) that at least one group will be all heads, and (2) that only one group should be so? Of course, it is nearly certainty, but I should like to know the exact mathematical value of it. Concisely, if the probability of any event is $\frac{1}{n}$, what are the values of (1) and (2) in n trials, *mutatis mutandis*?—SCORPIO, Oystermouth.

[96773.]—**Saturn's Ninth Satellite.**—Would "F.R.A.S.," or some other astronomical authority, give me some information about this object? I recently saw it stated in a scientific magazine that the discoverer, Prof. W. H. Pickering, proposed the name of "Phœbe" for the new satellite. In conversation with a well-known observer a few days ago, however, I learnt that the discovery was regarded in certain quarters as a "mare's-nest." I have heard that some people "count their chickens before they are hatched," and that others name their babies before they are born. But surely astronomers cannot be charged with naming orbs which they have never discovered! At any rate, I would thank "F.R.A.S." if he could give me any news concerning the supposed new satellite, its period of revolution, and distance from Saturn, if the existence of the object is corroborated.—H. HINDAWSWEB.

[96774.]—**Isle of Man Steamers.**—Will any kind reader mention the speed, size, and description of engines, pressure, and passenger capacity of the *Mona's Queen*, *Tyndwald*, and *Peveril*, as I had trips in same little while back, and noticed such a comparison in style, &c.?—ALEXANDER.

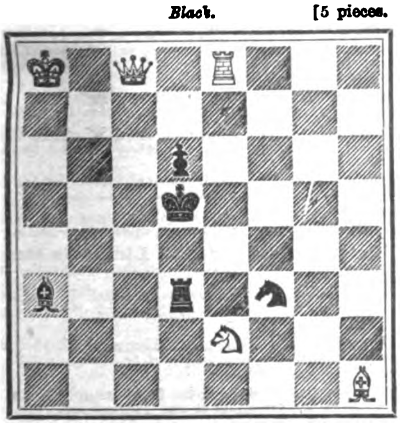
[96775.]—**Boiler for Marine Engine.**—Kindly recommend a suitable tubular boiler for model steamboat I have, which is 52in. by 6½in. by 7in. The engines are slide-valve, 1¼in. by ¾in. double. I want one that can be used other than charcoal fire. I have heard of lamp using benzoline or naphtha for fast generating steam at 40lb. If so, please give a sketch of one suitable that forms its own gas, and gives a very fierce heat.—ALEXANDER.

CHESS.

All communications for this column to be addressed to THE CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1694.—By F. M. TEED.

Black. [5 pieces.



White. [5 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Oct. 9.*)

Solution of PROBLEM No. 1692.—By H. CUDMORE.

Key-move, B-R 3.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1692.—Correct solution has been received from Geo. Christie, F. B. L. (Devonport), E. C. Weatherley, Quizco, A. Tupman, Rev. Dr. Quilter, Whin Hurst, Richard Inwards, Hampstead Heathen, J. E. Gore, G. W. Underhill, T. Clarke, F. B. Oldham, E. Loebell, Jun.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Sept. 27, and unacknowledged elsewhere:—

L. B., E. M.—F. M.—E. L. Garbett.—B.Sc., Ipswich.—Loco.—H. O.—G. Barton.—A Fellow of the Royal Astronomical Society.—An Old Subscriber.—Wind-Gauge.

B. A., Oxon.—Your introduction of personalities, and of the correspondent's *name*, is quite unwarranted, and we cannot therefore insert. Any criticism of his arguments would be admissible.

ADVICE.—Better patent it, we suppose. The first stage—obtaining provisional protection—costs little. All information and forms can be had at the Government Patent Office.

INVISIBLE.—A very old device. The body is simply concealed, and the head is seen. The performer can, of course, speak. There are several devices of the kind, and similar illusions described in back volumes.

R. W. A.—An electric motor is generally used. There is an illustrated description of a speed governor for the phonograph in No. 1457, Feb. 24, 1893.

H. K.—Any good "black" ink will do, and the sketches should generally be twice the size they are intended to be when printed in the magazine or newspaper. That is, they should be so "scaled" as to enable the block to be one-half size, and suitable for the width of the column or page in which it is to appear.

LEE.—On p. 363, Dec. 9, 1892, you will find a list giving the "Pronunciation of Some Astronomical Terms," and in following numbers some comments. The best way to learn is to join the British Astronomical Association, and take notes on the pronunciation generally adopted by the readers of papers. See the index to Vol. LVI.

H. G. COOMB.—We quite agree with you; but with the terrible flood of letters in upon us about the Deluge, pardon us if we shrink from another about the Tower of Babel. The dull season is drawing to a close, and so are the innings of "E. L. G." and his friends!

MAJOR BADEN POWELL.—Sorry, but we cannot depart from the usual rule. See "Hints to Correspondents" No. 6 above.

JAMES BROXUP.—We do not know the address.

H. C.—Simply a matter of will. Learn to control your "feelings," and you will not blush.

J. MUIRHEAD.—There are plenty of notes on the construction of hydraulic rams in back volumes, but apparently you want working drawings. You can see the volumes in any of the free libraries in your city, and with the aid of the illustrations therein given can work out the necessary drawings.

A. MORGAN.—See many notes in back volumes. A fair consumption for a decent gas-burner is five cubic feet per hour; but they are of various sizes, and something depends on the quality of the gas. The mantle, so to speak, conserves the lighting power, and becoming incandescent, increases the illumination. The given burner passes the same amount of gas.

M. L. ROUSE.—You would take us too far. This is not the paper in which to discuss the advisability of new translations, &c. When we discuss the Deluge, or any other event recorded in sacred or profane history, we desire to do so—in these columns—purely as ordinary natural phenomena, and without any reference to religious opinion. Mr. Garbett nearly always get us out of our depth at once, and we fear we are much to blame very often for allowing him to do it; but we have our weaknesses, like other people. Just now we have enough of the Deluge, and so we think have most of our readers.

VER-VIR.—Of any wholesale homœopathic chemist. We cannot give addresses. See Post-Office Directory.

FREETHINKER.—In preparation; the author has been ill, but promises the article soon. 2. Very likely! Between your "surprise" at our encouraging what you call "religious nonsense" and the remonstrances of readers on the other side who insist we are "encouraging infidelity," we get a lively time of it! At the present moment we feel rather sorry that Noah's Ark *did* escape the Flood!

IN connection with the export of anthracite coal from Philadelphia, it is stated that a representative of this industry is visiting European countries, including Britain, with a view to opening up the trade.

IN countries where sand is plentiful it is used instead of hay or straw as beds for cows. It keeps the animals perfectly clean.

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Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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All Cheques and Post-Office Orders to be made payable to THE STRAND NEWSPAPER COMPANY, LIMITED, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

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The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 6, 1899.

MOTOR CYCLES.—XX.

[CONCLUSION.]

FIG. 115 shows the axles of the front hubs and steering pivots. These are forged in good mild steel, and too much care cannot be taken to insure the forgings being sound. I advise the forgings being made in one piece,

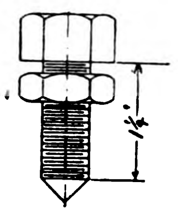


FIG. 116.

and no welding used at all. It will be noticed that the short levers, A, are not at right angles with the hub spindles; this is to allow the wheels turning to different angles. Were these levers square with the spindles, the wheels would always be parallel, and one wheel would skid in turning corners. The countersinks at top and bottom of the steering-pivot require to be well case-hardened. I have also shown a 1/16in. hole carried through from the top to the bottom.

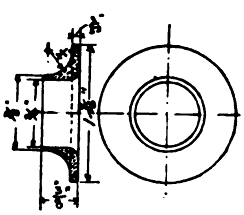


FIG. 117.

This is to facilitate the lubrication of the bottom pivot. The weight is all taken on the top pivot, the lower one merely steadying the forging. Observe that the spindle-ends are screwed, one right and one left-hand. The spindle with the left-hand thread goes on the right-hand side of the machine. The centres on which the steering-pivots work are seen in Fig. 116. They are made of tool-steel carefully fitted to the screwed holes in the forks on the ends of the front axle.

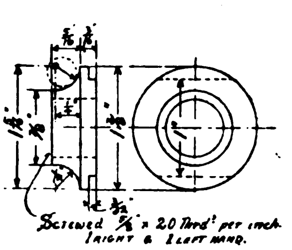


FIG. 118.

When made, they must be hardened and tempered to a dark-brown. The points must be made a good fit to the countersinks in the steering pivots. The lower screw is adjustable; the upper being screwed hard home, and prevented from slacking back by a ¼in. set-screw being put through the boss of the fork, with its point just entering the centre-screws. Fig. 117 gives the dimensions for the fast cones for the ball-bearings of the front hubs, and Fig. 118 the loose or adjusting cones. The fast cones, Fig. 117, are bored a good fit for

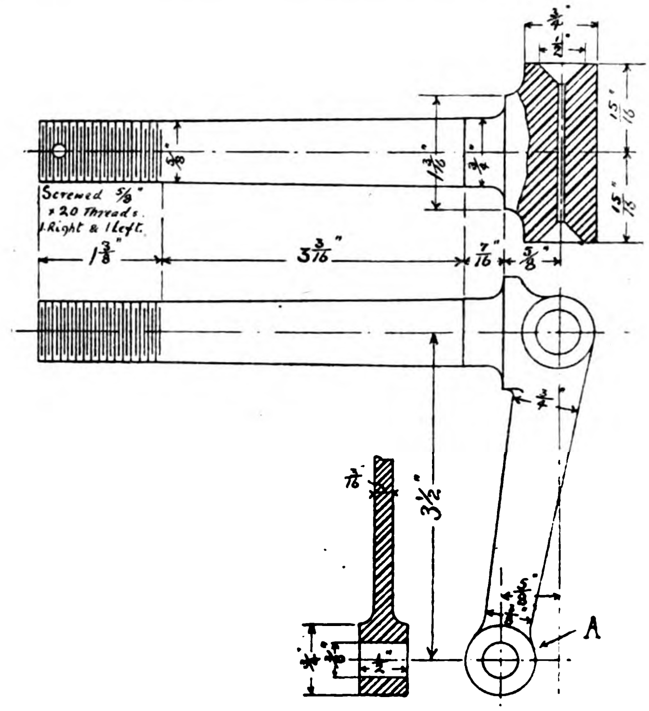


FIG. 115.

the part of the front axles figured ⅝in. diam., this part being left parallel for 7/16in. long. The loose cones are threaded to fit the screwed

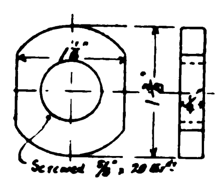


FIG. 119.

ends of the axles. All four cones are to be hardened, the loose cones being tempered a medium straw colour. The fast cones have

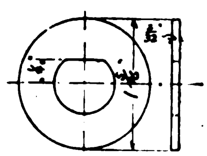


FIG. 120.

to be sweated on to the spindles, and the heat employed for this will be sufficient to temper them. The loose cones are locked in position after the bearings have been adjusted by the nuts, Fig. 119. The washers, with D-shaped hole, Fig. 120, are placed between the cones and lock-nuts, a flat being filed on the spindles to fit the holes in the washers. Then when the lock-nuts are screwed up, the washers will prevent the adjustment of the cones from being altered. As an additional precaution, a ⅛in. split pin is put through the axle ends.

The hubs themselves are turned from mild steel to the shape and dimensions given in Fig. 121, the flanges being drilled with

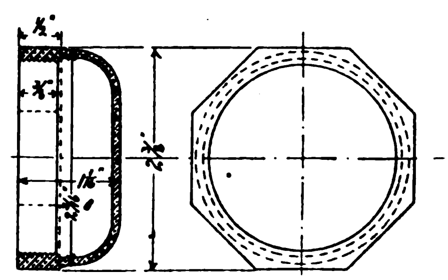


FIG. 122.

twenty holes for No. 10 B.W.G. spokes. The holes are countersunk alternately inside and outside as described when dealing with the back wheel hubs. At the outer ends the hubs are screwed to receive the gunmetal dust-caps, Fig. 122. The ends are counter-bored to take the hardened steel bearing cups, Fig. 123. Make the cups of such a size on the exterior that they will just fail to enter the counterbore in the hubs. Then when they have been hardened and tempered to a pale straw colour, the hubs are to be heated until they expand sufficiently to allow the cups to be drawn into place by means of a

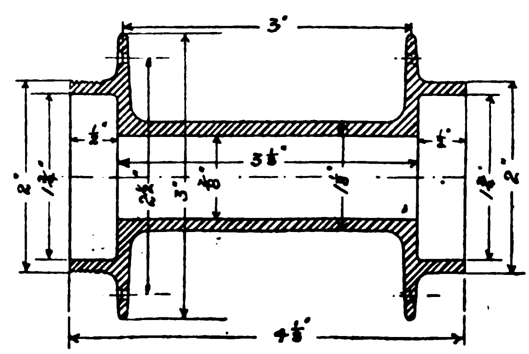


FIG. 121.

long bolt with washers each end and a nut. This will be safer than driving the cups in by hammering, which is liable to split them. As soon as the cups are home, cool the hubs off in water, otherwise they may be softened. To make a first-class job the cups should now be ground out with lead laps and emery and oil till they are perfectly circular and dead to size. It goes without saying that the cups must be perfectly square with

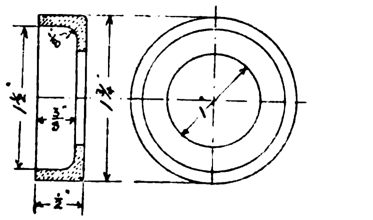


FIG. 123.

each other to allow the bearings to be free, but not loose. The dust-caps, Fig. 122, are of cast gunmetal, and are to be made a good fit on the thread on hub ends. Their exteriors are turned bright all over, and should be nickel-plated to match the hubs. From a piece of ¼in. or 5/16in. iron a key or spanner to fit the octagon of dust-caps is made so that they can be tightly screwed up without damaging the plating.

To connect the two short levers A, Fig. 115, a length of ⅜in. by 16 gauge steel tube, with a mild-steel fork brazed into each end, as seen in Fig. 124, is used. The forks are

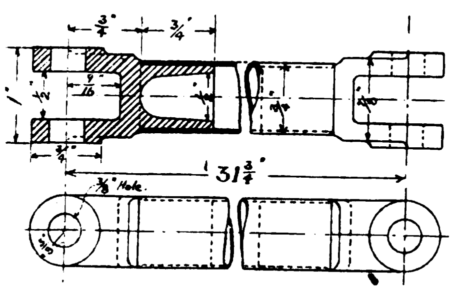


FIG. 124.

forged from mild steel, and should be nicely filed up to shape, and the jaws and ⅜in. holes case-hardened. The bosses on the ends of the steering pivot levers are also to be case-hardened. The exact length of the tube will be 30¼in., and from centre to centre of the ⅜in. holes in the forks 31¾in. This must be rigidly adhered to; otherwise the steering will not be correct. The part of each fork which is brazed into the tube should be bored

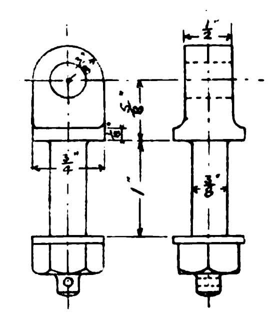


FIG. 125.

out, as much for the sake of increased strength as for lightness. Take care to drill a small hole in the tube to allow the air expanded by the heat, and the steam from the borax used in brazing, to escape; other- a serious accident may result. The pin for the fork at the left-hand side of the machine is shown in Fig. 125. The head of this pin is made flat, with a ⅜in. hole through it to take the fork on the end of the rod which couples the steering levers to the front forks. The pin for the fork at the other extremity will be the same size with the exception of the head, which will be flat, ¾in. diameter by 5/16in. thick. A malleable iron casting or mild steel forging, of the shape and sizes given in Fig. 126, will next be required. The exact length of this part will depend on the width between the extremities of the tricycle front forks. It should be the same as the length over the shoulders of the cones on the front-wheel hub. A 5/16in. bolt is passed through forks and casting and screwed up tightly. Through the boss A, Fig. 126, a pin, similar in all respects to Fig. 125, is passed. The position of the boss A is to the right of the centre line of the machine, as seen in the plan view of the quadricycle,

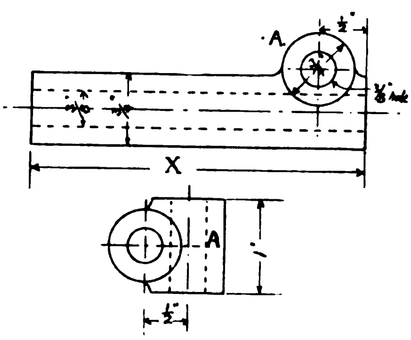


FIG. 126.

Fig. 107. The exact length of the rod connecting the forks to the left-hand steering-pivot had best be found after the other parts are all in position. It will be made exactly the same as the tubular rod, Fig. 124, the exception being the distance between the centres. It may be found necessary to crank this tube in order to get a good clearance between it and the front axle.

The front seat and tool-box, Fig. 107, is made of good dry mahogany, ⅜in. thick. The footboard will not need to be of such expensive material—good dry pine will be quite good enough. The seat is to be stuffed and sprung. Its width is 18in., length from front to back 19in., height from footboard 16in. The footboard is the same width as the seat, but 22in. from front to back. The rails at the back and sides of the seat are made of ⅞in. weldless steel tube, and should be nickel plated. The shape of the sides of the footboard are best left for each to make to individual taste. The tool-box below the seat should not be less than 6in. deep inside to be of any practical utility. Leather is as good as any material to cover the seat and back-rest with, as it does not hold the dust as cloth would. A mat of rubber or coir fibre is to be placed on the footboard. Mud guards can easily be arranged over both back and front wheels, and add to the appearance and finish of "Motor Cycles."

[The thousands of readers who have been interested in this series will be glad to know that in a few weeks the author will commence another on "How to Build a Small Motor-Car." The car to be described will be one embracing the very latest improvements, of a very solid and reliable type, and capable of being built and sold for about £60. We are sure that the coming series will do as much to popularise the motor-car as the ENGLISH MECHANIC did thirty years ago for the bicycle.—ED.]

ORNAMENTAL TURNING.—XXVIII.

By J. H. EVANS.

AS intimated in my last, I now take in hand the details of the spherical slide-rest. This, it will be remembered by many of our old subscribers, I have done once before. At that time I was called upon to give working drawings of this important instrument; but, for some reason, due probably to the occupation of valuable space otherwise required, they did not appear. Since that period, now nearly seven years ago, I have, I hope, found fresh information to impart.

Without endeavouring to touch upon the subject of such slide-rests of this character as were made in the very early period, I think a few words relative to the more simple ones, as used to some extent for trade purposes at the present time, will be of service, and show more distinctly the vast difference to that which may now be termed the most perfect instrument of its kind in existence.

There is little doubt that the difficulties arising in the production of the perfect sphere by plain hand turning, gave rise, on the part of many whose trade more or less depended upon such productions, to the institution of some mechanical means of overcoming the difficulty, and these appear, according to an earlier writer, to consist merely in the construction of a rest that would carry the tool in a circular path round the work while revolving in the lathe. This, with the means of placing the axis of the circular movement identical with that of the work, appears to be all that was considered. This particular type of rest I do not propose to further describe or illustrate. Should, however, any reader be desirous of further introduction to it, it will be found in Bergeron's work on the subject, which was published about 100 years ago.

As far as I know, it is only within the last 30 to 40 years that any attempt to improve this particular instrument has been made. This, indeed, is my experience, and by the various suggestions of scientific amateurs, coupled with a serious study of its capabilities, the spherical slide-rest has become at the present time a most effective, not to say complicated, piece of machinery, capable of many more movements with reference to concave as well as convex formations of solid forms, which when decorated by aid of the various instruments that can be made available for use in conjunction with it, it is one of the additions to an ornamental turner's outfit that should not be omitted. There is, of course, the one drawback, which is the costliness of its production; but when I have fully explained by the various diagrams the large amount of work and minutiæ it contains, it may be regarded as not the most expensive item when comparisons are indulged in.

I have now said sufficient, I hope, to create a desire on the part of many, not only to know more about it, but to undertake the interesting part of making one. I have had a considerable experience, and I find that amateurs take a much greater delight in using a tool of their own make than one that has to be purchased. When, by practical use of the instrument when finished, it is clearly shown what it is capable of, I feel every confidence in saying that the happy possessor of such a tool will rejoice that he was bold enough to make the attempt, for it will require an amount of serious thought to see distinctly what has to be overcome.

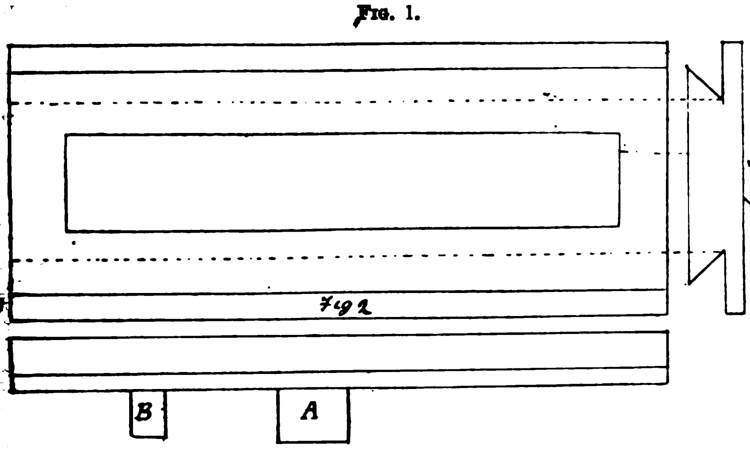
But I hope that the details following will offer every assistance, and I should like it understood that I am at the disposal of any gentleman for further information should it be required.

As in the case of all such tools, the commencement should be at the foundation, and this will be found in Fig. 1, which is the lower or first slide. In this particular part a considerable improvement has been made by extending the length of the slide beyond the lathe-bed, away from the operator. One of the principal advantages in this is found when the rest is used for the turning and decoration of large concave curves, which will be more fully explained as we proceed.

The material used for the slide should be compressed steel or malleable iron—the former is much preferable. Ordinary cast iron is no use; in the first place it is very difficult to get it free from blow-holes, and, secondly, the plates being of very light construction, it is not so suitable. So I will assume the compressed steel is decided upon, and as it may assist my readers, I may as well at once say that the best and only place I know where to obtain such forgings is Sir Joseph Whitworth and Co., Manchester. In order to obtain the forgings as nearly as possible to the required shape, it will be necessary to send well-made wooden patterns of each piece. The cost must not be considered in an expensive tool of this kind. I mention this simply because the material selected is the most expensive.

Fig. 1, then, shows the base or lower slide, which should be about 15in. from end to end, and the tenon, A, Fig. 2, placed 5½in. from the end

Fig. 1.



overhanging the lathe-bed. The width of A must, of course, be made in accordance with the corresponding interval in the lathe-bed. A projection, B, is forged in the solid, and so placed that it will allow the tenon and itself to pass freely over the bed. This so far arranged, and the forgings obtained, the slide is placed on a planing machine by the top face, and bolted securely to it. The under surfaces are then accurately planed to the required measurements.

The tenon must be planed perfectly true to a right angle to the slide. No approximation will do; it must be absolutely true, as a very great deal ultimately depends upon this point. When the under-part has been thus trued up, it must be reversed and re-chucked on the machine, that part already surfaced forming the means of setting it all out truly. In consequence of the two projections at the base, a pair of parallel slips must be employed, upon which the slide is placed, in order that the surfaces may be adjusted to be both flat and true. The top surface and angles will form the next proceeding. Fig. 3 illustrates the end view of the slide. It will require great care in bolting the slide to the machine, in order to avoid springing it, which, if it occurs, will cause no end of bother in getting up the slide, as it will become tight and loose from end to end without any apparent cause, provided the angles are planed quite parallel, which is a point also that requires equal care and attention.

When planing up the tenon it is not necessary that it should accurately fit the interval of lathe-bed. It is preferable to have it quite free. A screw is fitted through B, at the centre of the depth of flange of bed, and when this screw is tightened against it, it draws the tenon into close contact with the inside of bed, and thus certifies its permanent accuracy.

Although scarcely necessary, I will again revert to the extreme caution that is required with reference to the accuracy of the tenon in relation to the slide. When planed at a right angle it will be readily understood that a very minute error will be greatly multiplied by the length of the slide.

We will now proceed with the plate which forms the slide that works on the lower part we have just so far finished. This is made as illustrated by Fig. 3*, and has one side forged in the solid. This must be first surfaced on the upper side, and then carefully chuck by that surface, while the inside and angle are planed. Here again considerable care is required to prevent the plate from buckling or twisting, which any foreign substance under one end would cause it to do. When this slide is correctly scraped and surfaced, both on the flat and angle, they must be ground together with a little very fine oil-stone powder. It is better to avoid emery of any kind. If carefully surfaced they will not require very much grinding at all.

We may now get to work upon the side strip, Fig. 4, for the opposite side. By referring to this it will be seen that it is precisely of the same form as that in the solid; it may be composed of either steel or gunmetal, the former for preference. A hole is countersunk at each end, to receive the head and plain part of the screw that fix it to the plate. These holes must be slightly elongated to allow the two set-screws to move it forward when set up, for the purpose of adjusting the slide with this strip, or the slide may be finished straight off. The screws that hold the side bar to plate are made with countersunk heads, because the space is so limited that there is insufficient room for projecting or button heads, when it is remembered that within the space of less than 5in. we have to provide for four slides and a circular movement, it will be equally clear that we have no room for superfluous material, therefore all the screw-heads are sunk to the level of the strips.

Fig. 3*.

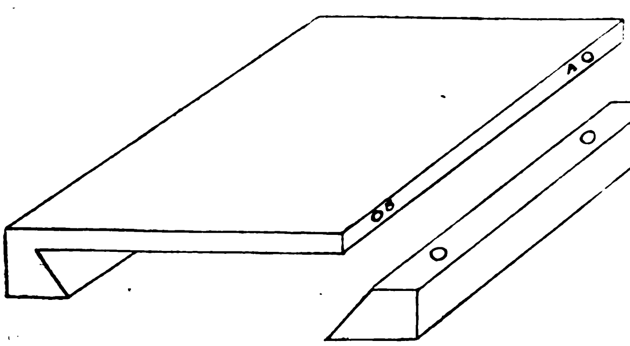


Fig. 4.

So far, then, and I may say after a good deal of talking, or rather writing, we have one slide, and one only, completed; but as the process for those remaining to be done is precisely similar, so much explanation will not be required.

The set-screws must be tapped into the slide (Fig. 3*), as shown by A and B. It is usual to place the hole as near as possible to the lower face of the slide; but the plate being necessarily narrow, in this case it is better to place them in the centre, as there is ample projection of the screw-head to operate against the loose strip when it is set up.

It is quite a matter of indifference whether the lower slide be now drilled and countersunk to receive the main screw, and the nut fixed; but, as a matter of preference, I should advise that it be left till all the slides are got up, and the fitting of screws and nuts all be done at the same time, while the drills and cutters are about.

I have now given sufficient details for the commencement of this important addition to the ornamental lathe, which I feel sure will render the undertaking in every way more easily carried through.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—V.

THE annual cost of preparing weather forecasts in the British Islands works out at one-third of a farthing per head of population. Per square mile meteorology costs 2s. 6d. in the British Isles, as compared with 1s. in the United States of America, the amount spent by the latter Government being more than that disbursed by all the other meteorological services of the world put together. Seeing, therefore, that each member of the British community is called upon to pay so little for his forecasts of weather, it is not altogether surprising that he is not stimulated to take much interest in the subject of meteorology, apart from criticising the unfortunate weather prophets when they make a mistake. In many other countries, however, methods are adopted to create a public interest in the subject, and means are devised for keeping the members of the community well informed as to the changes taking place in the weather, and there is a generosity displayed as regards the distribution of weather charts and bulletins, and other meteorological publications which far exceeds anything our own Weather Office is able to do. The United States Weather Bureau, whose methods of procedure continually serve as models to all the sister weather services, not only provides general forecasts, but special warnings are prepared by local officers concerning such matters, for instance, as floods and "cold wave" warnings, which have proved of immense service to growers of fruit, cotton, and similar agricultural products. It would be impossible just now to give a detailed account of the many methods adopted to place the latest weather information in the hands of the people, and, indeed, there is no necessity to emphasise the fact that, compared with other communities, we, in this country, have not yet thoroughly realised the importance of making it possible for the authorities to disseminate promptly the weather information which is daily received at a central office from all parts of the country.

Now, supposing an isolated observer, is thus cut off from all supplies of meteorological information, he will experience great difficulty in interpreting the changes which takes place in his barometer. In the preceding articles many different kinds of barometer have been described; but even the best of them will tell little about coming changes in the weather unless its readings are supplemented by other information concerning the movements of the clouds and thewind, and the changes occurring in the humidity and temperature of the air. The two great divisions to which all forms of distribution of atmospheric pressure may be referred are cyclonic and anticyclonic, and since the winds circulate in opposite directions in the two systems, the characteristics of the accompanying weather being also no less different, it becomes of primary importance for an isolated observer to discover which sort of system is passing overhead at any given time. Moreover, if he desires to gain clearer notions as to the uses to which his barometer may be put, he should commence his investigations by briefly considering the movements of the atmosphere as a whole. Commonly it is considered a sufficient explanation of these larger atmospheric movements to say that there are heated currents of air which rise at the Equator and flow towards the Poles, and complete the circulation by returning at a lower level to the Equator again. But these currents of air, when they reach polar regions, become greatly reduced in temperature, and grow more dense, and it might at first thoughts be supposed that all around this region the atmospheric pressure would be very great, and only high barometer readings recorded. In reality, however, observations show that there is a low pressure at the Poles, and, without going farther with a subject which is only referred to as a means of clearing the way to other matters, it need only be noted that this lessening of the atmospheric pressure is owing to the fact that the currents of air are distorted by the rotation of the earth. The researches of Ferrel have given meteorologists clearer conceptions as to how these low barometer readings are produced, and, very roughly stated, they are produced by the centrifugal force of the earth's rotation, so that much in the same way that

the earth itself is flattened at the Poles, so is the atmosphere, the result being to produce a gigantic atmospheric whirl around the Polar regions.

Ferrel also pointed out that, supposing there was an absence of friction at the Poles, the immense centrifugal force of this unrestrained polar vortex would result in there being no air there at all; but it is probably owing to the friction of the land that this whirl is broken up and the Polar outflow allowed to creep back to the Equator. At the South Pole where the masses of land, so far as is at present known, are smaller than at the North, the lessened friction would, according to this theory, result in lower barometer readings—a forecast, it is of interest to observe, verified by each new set of observations obtained in these areas. Not the least interesting of the many facts which forthcoming Antarctic expeditions may be expected to provide will be those which throw additional light on the theories which meteorology owes to the genius of Ferrel. The search for the causes which produce the cyclones and anticyclones may, therefore, well be begun by making some attempt to realise the manner in which the atmosphere circulates as a whole, and although only a few of the factors which form part of this problem are as yet known, it is desirable to understand something of the early stages of the greater aërial currents which are primarily responsible for the pulsations to be noticed in the barometer. In these initial researches the understanding is possibly only embarrassed if it is required to contemplate the various effects exerted upon the great aërial currents by masses of land and areas of water and by the rotating earth, and all therefore that needs be done at this stage, from the standpoint of the isolated observer, is that he recollect that cyclones and anticyclones have probably had their individual characteristics impressed upon them by the movements of the atmosphere in far-distant localities.

To continue a little further, there are reasons for supposing that as the great currents of air flow along in the upper regions of the air, certain portions of them reach the surface of the earth in spots or areas, which help to build up the anticyclones or regions of high pressure. Under certain conditions this descending air would have its temperature raised by compression, but owing to the action of radiation this heating is overcome, and an anticyclone, wherein the pressure is high and the air cold and dry, is the result. It has further been suggested that the cold air which flows outwards from these anticyclonic areas underflows the moist warm currents at the surface of the earth, and in this way the lighter air between the anticyclones is lifted up and set in cyclonic rotation, the rotatory motion being largely due to the fact that the currents of air flow in towards one another from various directions. Now, the energy in an ordinary cyclonic storm has been described as being equal to 500,000,000H.P., or more than that of all the mechanical, human, and animal labour in the world at the same time. Such tremendous activity requires equally great force to keep it going, and among the interesting matters connected with this part of the subject is that which concerns itself with discovering the hidden sourses of this energy. When, therefore, a cyclone is swirling overhead, and the wind blowing, say, at 70 miles an hour during the great part of a day, it is a question worth asking "How is this vortex maintained?" Now, it may at once be said that this subject, similarly to those connected with the greater air currents, has not yet emerged from the region of theory, and were one to propound a series of questions it would be found that to any one of them a dozen different answers could be given. If, therefore, it be asked, "How is a cyclone produced?" and "How is its energy maintained?" it will be found that meteorologists are not yet agreed as to the final answers to be given to these queries. But in all investigations some sort of working hypothesis is desirable, and there are few students of the weather who do not find themselves drawn towards some particular theory among the many offered for their consideration, and it is advisable thus to determine upon some point of view with which one's observations and conclusions may be compared.

Few phenomena provide so many interesting points for consideration and investigation as the moisture in the air, and it appears to be more than probable that the energy of a storm is kept going by the latent heat which is set free during the condensations of moisture which occur during most cyclonic disturbances. According to this widely accepted theory, a cyclone commences as an ascending current of warm moist air, the place of this rising air being taken by currents which flow inwards from surrounding areas. This rising current of air presently reaches a level where clouds commence to form and rain to fall, the air being carried still higher by the heat which is thus set free during the processes of condensation. Now, in this statement there is something with which an observer may compare his weather observations, and if he once commences to try and trace the inflow of these cyclonic winds, the changes which occur in the temperature and humidity of the air, and seeks also to trace the alterations in the movements, shape, and distribution of the clouds, he will find that the subject of the weather will become an attractive one. Similarly, however, to all other meteorologists, his researches will mainly refer to the lower strata of the atmosphere, and unless he be an adept at observing the movements of the upper clouds, the changes taking place at high levels will remain as a sealed book to him. A pause has indeed occurred in meteorological progress for want of knowledge as to the conditions prevailing in the upper regions of the air at any given time, and although much useful work has been done by means of mountain observatories, balloons, and kites, the exploration of these upper regions is as yet only in its infancy. It is, therefore, to the upper clouds, and more especially to the cirrus, cirro-stratus, and cirro-cumulus, that an isolated observer must look for early knowledge of approaching storms, and by combining such observations with those obtained from a well-exposed wind-vane and a good barometer, considerable success may be achieved in preparing local forecasts of the weather.

Supposing, then, that a solitary observer, who has no information concerning the distribution of atmospheric pressure other than that which his own local observation supplies him, has gained some idea of the general circulation of the atmosphere, and has become able to distinguish cyclonic from anticyclonic conditions, he is in a position to make further advances. Now, probably the first consideration which obtrudes itself in connection with cyclones and anticyclones is that different kinds of weather and different winds are associated with each different quadrant of the system. These differences are most readily illustrated by the varying kinds of weather which occur at the front and rear of a cyclone, or depression as it advances from the westward. Thus the haloes and cirro-stratus clouds develop at the front of the system with a falling barometer, while at the rear the barometer rises and the sky becomes covered with cumulus clouds. A rise in temperature and winds drawing in from the south-east herald the approach of a storm, and a wind from the north-west and a drop in the thermometer commonly announce that the disturbance is passing away.

Similar changes are to be observed in the different quadrants of an anticyclone; but since these high-pressure systems drift through the air more slowly than the cyclones, the changes from one kind of weather to the other are less rapid. A cyclone, for instance, may traverse England in half a day, and during this period the weather will run through a whole gamut of changes, and rain, thunderstorms, gales, and blue sky will be experienced in a few hours. An anticyclone, however, will often take two or three days to accomplish the same journey, and under these latter conditions the weather is more permanent, and the changes more gradual and less violent. As a general rule, therefore, it is easier to forecast the weather under anticyclonic conditions than under cyclonic, and, in these autumn days, local weather prophets may be recommended to turn their attention to the anticyclones; for it is at this season of the year that anticyclonic weather is most easily recognised. The early morning frost and mist which gives place to midday sunshine are very typical, and it has long been noticed that animals and birds respond to these exhilarating conditions. It is, indeed, from these signs, together with the local weather saws and proverbs, that an isolated observer must glean his information concerning the distribution of atmospheric pressure and coming weather. His barometer will tell him the amplitude of the diurnal range in pressure, and this knowledge, coupled with his own local observation, will assist him to interpret the meaning of those atmospheric variations which are, indeed, but offshoots from greater and more complicated aërial currents.

MILLWRIGHT'S WORK.—XI.

If a swivel bearing is more economical of power than a rigid bearing, a roller-bearing should effect a still further economy. Actually, there is a saving of about 25 per cent. of the roller over

FIG 68

FIG 69

the rigid type. A considerable number of experiments have been made with a view to ascertain the relative values of the friction of sliding and that of rolling as applied to the bearings of vehicles. Thus, a loaded waggon weighing 5½ tons, when fitted with ordinary bearings, requires 110lb. to start it on a level; one fitted with roller-bearings, 15lb. only. A tramway car fitted with ordinary bearings and weighing 2 tons 15cwt. was let loose from a point 56ft. up an incline with 1ft. 6½in. rise. It ran down this incline, and 57ft. along the level—a distance of 113ft. A similar car with roller-bearings ran

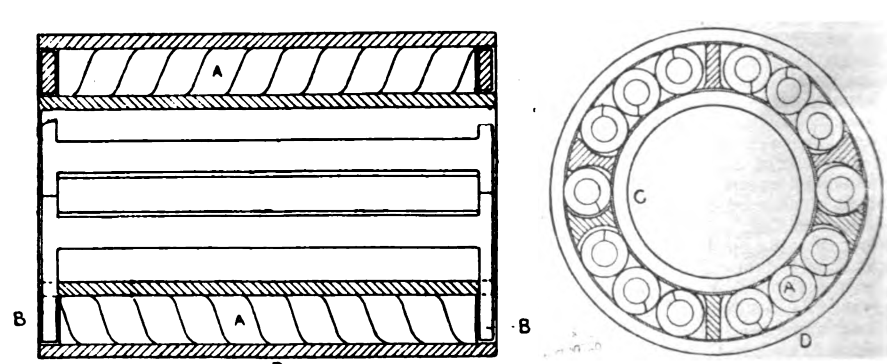


Fig. 70.

376ft. It has been proved experimentally that the power required to drive two Blackpool cars precisely alike as regards weight, dimensions, &c., was 30 per cent. less with roller-bearings than that with common bearings.

The difference between sliding and roller friction is illustrated in a rough way by rubbing the palms of the hands together and then rubbing them with a pencil interposed. Another illustration is that a roller will run quickly down a slope of 1 in 100 (Fig. 68), while a poli-hed

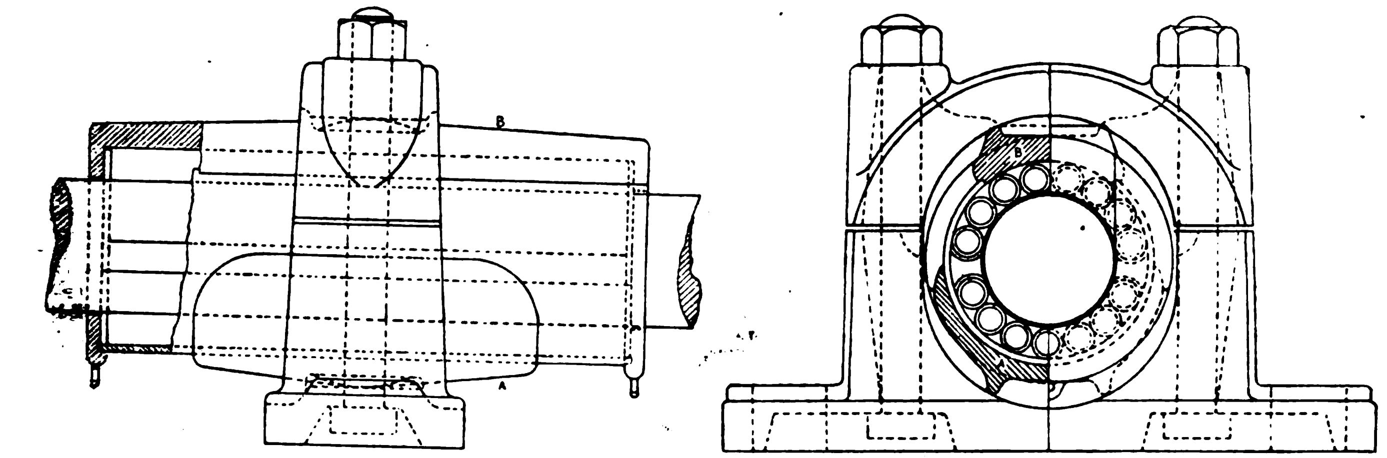


Fig. 71.

metal block will barely slide down a well-oiled slope of 1 in 14 (Fig. 69). Another is, the difference between a sledge and a wheel, between the old wheelless cars which one may still see in Devonshire, and the wheeled vehicles. It is, in a lesser degree the difference between a very small wheel and one of large size.

These obvious facts are being applied to the bearings for shafting. There is nothing new in the idea, but the practical difficulties in the way of its application have been immense.

Whatever lessens friction in the shaft bearings lessens other expenses, besides that of engine power. It diminishes the wear of the bearings and of the shaft journal. It lessens cost of belting by diminution of strain thereon, and less lubricant is required. The rivalry now lies between ball-bearings, solid roller-bearings, and flexible roller-bearings.

The ball-bearings are hardly suitable for shafting, though they are employed very satisfactorily

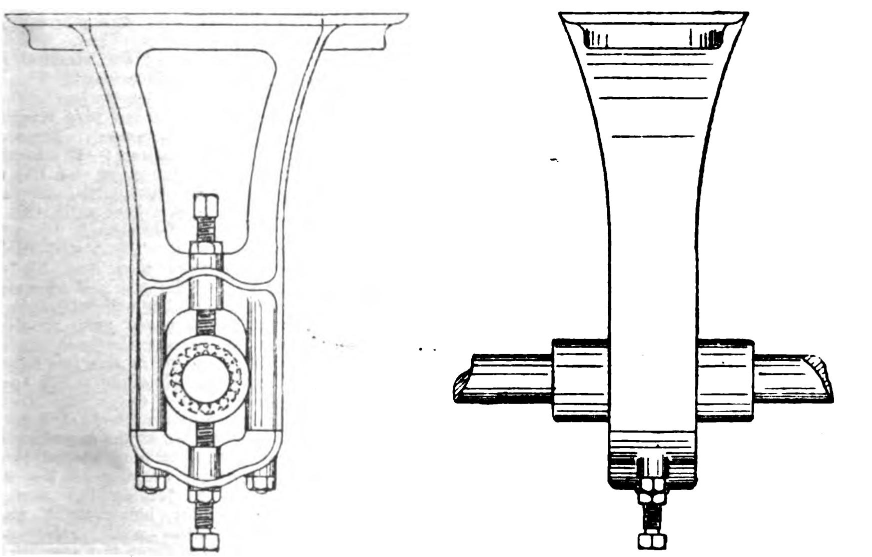


Fig. 72.

for the end-thrusts of various machine-spindles, and worms; for tramcar journals, and light-running spindles generally. The general objection to these for shafts is that contact occurs only at a point, by which pressure is concentrated to an undesirable extent, and that, if the points of contact are increased by increasing the number of the balls, the friction is increased. The fitting of such balls, too, is costly, because they and their races have to be hardened and ground very exactly in order to insure that they all take their share of the work. Practically, therefore, for ordinary shafting ball-bearings would appear to be ill adapted.

In roller-bearings, the rollers, like balls, revolve about the shaft; but they are arranged in various ways. They are loosely in contact or they are retained in cages, which may consist of washers having holes drilled to receive pins, turned on the roller ends or in other ways. In one the rollers revolve on pins. The difference between the two types is this: that in the first, the rollers in their revolutions come into frictional contact with each other; in the second, these are kept apart.

Solid roller-bearings have the advantage that they take their bearing along a line, so distributing the pressure better than in balls. But the cost of hardening and grinding accurately applies here as in ball-bearings. Though used largely for tramcars, they have as yet had comparatively little application to shaft bearings.

Illustrations are here given of the applications of the third class, the Hyatt roller-bearing to shafting. These are termed "flexible," to distinguish them from solid rollers, because each roller is formed by winding two strips of steel of rectangular section into a helix, which is afterwards ground truly in special machines. These are of American manufacture. Detail drawings have been kindly furnished me by R. W. Blackwell and Co., of Westminster, the English agents of the Hyatt Company.

There are two main types of roller arrangements. In one, a yoke guide made of gunmetal maintains the rollers in alignment, dividing them into groups. In the other, the rollers are maintained in position by means of rods passing through the centre. The rods are retained in end rings, through which they are riveted. These are made as solid rings, forming a bush type of bearings, or as half-rings for divided bearings. Steel sleeves or inner bushes are sometimes inserted to protect the shafts from wear, and outer bushes or linings nearly invariably for cast-iron boxes in cases where high pressures have to be sustained.

Fig. 70 shows the standard type of bearing in section, A being the rollers, B the yokes, C the inner bushing, and D the outer lining. Roller bearings of this type have been made from $\frac{3}{4}$in. to 20in. in diameter, from 1in. to 28in. in length, and with rolls from $\frac{1}{4}$in. to $1\frac{5}{8}$in. in diameter.

These bearings are applied to rigid and to swivelling plummer-blocks, to hangers and wall brackets alike. They are fitted to the swivel boxes by riveting guides or saddles to the outside of the steel shell. These guides are made to suit purchaser's requirements. In the case of hangers, floor stands, and wall brackets, the guide-pieces also receive the screws by which the bearings are adjusted, and upon which they pivot.

Fig. 71 illustrates a Hyatt bearing fitted to a swivelling plummer-block. A B are the fittings riveted to the outer lining. The upper one, B, is continued out, and brought over the ends of the rollers to confine them endwise, and a corresponding collar is fitted over the lower portions of the outer sleeve to fulfil the same purpose. The rollers are confined sideways between yoke-guides. These bearings are four diameters long. The boxes are of steel, securing the minimum of weight, a matter of importance in overhead shafting.

Fig. 72 shows a Hyatt bearing fitted to a hanger. The same inverted becomes a floor bearing. The steel box or cage fits wall brackets by

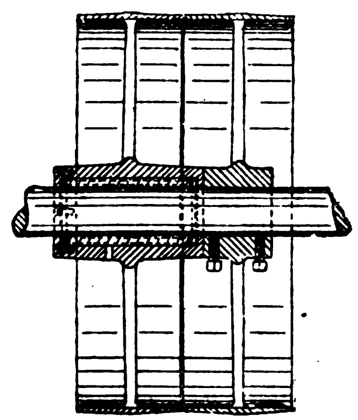


Fig. 73.

the guide or saddle. The construction of the bearing is similar to that shown in Figs. 70 and 71.

The Hyatt bearings are fitted to loose pulleys, Fig. 73. The pulley is bored up to a shoulder, the cage of rollers inserted, and inclosed by a loose flange screwed over the end.

The increasing use of roller bearings during the last half-dozen years has come rather as a surprise to many. The writer has known attempts made to produce large roller-bearings, among the work of a general shop, but always with unsatisfactory results. The difficulty has usually been got over by abandoning hardened surfaces, and using a tough quality of cast or mild steel. The fact is, however, that the successful manufacture of rollers, as of ball-bearings, is not work for general engineers. Inaccurate bearings are worse than plain friction bearings, and that is probably the reason why these have only found much favour of late years since a few firms have laid themselves out specially for their reproduction.

J. H.

Only one marble statue of the human figure with eyelashes is known. It is the sleeping Ariadne, one of the gems of the Vatican, and was found in 1503.

SCIENTIFIC RESEARCH IN ENGLAND AND GERMANY.

In view of the progress made with the scheme for the enlargement of the Government Physical Laboratory at Kew, where researches in theoretical and applied science are to be carried out, it may be of interest to present some details of the foundation and work of the two similar laboratories—the Reichs-Anstalt and the Technischen Anstalt—in Berlin, the prototypes of all such institutions.

The facts and information given below are derived from an article by the late Prof. von Helmholtz, which appears in Volume I. of the "Abhandlungen der Physikalischen-Technischen Reichs-Anstalt": Springer, Berlin, 1894.

The first proposal to found such an institution was made in 1872, and was due to the interest of the late Emperor Frederick (then Crown Prince) in technical science. Commissioners were appointed to investigate and report upon the training of mechanics in the higher branches of optics and trigonometry. They sat in 1875-76, and again in 1882-83. The direct outcome of their labour was the foundation of the Physikalisch-Technisches Institut at Charlottenburg as a branch of the Technical School. The need for the addition of a second department to this new institute was emphasised by von Helmholtz and by Dr. Werner von Siemens, both of whom had been on the commission. On account of the hindrances caused by lack of funds, Dr. Werner von Siemens presented a plot of ground next to the Technical School in Charlottenburg, and later £25,000 (500,000M.) for the erection and fitting of such an addition.

In the letter accompanying this gift, dated March 20, 1884, Dr. Siemens stated that the usual State assistance to the progress of science was limited to care for instruction in physical science. The progress of scientific knowledge was thus left to private effort. Russia was the only country where university funds were spent directly in supporting original workers whose duties did not include teaching.

The increased cost of apparatus and chemicals and greater energy and knowledge now demanded for original investigation had also rendered it more difficult for those engaged in teaching work, and drawing only the usual stipends, to engage in original research. As an example of this difficulty, Dr. Siemens mentioned the determination of the exact value of the units of electrical measurement, a work that was performed in England in private laboratories. It was the work of rich independent scientists that gave to England an important place in the present progress of scientific knowledge. Without these *dilettanten* she would be nowhere.

These considerations led Dr. Werner von Siemens to decide to leave a legacy for founding a laboratory where investigations of fundamental principles could be carried out. One hectare of ground in Marchstrasse, Charlottenburg, was bequeathed. The necessity for recognising the national character of the new step in scientific progress was now forced upon Dr. Siemens's attention. "In the present vigorous competition between different nations, that nation which first steps out along new paths, and applies the newly-studied scientific laws and principles to industrial purposes, has a decided advantage in the struggle. . . . Investigation of difficult theoretical problems in abstract science often lead to most valuable industrial processes; and therefore the promotion of abstract science is of highest value for the material progress of any country."

In consequence of Dr. Siemens's gift, the original plan of the Institute was much enlarged in scope. (See Reichstag proceedings, Budget, 1887-1888.) Theoretical work commenced in the new building in 1890-1891, but had proceeded in temporary premises since 1887. The technical branch was carried on at first in rooms lent by the technical school at Charlottenburg; but as the work of this branch rapidly increased, new buildings were erected in 1894 on ground rented to the Reichs-Anstalt.

The superintendence is intrusted to a council appointed every five years by the Emperor, the selection being made from scientists in every part of the Empire. The president of this council is head of the Reichs-Anstalt, while a special director is charged with the superintendence of the technical department.

The *Ersten* or *Physikalischen Abtheilung* devotes itself to physical investigation and measurements, which, on account of expense or time, cannot well be carried out in private laboratories. The *Zweiten* or *Technischen Abtheilung* is devoted to scientific problems directly connected with industry and to the technical application of the results obtained in the first department of the institute. The results of the first *Abtheilung* are only published at long intervals, since the investigations carried out in it usually demand much time to complete. Those of the second *Abtheilung* are published as rapidly as possible in order that the industries concerned may have the benefit of the researches made. The results of the investigations carried out in the latter department are also published in the *Zeits. für Instrumentenkunde.*

The first inquiry undertaken by the *Physikalischen Abtheilung* was the investigation of all the units and laws connected with the mechanical theory of heat.

It is interesting to note that, while Government aid has been necessary to bring about the initiation of the English scheme, private effort was sufficient in the case of Germany; and only at a later stage did the German Government take the financial responsibility for the laboratory. This is a reversal of the usual procedure in the two countries. The remarks made by Dr. Werner von Siemens upon the relative position of scientific research in England and Germany are of considerable interest, and are no less true to-day than at the time they were written.

The researches carried out in the two institutions in Charlottenburg—whose humble beginnings are described above—have grown in number and importance year by year, and four quarto and 16 octavo volumes, published by Springer, of Berlin, bear witness to the activity of the scientists attached to the two *Anstalten*. It is to be regretted that those engaged in certain English manufactures and industries do not make greater use of this valuable reference library of scientific research. With the exception of the researches of the Charlottenburg experts on the durability of writing and printing paper (abstracts of which were published by the Society of Arts in 1898), these investigations have been much neglected by English chemists and manufacturers.

In time, no doubt, the research laboratory in Albemarle-street, presented to the nation in 1897 by Dr. Ludwig Mond, and the new research laboratory at Kew will yield equally valuable results; and the reproach of Dr. Werner von Siemens that without her rich *Dilettanten* England would be nowhere in the field of scientific research will cease to be justified by the actual facts.—By "A Correspondent" in the *Times.*

NOVEL HYDRAULIC PRESS.

The accompanying engraving shows a hydraulic jack press which was designed by General Foreman R. B. Gibbons, of the Santa Fé-road at

Las Vegas. We are using it for rod and driving-box work, and it has given good service for over a year. Most of the old screw press now decorates the scrap pile, and we wonder how we got along without this as long as we did. The columns are made of cast-iron extension piston-rod casings. The arch is the top of the old screw press. A 30-ton jack is hung from the top by a swivel-plate bolted to arch, the barrel of the jack being held by the two rods shown and a weight which is connected to rods by rope. One man now does the work which took six or seven with the old screw press. Hope this will be of interest, as it is easily made in any shop.—L. D. Webb, in *Locomotive Engineering*, N.Y.

TARSIA WORK, OR WOOD MOSAIC.*

This interesting handicraft was the forerunner of the better-known work, marquetry. It was introduced into Italy in the fifteenth century from Persia and India, and was a kind of mosaic in woods, representing houses in perspective view by inlaying pieces of various-coloured woods into panels of walnut wood, which were used to decorate the backs of seats and chairs in churches. It was also used for the decoration of furniture. The woods of our ancient craftsmen were lime, holly, box, beech, and poplar for those parts to represent white; for a brown colour, pine, laburnum, palm, lignum-vitæ, walnut, teak, and partridge wood; for red, logwood, mahogany, and cam-wood; satinwood for yellow; tulip for purple and rose-wood. These woods are cut into thin sheets.

To-day the professional inlay-workers use dyes, such as aniline and chemical compounds, to enhance their work. For the beginner the following stains will be found sufficient. With these stains we will select three woods to work with: Walnut as the ground, with holly, maple, or lime as the white woods, which can be used either natural or stained any colour by using different coloured dry pigments dissolved in spirits of turpentine to about the consistency of milk. The veneers, which are about ⅛in. to ⅜in. thick, are allowed to soak in the liquid for one hour or more, according to the thickness of the wood used. When taken out of the dye, the veneers are wiped with a rag to remove the surplus liquid, then placed between two boards, which should have a weight upon them until they are dry. When thoroughly dry, several colours are selected for the design in hand. These are gummed together, with a piece of newspaper in between, thus forming one solid piece. The grain of the woods should be all one way, not crossing each other. The design, which is generally of a geometrical pattern, is traced upon thin paper and gummed upon the board. As the inlaid surface is generally a repeat, there are several duplicates of the same pattern, but in different colours. For instance, take walnut as the ground, with yellow and green as the ornament. One set would have a yellow ground with walnut and green ornaments, and the other a green ground with walnut and yellow ornaments. Of course, this could not very well be done if the design was flowers and birds, therefore the repeats would be wasted. The bench for piercing, providing the machine is not used, is a piece of board 18in. long, 12in. wide, and about 1in. thick. Clear maple is preferred; 12in. of this overlaps the table. The other 6in. is either fastened to the table by clamps or screws. Up the centre is cut a V-shaped slot, about 1¼in. wide at the outer edge, tapering for about 4in. down the board. This slot is the clearance for the saw. The seat should be very low, so that the chin of the worker does not come more than 5in. above the work.

The sawing out of the design is the next operation. This is done with the ordinary fret-saw bow, or with the fret cutting machine. A small hole is made with a fine gimlet upon one of the lines of the design, through which a very fine piercing marquetry saw is put, which has been previously secured in the upper jaw of the piercing frame with the teeth of the saw downward. The other end is now fastened in the lower jaw. This requires great skill, as the saws are very fragile and break with the least side movement. The method of securing the saw is as follows:—The handle of the bow is placed against the chest and the upper jaw against the slot in the saw bench. The saw is now fastened in the upper jaw with the teeth towards you. This is determined by passing the thumb along the edge. The teeth, being so very fine, they cannot be seen, but by feeling you will find one way of the saw will be comparatively smooth, while the other will be rough. The saw being secured to the upper jaw, it is passed with the right hand through the hole previously referred to. Hold the work in the left hand, the design away from you. Now press the bow together, and secure the other end. The saw when fastened should be taut like a banjo string. Now turn the saw bow, and work at the same time on to the table, and start the piercing, keeping the saw in a horizontal position, working all the while, and at the same time feeding the saw with the left hand—the cut being made on the downward movement—the work being moved with the left hand to follow the saw, not the saw to follow the work. This must be done with the utmost care, following the outline of the pattern. The course of the saw should cause no greater waste than the width of the pen line laid down for its guidance. The suppleness and narrowness of the steel permits the saw to turn in and out of the smallest curves, making every angle with distinctness and indicating with accuracy the abruptness of a corner. After being cut, the different layers are separated by using a long, thin knife-blade inserted between them. When all are separated, each layer presents a groundwork and set of ornaments. The pieces from the green and yellow layers can be immediately set in the walnut layer, and *vice-versâ*. When properly pierced out, it will be found that an exact fit in every line is secured. These pieces are now glued down upon a board of a certain thickness, according to what the work is intended for. This should be of the same material as the ground which forms a backing. A little glue and sawdust from the woods used join the edges and fill up all the fine openings made by the saw.

When all is completed the panel is placed between boards bearing heavy weights, or compressed with a vice or clamps. This will serve to straighten out the thin wood, which will naturally curl up from

* Extracted from an article by Richard Wells, in the *Art Amateur*, N.Y.

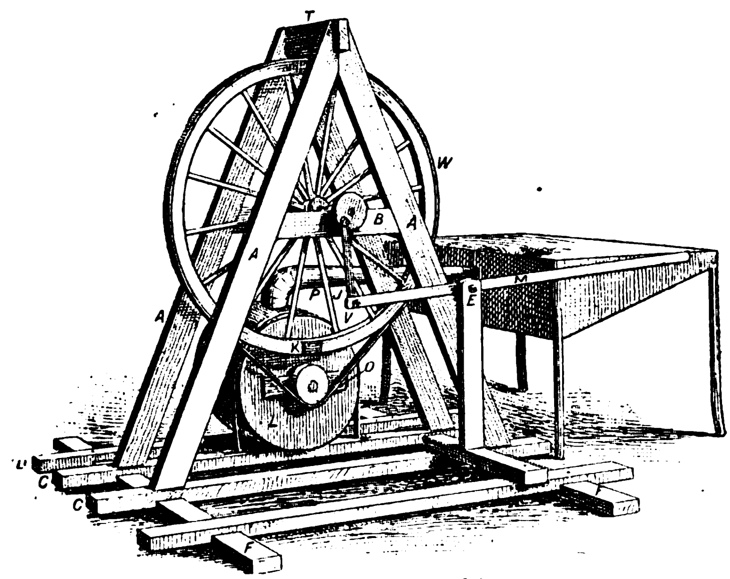


FIG. 1.—The Forge complete.

the moist glue being put upon it, and at the same time drive the small pieces together, producing an even surface. When thoroughly dry, the surface is scraped down smooth and even and sandpapered with several grades of paper until all blemishes and scratches are removed. Should there be any gaps in the joints, these should be filled in with coloured sawdust and glue. It is now ready to be "French" polished.

HOME-MADE FORGE.

THE following directions for making a forge are given by Mr. A. D. Marootte, Church Point, Louisana, in the *Blacksmith and Wheelwright.* I herewith inclose plan and illustration for building a home-made forge. Referring to the sketch, we will

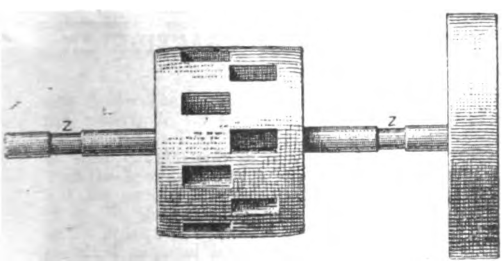


FIG. 2.—The Flywheel Hub.

start at the foundation, F F, which is two pieces 2ft. by 4ft. by 4ft.; C C, two pieces 2ft by 4ft. by 6ft., notched and bolted to F F. A A represents main stock, four pieces 2ft. by 4ft. by 5ft. 11in.,

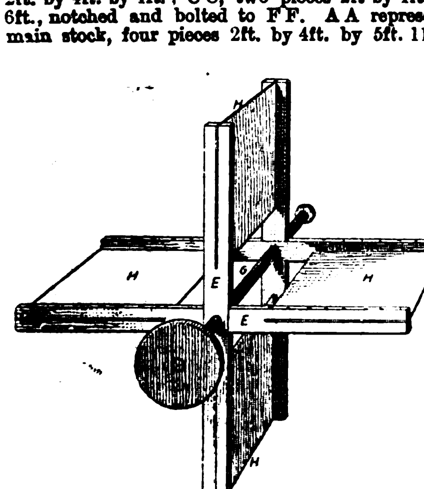


FIG. 3.—The Fan.

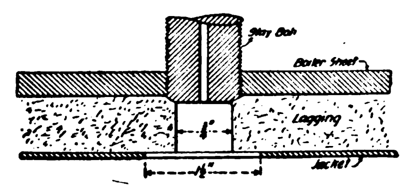
4ft. open at bottom, bolted to C C. B B, cross-bars that support flywheel bolted to A A. T, top bar to hold stock A A. W, wheel, which is made as follows:—Take an old buggy with hub parts dodged, Fig. 2, cut off each end up to the iron band, and fill with spokes to fit, turning the dish inside—i.e., fill every other mortise near the edge with dish inside rim with 1½ by 2 rim; drive in peter, which can be obtained from an old reaper and binder. Cut the rod 28 at 18in. from shoulder; file end down to fit box at Z and Z, 73, put in place and bolt to B B, cross bars, and the wheel is complete. The fan is made thus:—Take an oil barrel; cut ends off so as to leave centre of barrel the proper width for fan, as per Fig. 3. E E are two pieces of oak, 1½ by 1, the length of your barrel—i.e., the diameter. Rip the ends with a fine saw, so as to insert the fan blades H, which are of tin; screw on firmly, insert axle G, and your blast-wheel is ready to go in fan case L. Head neatly, leaving a 4in. hole for air at each end. Bolt a cross-piece, O, to support fan axle G. Put on wheel 5in. in diam. P is pipe made cone shape, the proper length. The elbow is an ordinary stove elbow. Lever B is supported by a piece 15ft. 2in. by 4ft., height to suit, hinged at E. Connecting rod J is attached to fetter and lever M at V, which runs flywheel W. Put a weight on wheel at K to make the wheel start in the proper direction. Wheel W should be 3½ft. in diameter. Place tuyere iron in hearth, insert blowpipe at back of chimney in tuyere iron, and your forge is ready for use.

HEAT-ABSORPTION POWER OF WATER.

THE subject of the heat-absorption of water has been recently before the Institute of Marine Engineers, and notes have been received from members which are of special interest. The paper which was the cause of the discussion and the notes was read some time ago by Mr. G. Halliday, and that gentleman, in the course of a reply, said that a number of the theories brought forward by Mr. Northcote were very similar to the theories brought forward by Mr. McFarlane Gray at a previous meeting. Mr. McFarlane Gray and Mr. Northcote were both wide-world authorities on the subject of this transmission of heat and its application to modern industries; but they had not got rid of some of the old ideas, and he (Mr. Halliday) thought they were not standing still—that it was not necessary to simply believe in old ideas when new experiments had proved that they did not give sufficient reasons for what happened. Mr. McFarlane Gray tried to prove that he was wrong in his experimental results when those results showed that there was a drop in transmission after a certain point in the velocity. His reason was that Rankine held that the rate of transmission varied approximately as the square of the difference of temperature between the fire side of the plate and the water side of the plate. That was quite right if they left everything out of account but the simple transmission due to difference of temperature. The rate of transmission did vary, but a great number of other things came in. There was the condition of the water in the tube, and there was the condition of the water on the other side of the plate. If they allowed the water to remain quite stationary on the side of the plate, a film of steam came between the water and the plate; if they rushed the water quickly over the plate, that film of steam was rubbed away, and therefore there was better contact between the water and the plate and better transmission. Rankine was quite right in his theory, but he did not bring in the condition of the water on the side of the plate; that was a later theory, which was brought forward by Lord Kelvin, and gives absolutely new ideas with regard to transmission, and, looking at the question of transmission from Lord Kelvin's views, they found that the law put forward by Rankine was almost insignificant in comparison to that put forward by Lord Kelvin. Both Mr. Northcote and Mr. McFarlane Gray had forgotten or insufficiently read the new ideas by Lord Kelvin. Mr. Northcote put forward the old idea that they could not expect to gain anything by robbing Peter to pay Paul. Paul stood for the water and Peter for the steam. There was no attempt on the part of Paul to try and steal anything from Peter; they were a joint stock company, and Paul goes up to Peter and says: "Peter, if you will give a little of the heat of your steam away to heat up the feed-water before it comes in to me I will have higher efficiency, I will produce more steam, I will gain by it more than you lose." There was the arrangement between the water and the steam. The water says to the steam, "You give a little, I will gain more." Paul, as the water, tries to get as much heat out of the heating surface as he can by travelling as quickly as possible across it, but as soon as he did this cold water was thrown on his exertions through the cold-water feed, and he was prevented from taking heat as he would under other conditions. He could only get up his speed by keeping the temperature of the water in the boiler always the same, always at boiling-point; and, although there was a loss of efficiency by using live steam to heat up the feed water, the loss of efficiency was not so great as the gain received by keeping the temperature of the water in the boiler always the same.

FIREBOX LAGGING FOR LOCOMOTIVES.

THE results of the elaborate tests of the efficiency of different locomotive boiler coverings made last winter on the Chicago and Northwestern Railway, made such a favourable showing for the general practice of covering about 61 per cent. of the exposed surface with lagging, as to lead to an extension of the covering to the sides and throats of boilers having narrow fire-boxes. The advantages of this were obvious; but the difficulty was to provide for



the necessary inspection of the stay-bolts. All of the stay-bolts are drilled with tell-tale holes, and wire nails of suitable length are inserted in these holes, after which the sides and throat of the fire-box, below the running-board, are covered with a plastic covering about ½in. or ⅝in. thick, taking care to have it fit the sheets closely. When this has dried sufficiently, the ends of the stay-bolts are exposed by cutting out the lagging opposite each bolt by means of a circular punch about ⅞in. in diameter. The nails inserted in the holes serve to locate the bolts.

The jacket is of sheet steel, about $\frac{1}{16}$in. thick, and it is perforated with holes opposite the stay-bolts, as shown in the sketch. The holes in the lagging are made as small as practicable, in order to cover as much surface as possible, and those in the jacket are made larger, in order to facilitate the removal of broken bolts. The jacket is put on in three pieces, one on each side and one at the throat. The throat and side sheets are lapped over each other at the front corners of the fire-box. The jacket is held in position by a number of ½in. bolts placed about 16in. apart. Care is taken to make the jacket fit the lagging as closely as possible.

In this way probably about 80 per cent. of the entire surface of the boiler is protected against radiation, and, according to the tests referred to, this should effect a respectable saving in coal. It was found that when the lagging was extended to the back heads of the boilers the men found the cabs too cold in severe weather, and parts of it were removed. It should be possible to cover the back heads for warm weather, and remove enough of the lagging to properly heat the cabs in winter.—*American Engineer.*

SANITATION AND TROPICAL MEDICINE.

ADDRESSING the students of the London School of Tropical Medicine, Dr. Manson, lecturer on tropical diseases at St. George's Hospital and Charing-cross Hospital Medical Schools, said that the first lesson, and a most important one it is, that the student of tropical medicine should learn is that the distribution of the

germs of the more important tropical diseases is not in any way dependent on the influence of temperature on the human body, which is proved by the fact that once established in the human body the germ will flourish therein, in the coldest as well as in the warmest climate. Thus, for example, a malaria parasite acquired in tropical Africa may remain alive for months, perhaps for years, after its human host has come to live in England. The same may be said of the filariæ, of the ankylostomum, and of many other parasites, proving that temperature regulates the distribution of disease by directly or indirectly acting on the germ during its passage from human host to human host, and not by any direct influence it may have on that host. Our sanitarians and the public do not fully recognise all that the community of interest as regards disease germs of man and beast means in the spread of disease. At all events, if they do understand it they certainly do not act as if they appreciated it. To turn for an illustration to a subject which, at the moment, is of pressing importance—the extension of plague. This disease, no longer, as it had been for some 200 years, of academic interest, merely, in one of those recrudescences, the explanation of which is still obscure, is again threatening to spread over the world. It is even now knocking at the door of Europe. What have sanitarians done with the mass of facts about this disease which has been accumulated for them by etiologists and pathologists during recent years, and, more especially, what have they done with the demonstrated fact that the *Bacillus pestis* is a parasite of rats? Judging from the recent history of the disease in Hong-kong, Bombay, Poona, Mauritius, and other places, plague goes on as if there were no such thing as sanitary science. The reason for this lies in the fact that the sanitarian, like other mortals, is slow to depart from traditions and customs, slow to adopt new ideas, slow to adapt himself to novel circumstances. He has been active and willing enough, but not active in the right direction. Like some physicians he has only one remedy for every disease. In his efforts at preventing and stamping out plague, he has simply followed old and stereotyped lines applicable to certain other diseases, but not applicable to plague, and has disregarded, practically ignored, the well-attested fact that the ubiquitous rat contracts plague before and more readily than man. From the fact that the rat is attacked by plague before the disease appears in epidemic form in a human community, the inference is indicated that the rats are a principal agency in preparing any given place for the epidemic outburst of disease in man; and it also suggests that if the rats in any given place were destroyed, although plague might be introduced, the disease would not spread as an epidemic among the people, at all events that its chances of spreading would be enormously reduced. As regards communicability plague cannot be said to be a very infectious disease, certainly not nearly so infectious as smallpox, scarlet fever, or even typhus. The attendants on plague cases, provided they exercise a reasonable and by no means irksome care, do not contract the disease. Man to man infection, therefore, cannot be the only, or even the principal, means by which this disease is conveyed; were it so, plague would not have spread as it has done in the recent and current epidemics in China, India, and elsewhere. Did its prevalence depend on man to man infection, considering the sanitary measures that have been put in operation, sanitary measures which have proved so effective in typhus—a much more communicable disease than plague—it would have died out long ago. There is certainly some way, other than man to man infection, by which plague epidemics are kept going. In my opinion that way is the rat. This animal is not included in and is not affected by ordinary disinfection operations, it cannot be isolated or segregated like the human being, it runs about from house to house unrestrained, infecting other rats and spreading the disease. It is completely indifferent to Orders in Council, to sanitary authorities, to Acts of Parliament, and even to men in uniform. We know all this, but is the knowledge acted on in that energetic and efficient manner which a lively belief would imply and insure? Certainly not. Attention in plague epidemics is principally directed against man to man infection, hardly at all against the most important rat to rat and rat to man infection. I believe were rats exterminated in any place, plague could not become established in that place.

The Baldwin Locomotive Works have secured an order for the construction and supply of twenty compound locomotives to the Saxon State Railway Administration. The engines will cost 54,760 marks each, and will be delivered free at Chemnitz railway-station, the price including the payment of customs duty and the cost of erecting the locomotives complete at that station. The lowest German tender was 54,540 marks, but the time required for completion of the engines was much longer.

PRESS WORK WITHOUT THE PRESS.*

At one time it was my province to act as a sort of commissioner of ways and means in a small machine shop. The size of the shop was not, however, comparable to the ambition of the proprietor, and, despite the paucity of tools, we undertook to repair almost anything, from a steam-engine to a musical box. A good deal of the business, early in the history of the shop, depended upon the working out of the ideas of several inventors, so far as these could be embodied into actual models and machines. As a general thing, inventors labour under a double disadvantage: Limited means and an inability to fully appreciate the value of the labour required to give their ideas mechanical form. Under stress of these forces, acting in and out of the shop, some peculiar jobs were handled in an equally peculiar way. For instance, take Fig. 1. Here the shoe bears a snugly-fitting metal cap A, which comes

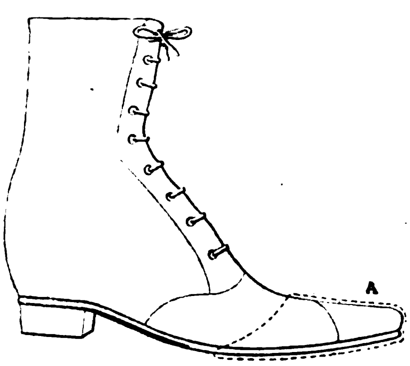


Fig. 1

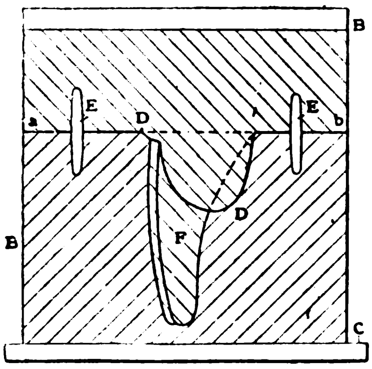


Fig. 2

Fig. 3

well up over the toe and back under the sole, as shown by the dotted lines. The cap was roughened underneath and a sheet steel clamp was applied, somewhat similar to the arrangement on an "Acme" skate, to hold the whole thing in place. The inventor's hopes and fears centred about the clamp, while the machinist was mainly concerned with the means to produce the cap.

Several plans might have been adopted. A last equal to the exterior of the shoe might have been procured, and some sheet brass or copper carefully hammered to fit the upper part, and then another piece could have been bent up for the sole, and the two pieces soldered together at the edges. Or a cast-iron die might have been made from the shoe to strike up the two halves, which could then have been joined to form the cap as before.

It may be mentioned here that a veteran moulder who took some interest in the article on "Cast-Iron Dies," in issue of May 11, tells me that the secret of making cast-iron dies is in the use of oil-tempered sand.

To get back to the shoe cap, which may be cast as in Fig. 2. The shoe is covered with clay to the thickness of metal required. The cylindrical shell B and flat plate C retain the plaster in place when poured in up to *a b*. The dowels E E are put in and the parts D D are cut away while the stuff is soft. The surface is oiled after hardening, and the cylinder B filled to the top with plaster. When the two halves of the mould are taken apart the portion F is gone over with a steel point or graver—the point projecting out of the handle the requisite depth—and then the surface is cut away to the lines thus made, and holes are made for the passage of the molten metal and for vent.

The above method could be varied by first making a plaster-cast of the shoe, then increasing the size of it by the addition of clay, and then making the other half of the mould, afterwards removing the clay and leaving a space, when the two halves were put together, for the desired thickness of shell. One of these methods, and I dare say both, have been used in the making of ornamental metal work.

I give these methods because they were suggested to me as the way in which the job was actually done. As a matter of fact, the groove around the sole was partially filled, and over the surface to be covered by the cap was applied a good coat of blacklead, and it was then electro-plated with copper to the proper thickness, after which the copper surface was buffed and nickel-plated. We were then handling, in the shop, platers' repairs and supplies, and the consequent trade made a very cheap, good job.

If the plating was put on slowly, as in the days of the old Smee battery, the cap would be about as smooth on the outside as on the inside. Life is too short for that process; and with such a task as that I have described, where the outside can be easily polished, the dynamo does very well. Should, however, the circumstances be reversed, and it was necessary that the metal article be smoothest on the outside, a guttapercha case or mould could be made, by coating the pattern and then plating inside the mould. Where articles of this sort are to be made in quantities, of course it is a different story; but when only one or two are needed, the kink is useful.

Fig. 3 is similar to a sketch that came my way along with a few strips of sheet copper and the instructions: "There's nothing particular about this; probably you can find something about the press to feed them along and force them up into shape." The strips were about ½in. wide and 3ft. long, and No. 26 B. and S. gauge. The dimensions on the sketch came very near a 6-P gear tooth, and the draw-bench gears, being that pitch, were put in motion to act both as feed and press.

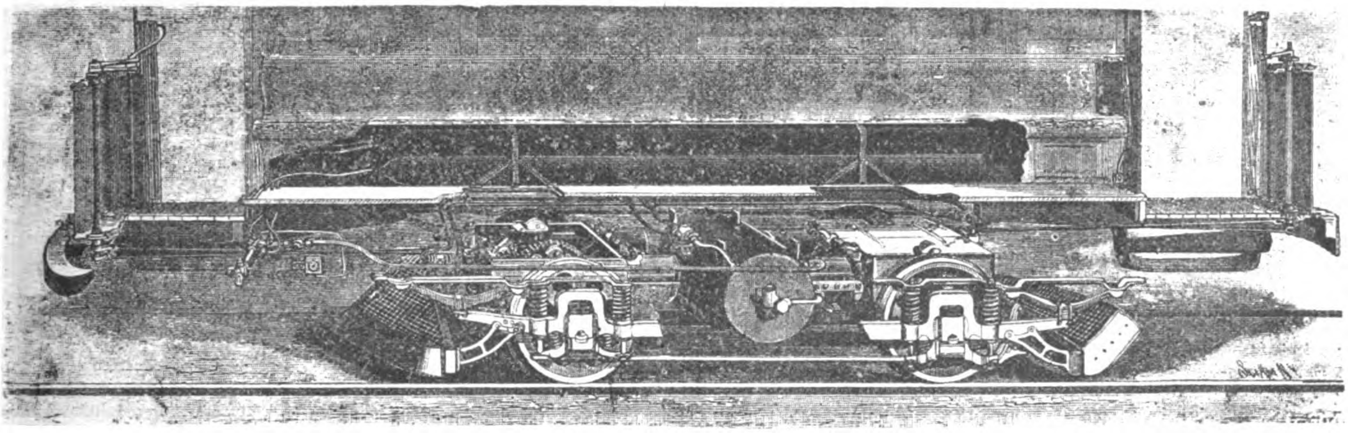
Both of these, the shoe cap and the corrugated strips, may be not improperly considered press work; and there is some satisfaction in avoiding the use of expensive tools on an occasional task of this sort, even if the one for whom it is done has little or no interest in the means by which it is accomplished.

* By R. L. Clegg, in the *American Machinist*.

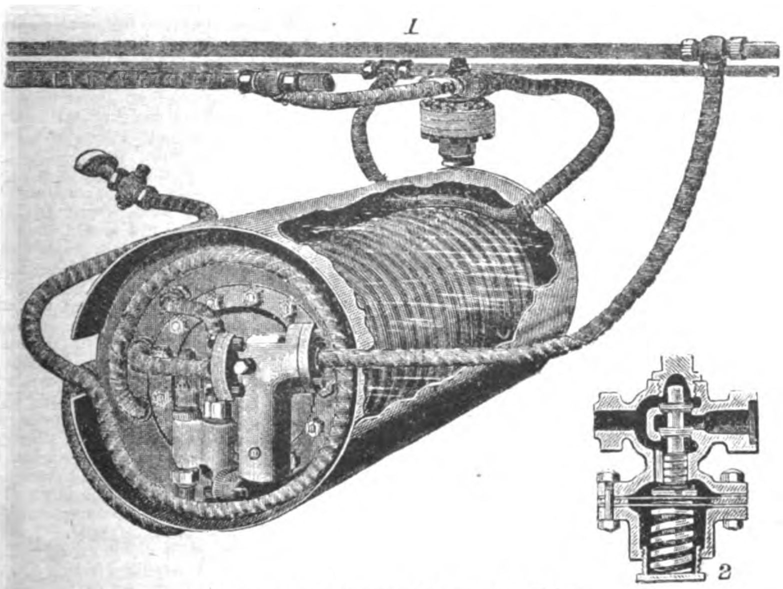
COMPRESSED-AIR TRACTION IN NEW YORK.*

The extensive compressed-air plant which has recently been erected by the American Air Power Company, at the corner of Twelfth-avenue and Twenty-fourth-street in this city, is now in active operation, and the new compressed-air cars which it supplies are in regular service on the Twenty-eighth and Twenty-ninth-street lines of the Metropolitan Street Railway Company. The compressing-engine is of special interest, both on account of its abnormal size and power and the high working pressure which is obtained. The single compressing-engine is of 1,000H.P., and the compressed air, after the fourth stage of cooling, is stored in the flasks at the high pressure of 2,400lb. to the square inch. The engine, which is of the vertical cross-compound type, built by the Allis Company, of Milwaukee, is an extremely handsome specimen of the engine-builders' art, and together with its massive brick foundations, it towers 60ft. above the ground-floor of the building. The diagram of the whole plant shows the compressors and the four inter-coolers situated on the ground floor of the building. The compressing-engine has cylinders 32in. and 68in. in diameter by 60in. stroke. Steam is furnished at a pressure of 150lb. to the square inch, and working with the most economical point of cut-off the horse-power is just 1 000. Our illustration shows the massive character of the construction, and as an instance of the size of its parts, we may mention that the crank-shaft is 22in. in diameter, with bearings 20in. in diameter by 36in. in length, while the flywheel, which is placed centrally on the shaft between the cranks, is 22ft. in diameter, and weighs 60 tons. The air compressor, which is carried directly beneath, is of the four-cylinder type, the compressing-cylinders being securely anchored between the masses of brickwork which form the two legs of the piers. The low-pressure cylinder is 46in., the intermediates are 24in. and 14in., and the high-pressure cylinder 6in. in diameter, the common stroke, of course, being 60in., or the same as that of the engine. The initial and first intermediate air cylinders are placed directly below the low-pressure steam cylinder, and the second intermediate and high-pressure air cylinders are below the high-pressure steam cylinders. Each crosshead of the steam-engine has four transverse arms, from which four distance-rods lead down to connect with the corresponding crosshead to which the air-pressure piston-rod is attached.

* Extracted from the *Scientific American*.

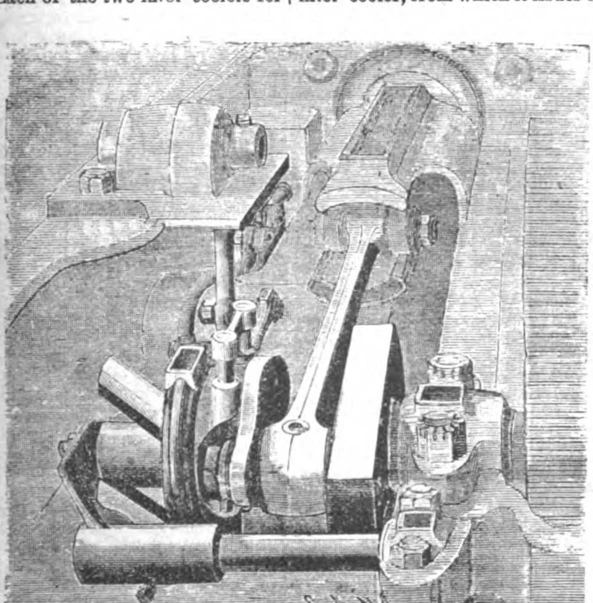


Arrangement of Storage-Flasks, Motors, and Heater on Compressed Air-Cars of Metropolitan Street Railway Company.



Details of the Heater and Reducing-Valve.

There are four sets of intermediate coolers for reducing the temperature of the air at each stage of compression, placed conveniently on either side of the foundations. Each of the two inter-coolers for



Half-View of one Motor, showing Reversing Gear.

the lower pressures consists of a cylindrical shell containing a set of vertical cooling-pipes, while in the coolers for the higher pressures a single-coil pipe is used, the air in each case passing through the pipes, which are surrounded with circulating water at atmospheric temperature. The action of the system is as follows:—The air after compression in the low-pressure cylinder is led through the first inter-cooler, from which it issues carrying a pressure of 40lb. to the square inch. It then passes to the first intermediate cylinder, where, after further compression, it is led to the second inter-cooler, which it leaves at a pressure of 180lb. to the square inch. It is next compressed in the second intermediate cylinder, then cooled to atmospheric temperature at a pressure of 850lb., and finally it is compressed in the 6in. cylinder and cooled to atmospheric temperature under a pressure of 2,400lb. to the square inch, at which pressure it is led to a nest of storage cylinders in the charging-room. The water used for cooling the air in the inter-coolers is taken from the North River, which is only a couple of hundred yards distant, through a 16in. water-main, and after passing through the inter-coolers the water is returned to the river through a discharge-main of the same size. Adjoining the engine-house is a charging-plant and a car-house. The cars on their return from a trip are run in on the tracks adjoining the storage-cylinders, where suitable connections are made, and a fresh supply of compressed air at the working pressure is fed to the storage-cylinders, which are carried beneath the seats of the cars.

The cars which are being used in this service are practically the same in construction as the four-wheel cars which are used on the underground trolley lines. The car body weighs 6,000lb., the trucks 4,500lb., the air-reservoirs 4,200lb., two motors weigh each 1,400lb., and the other parts and fittings of the car bring up the total weight to about 9½ tons. The air motors are carried one upon each axle, in two dustproof cast-iron casings. Each axle is driven independently, one of them by the two high-pressure motors, and the other two by the two low-pressure motors. It will be thus seen that the cars are made to conform in respect of distribution of the driving power to the standard practice on electrically-equipped lines. The high-pressure motor has now two high-pressure cylinders, each 4in. diameter with a 6in. stroke, and similarly the low-pressure motor has two cylinders 8in. in diameter by 6in. stroke. In each case a 9¼in. pinion is geared upon the crankshaft, and meshes with a 21in. gear-wheel keyed on the middle of the car-axle. The cylinders are bolted to the casing, and lie outside of the same, while within the casing are the piston-rods, crossheads, cranks, gears, and, in fact, all of the moving mechanism, and the whole is closed in with a cast-iron cover, which on being lifted exposes all the moving parts for inspection or repairs. One of our engravings, showing one cylinder and its connections, is introduced to illustrate the construction of the reversing mechanism. The eccentric disc is not mounted directly upon the shaft, but upon a pair of parallel guides, which are pitched at an angle to the shaft, one above and one below it, and have a motion parallel to its axis. When the guides are thrust in towards the crank the eccentric disc is thrown up, and when they are drawn out the disc is thrown down, thereby giving a forward or reverse motion to the engine. The idea is not new; but it has been ingeniously applied in the present instance, and lends itself admirably to the peculiar construction of these motors. It does away with one eccentric and the usual link motion. The bottom of the casing is filled with oil, so that the motors are self-lubricating, after the fashion of the Westinghouse and other fast-running engines. The construction is very compact, and the whole design well worked out.

The compressed air is carried in seamless steel flasks, which are placed beneath the seats of the car, three on each side, as shown in the accompanying engraving. The flasks are 2¼ft. in length by 2ft. 5in. in external circumference, and they are tested, before being placed in service, to a pressure three times as great as the working pressure. From the ends of flasks the air is led through the heater, a wrought-iron cylindrical reservoir which is supported between the two motors, as shown in the detail drawings of the car and the heater. The latter is charged with 60c.ft. of hot water under a pressure of 210lb. at a temperature of 400°. After the pipe has passed through the heater, where the air takes up sufficient heat to prevent the sub-

sequent freezing of any moisture which it may contain, the air enters another reducing-valve, of which we show a sectional view, where its pressure is lowered from 2,400lb. to 320lb. to the square inch. It then passes to the throttle-valves at each end of the car, and thence to the injector, where a proper amount of moisture is sprayed into the air from the heater, the temperature of the spray being, of course, 400°. The air with the moisture which it has taken up now passes through a spiral coil in the heater (see detail view), where its temperature is raised to that of the heater, or 400°, at which temperature and corresponding pressure it enters the high-pressure cylinders. From the high-pressure cylinders it is carried direct to the low-pressure cylinders, and then exhausts to the atmosphere on the under side of these cylinders through a muffler. The exhaust, except at starting, is scarcely audible.

Under the present conditions of working, the cars have a capacity of 15 miles with a charge of air occupying all space intermediate the seats, or the capacity could be increased up to as high as 40 miles by placing on the cars as large a number of flasks as could possibly be crowded in, or it could be increased by raising the working pressure, a change which the company is now about to make. The motion of the cars is very agreeable; there is an absence of jar such as is noticeable on the cable and electric roads, and we understand that, as far as they have been tested, they are giving great satisfaction. We are indebted for our particulars to the courtesy of Mr. W. Hoadley Knight, the engineer of the American Air Power Company.

JAPANESE AND CHINESE PAPER.

THE results of the inquiries of the commission of industrial experts, which was appointed by the German Government to visit and report upon the markets of East Asia, show, according to a German trade review, that the various markets present excellent prospects for the paper trade, and the paper industry generally. The Corean hand-made papers, thus far very little known in foreign countries, are of much interest. They are of yellowish colour, silk-like gloss, and extraordinary strength. In purity they are behind the better grades of Chinese papers. These papers are made in sheets about 29½in. by 51in. Oiled papers of this kind are used in place of window glass, and very impure, but extremely strong, board is also made of the same raw material, as well as blotting and wrapping papers. The Japanese hand-made papers are divided into two classes. The so-called "hanshi" (half paper) is loaded with about 20 per cent. of rice starch; the "minogami" consists entirely of fibre. The Hanshi papers are the stronger and coarser, and are made in smaller sizes (about 9¾in. by 13in.), while the Minogami papers are thinner and better, and of larger size (11in. by 16in.) A quire of paper is called "jo" in Japanese, and has from 20 to 48 sheets; a ream is called "shine," and has from 480 to 2,400 sheets. The prices of hand-made paper have recently risen about 15 per cent., because the growers of bast demand and obtain higher prices for their product. Printing paper is used in Japan not only for printing purposes, but also for writing. The most popular sizes of printing paper are 25in. by 27in., and 31in. by 43in., flat. The consumption of paper has increased extraordinarily in Japan, and, although the home production is large, there is a good market for imported paper. Rice straw is an important factor in the manufacture of Japanese machine-made paper; only when there is a poor rice crop is wood fibre imported to any appreciable extent. Several Japanese paper-mills, as well as the Fuji paper-mill (the largest in Japan), produce their own wood pulp and wood fibre; the Ixono mill is said to be the only fibre-mill which sells its products. Wood fibre is imported for the most part from Sweden, and fetches, according to quality, from £16 to £24 per ton. In Skiroishi and in Atami, families make a paper textile in which the warp threads consists of silk or cotton yarn, while the woof threads are twisted from narrow strips of hand-made paper. How much the production of hand-made paper increases is demonstrated by the fact that in 1887 the total value of the production amounted to £940,000, while in 1895 it had risen to £1,820,000. The production of machine-made paper in Japan was in 1896 approximately as follows:—Fuji, 12,000,000lb.; Oji, 12,000,000; Kobe, 7,000,000; Senji, 6,000,000; Yakaichi, 3,000,000; Abe, 2,000,000; Yukosha, 800,000; Shimozato, 800,000; Ixono, 200,000; or a total of 43,800,000lb. The Muramatsu paper-mills, near Shizuoka, produce excellent hand-made paper, and especially noteworthy are the napkin tissue-papers, unrivalled in silky gloss and beauty, which are also painted or printed with pictures, as well as the unsurpassed Japanese crape tissue-paper. Among the most curious things to be seen in Japan are the jackets and trousers of strong hand-made paper with which the Japanese Japanese soldiers were supplied during the war between Japan and China. The seams and button-holes were sewn with cotton-thread. Chinese hand-made papers are made mostly of rice straw, and are coloured or stained on one side by hand; for instance, crimson for visiting cards (which are thin large octavo sheets), pale red for bills, yellow sprinkled with gold or green for wrapping goods, orange for wedding finery, &c. Large quantities are consumed in the principal place of its manufacture for decorating various places of worship, which are visited by Chinese from all over the country, and considerable quantities are also sent to the adjoining provinces. There is no doubt that cheap imported machine-made printing papers, stained or unstained, could successfully compete with these home-made and hand-made papers, and the East Asiatic countries would certainly appear to present an attractive and lucrative field for the European exporter of paper.

"THE QUEST OF THE IDEAL."

SIR JAMES CRICHTON BROWNE on Monday delivered the address introductory to the session in the Department of Medicine at Owens College. In the course of it he said: One of Manchester's most gifted sons, who has embellished our literature by his stately rhetoric and so used our language as to add to its polish and beauty—Thomas de Quincey,—born near this spot in 1785, has described his native town as "gloomy and of repulsive exterior, mud below and smoke above"; but he has added that it contained a population with strong hearts, of noble moral qualities, and infinite perseverance, and "as yet not much alloyed with Celtic adulteration." At the time of which De Quincey wrote—a hundred years ago—the torch of improvement had not been lit in Manchester or carried through its slums and alleys, and could he revisit the glimpses of it to-day, he would have to withdraw his "repulsive" adjective, admit that the gloom has been pierced if not scattered, as perhaps it never can be altogether where a teeming and steam-drudging population closely congregates—and he would have to redouble even his fervid approbation of the enterprise and resolution of its inhabitants with or without Celtic admixture! On all hands he would discover growth and evolution, unmistakable and marvellous signs of progress, enrichment, refinement, philanthropy, and, in this institution, under the auspices of which we are assembled here, he would recognise not the least admirable of the many great public works to which the spirit of Manchester of the 19th-century has given birth.

Manchester and Collegiate Education.

The primary impression on the Outlander surveying your College and school is one of wonder at their early maturity and youthful lustihood. They are of yesterday, and yet the vigour of centuries is in their veins. At the period to which I have already alluded, 100 years ago, when De Quincey was learning Greek, to some purpose, in your Grammar School, then 330 years old, there was no serious thought of a college in Manchester. No doubt some vague schemes for providing training for those entering the learned professions and commerce had been put forth, but these had been speedily snuffed out by the practical men, who argued that higher education spoilt boys for commerce, and that to be successful in business men must be kept intellectually lean and hungry, and it was not until 1825 that the first successful effort was made to establish an institution for systematic teaching in any of the higher branches of knowledge. Before that there had been isolated courses of lectures on anatomy and chemistry, so that the claims of science were beginning to be felt, and in 1814 Mr. Jordan had essayed to organise a medical school; but it was not until 1825 that a properly-equipped and co-ordinated school of science was commenced. I think we must be gratified to remember that that school was the work of the medical profession. It was Mr. Turner who founded it, and that action of his seems to me to have been the germinal vesicle of the magnificent organism Owens College, in which we now rejoice. This school, which was provided with lecturers on anatomy, chemistry, materia medica, surgery, midwifery, and botany, was the first provincial medical school in England, and in consideration of that fact and of its public usefulness it was permitted in 1836 to add the prefix "Royal" to its name. It is only three-quarters of a century—a man's life—since Mr. Turner's first step was taken; but in that brief span of time there has been incessant movement and steady advance in educational affairs in Manchester, advance marked here and there by momentous and memorable events, such as the foundation of Owens College in 1846 and the incorporation of your medical school with it in 1871. Your school buildings have cost the college authorities upwards of £70,000 since the school and college joined hands—that is to say, during the last 25 years—and this, I see, is frequently referred to as a munificent expenditure. So it may be, if measured by the standard of what has been done elsewhere, but so it is not if measured by the requirements of science in these days or by the duties and resources of this great city. I have no wish to startle, but use the words of soberness, when I say that the £70,000, although inadequate so far, does not exhaust the pecuniary claims of the medical school on the community, and that, if in the future it asks twice that sum to meet the educational calls made upon it, and to keep pace with science, which is now so mobile and so expensive, Manchester should cheerfully put its hand in its well-lined pocket and produce the money, knowing that, after all, it is only a judicious investment in life assurance.

A Medical School and its Work.

The lecturer contrasted the £70,000 spent on the school buildings with the enormous expenditure, drawn from the rates, on lunatic asylum. Mental and nervous diseases, he went on to say, are the diseases of the future, and we have as yet no protective serum to employ against them. All the more important is it therefore that they should be diligently studied and scientifically investigated. In the early days of your school the lunatic hospital of Manchester formed part of the General Infirmary, and then, for good reasons and with excellent results, it was moved out to Cheadle, where it now is, and where my friend Mr. Mould successfully presides over it and utilises it for clinical teaching. The Cheadle Hospital admirably supplies a clamant public want, but, I confess, I hope the day will come when another lunatic hospital will spring up in Manchester—an asylum organised in all respects like an ordinary hospital, and near to your school, so that you may have daily access to it. In the lunatic hospital of my imagination the medical staff, consisting of consulting, visiting, and assistant physicians, aided by specialists of several kinds, would be exempt from all the administrative and clerical work which now weigh so heavily on asylum medical officers, and would thus be free to devote themselves to their purely professional duties, to research, and to teaching. Resident house physicians and clinical clerks would maintain constant observation and keep the medical records, while psycho-physical and pathological laboratories would afford facilities for experiment and demonstration. Courses of lectures on psychology, neurology, comparative psychology, and mental and cerebral pathology would enable students to benefit fully by the work in the wards (which their critical presence would always maintain at a high pitch of thoroughness), and prepare them to deal in their own practice with a prevalent and obscure group of diseases, while an out-patient department would bring under skilled treatment cases of mental derangement in their incipient and most curable stage. I am *not* inappreciative of what is being already done in the way of science in our asylums in this country, and especially in the department of pathology, often under disheartening and difficult circumstances; but I say deliberately that until we obtain in London, Manchester, or elsewhere a lunatic hospital organised somewhat on the lines I have indicated, the great problems, social and medical, in connection with insanity, which press for solution, cannot be adequately dealt with. Perhaps some still hiddenly purposed benefactor of your school and lover of his species, perhaps the county council, tired of building costly receptacles for decayed and damaged mind-stuff, may bestow such a genuine lunatic hospital upon you, and thus vastly extend your usefulness and heighten your prestige. I am, I admit, heavily requisitioning the future on behalf of the Manchester Medical School, and it may be that in doing so I have not sufficiently acknowledged what Manchester has already done for it. No doubt the Medical School has owed much to Manchester; but, on the other hand, Manchester has owed much to the Medical School. In the central coil and in every purlieu of the city its influence has thrilled; there is not a sumptuous mansion or a miserable tenement in which some emanation of its virtues has not been felt, for a brisk and efficient medical school not only trains medical students, but raises the whole tone of medical practice in its vicinity, especially when, as in your case, it affords opportunities to medical men engaged in practice to renew their studies from time to time, and so to keep abreast of all advances made in our knowledge of disease, its nature, causes, and effects. I do not know any surer blessing which a populous district can enjoy than to have a medical school in its midst. This radient influence of a medical school, if I may so call it, cannot be weighed or measured, but it is real and substantial enough, and, of course, it will be most potent just where the conditions of life are most insanitary and provocative of disease. And so in Manchester in the past it has had free scope and sway. When the Queen visited the city in 1851 her keen and sympathetic eyes noticed, as she has set down in her diary, that the crowds in the streets, both of Salford and Manchester, were made up of "a very intelligent but painfully unhealthy population." And about the same time Mrs. Gaskell, whose writings did much to create kindly feeling and break down the barriers separating employers and employed, pictured the mill-hand in lugubrious

colours. The men, she said, in "Mary Barton," were of stunted growth and fragile build, and had wan, ashen faces, telling of scanty living and grinding toil; and the women, lacking in beauty and symmetry, showed pinched and sallow countenances, in which acuteness and intelligence contended with care and debility. All that has been changed. Manchester crowds to-day present no such saddening spectacle. Your proletariat is as winsome and robust as that of any other large manufacturing town. Your death-rate has dropped. Yet much—infinitely much—remains to be done before you can be said to have reached a level of public health that can be pronounced even tolerably satisfactory. In some of the slum districts of Salford—now happily to be cleared away—the death-rate has in recent years reached 100 and even 104 per 1,000; in one district it has never fallen below 60 per 1,000 for the last six years. In some parts of Manchester—for instance, in Hulme—shocking overcrowding prevails. At a recent meeting of the City Council it was stated that in one case there a father, mother, and six children all slept in one room 8ft. by 6ft., without a fireplace and with windows that would not open. In another case a father and mother, short of work, and so of food and fuel, occupied, with their two children, a small room the fireplace and windows of which were papered up to keep out the cold. Little wonder that one night the youngest child was asphyxiated. It is clear that still cheek by jowl with your opulence and refinement are pinching poverty and squalid debasement; and that those indefatigable promoters of disease and degradation, over-crowding, over pressure, over-drinking, under-feeding, under-breeding, under-thinking, are still busy at their deadly work amongst you. Strenuous efforts are still required of Manchester to raise its submerged masses into decent habits and health, and in these efforts it will, I am sure, draw inspiration, guidance, and support from this centre of medical science. In what has been already done to raise the masses your medical school has had some share, for whatever ameliorations have been secured have been due, not solely to economical changes, but also to the sound doctrine of sanitary reform which has here been preached. Your school has diffused around it just methods of thinking on medical and sanitary matters, and I question whether, but for the atmosphere it has created, those wise measures for the prevention of tuberculosis which Dr. Niven and Dr. Delapine have advocated would have been adopted by your civic authorities. I have already referred to what is no doubt a just source of pride to all connected with this school, and that is the steady arithmetical progression in the number of entries of students from year to year, a progression all the more gratifying because it has been, as the registers of the General Medical Council show, proportionately greater than that in the other medical schools of Great Britain. It is thus evident that the advantages you offer are attracting students from beyond your own proper fief or territory, and that you may in time become no longer a county palatine but a cosmopolitan institution. It is not, however, by its entries, but by its exits, that a medical school is to be judged—not by the raw material but by the finished article—and in that respect you have, I think, no reason to be ashamed, for having looked over the list of your associates and of your graduates in the Victoria and London Universities I observe that for so comparatively young a school you have sent forth quite a remarkable number of men who have already made their mark in their profession. They have won a good name for your school; and it is for the men I see before me to live up to the standard they have set, and, with ampler opportunities than they enjoyed—for your school is always improving its machinery—to better their example.

"The Materialistic Virus."

I should consider myself fortunate if I could say any word this afternoon that might stir one or two present to more vigorous endeavour in the work before them, that might heighten in a few their conception of their errand in life, that might bring home to the many an enhanced sense of the responsibilities they are undertaking. In considering how I might best in some small measure achieve this, it has occurred to me to improve the occasion by warning you against certain dangers which will assuredly beset your path, dangers not generally recognised, but to my thinking real enough. I allude to those tendencies to materialism, which regards mind as a mode of motion, or to its congeners, naturalism, which subordinates spirit to mechanism and sets unchangeable law as supreme, and agnosticism, which ignores both mind and matter and confines its attention to phenomena—tendencies the influence of which you are all certain to feel, and to which some of you are not unlikely to succumb. If your local teachers supply you with no antidote to the materialistic virus, the great catholic teachers to whom all who are interested in medical and biological science are obliged sooner or later to turn will inject it into your veins with tenfold virulence. Herbert Spencer is certainly responsible for a widespread diffusion of materialism. The splendid cogency of his argument that the whole procession of phenomena in the universe, the vast array of nebula and star, of sun and planet, of planet and moon, of rock and crystal, of plant and animal, is deducible as a physical and mathematical corollary from the simple fact that the quantity of force in the universe is fixed and unchanging, and that it exists under the antagonistic forms of attraction and repulsion, dazzles the intellect and disposes to the purblind acceptance of his deliverances on all other subjects. And thus it is perhaps that his theories as to the evolution of mind, which notwithstanding his admission of an Unknowable as a necessary datum of consciousness are pure and undiluted materialism, have obtained such ready currency. He insists that mind arises out of the molecular vibrations of matter, just as do light, heat, and electricity, and that the only difference between the commonest sensation and the most transcendent emotion lies in the number and complexity of the molecular vibrations of nerve substance. He does this with a subtlety and ingenuity that almost inevitably command for his propositions the assent of those whose daily experiences impress them with the constant and intimate connection between brain states and mental manifestations, and so his philosophy has dashed to pieces the ideals of many medical postulants. But if Herbert Spencer has done much to scatter broadcast materialistic ideas in medical circles, Huxley has done more, for, in spite of his repudiation of the title materialist as a reflection on his agnostic allegiance, there are few recent writers who have better deserved the designation. He invariably leans towards the primacy of the physical side in phenomena. He has said that the history of science has "in all ages meant, and now means more than ever, the extension of the province of what we call matter and causation, and the concomitant gradual banishment from the region of thought of what we call spirit and spontaneity." He has taught that molecular changes in the brain are the causes of all states of consciousness. Volitions, he affirms, do not enter into the chain of causation at all, voluntary acts being as purely mechanical as reflex action. High thinking, in his alembic, turns out to be merely increased resistance and friction in certain nerve circuits. He has reduced our species to conscious automata. Consciousness, according to him, is a collateral product of the working of the organism, and cannot under any circumstances, in man or brutes, be the cause of any change in the motion of the matter of the organism. With a matchless power of lucid exposition, with relentless logic, he has pressed home these views, and the weight of his authority as a scientific investigator, added to the charm of their simplicity and completeness, have given them potency and popularity, and helped them to swell that great tide of materialistic thought which surges through our medical schools to-day, and sweeps away many precious and ennobling ideals. As I have already hinted, the materialistic tendencies of the hour, dispersed everywhere, but focussed in our medical schools, have not even in them by any means undisputed dominion. They are resisted by those who are, by constitution or training, fortified against them, or who, by wrestling with them, have overcome them. The loss of the ideal is a personal calamity. "That way madness lies," as those engaged in my special department of practice are not seldom made aware; and the loss of the ideal is inevitable if no solution of the world-problem can be arrived at, or if that solution be materialism. For materialism reduces all things to the pull of opposing atoms. Under its interpretation intellect is the activity of nerve cells; immortality is a delusion; virtue, honour, duty are forms of selfishness, and heroism becomes a kind of disease. To drift into materialism from indolent acquiescence, or callous sensuousness, or out of deference to scientific authority; to adopt it in defiance or bravado; to rest in it without testing its credentials again and again in the new lights that the changing years bring to us, is the height of folly. To let the ideal slip from us by clutching it loosely, or by neglecting to supply it with the necessaries of its life, is to sacrifice our most precious birthright. I cannot help thinking that in our medical tribunals we are too apt to allow judgment to go in favour of materialism by default, and to let blatant assertion pass for proof. The battle is not ended; it is scarcely begun; and if I discern the signs of the times aright, there are hard knocks in store for materialism, naturalism, and agnosticism. What I have to say is simply an exhortation to hold fast, as your sure refuge, by idealism, which, in one shape or another and however smothered up, still dwells in each of you, and with that exhortation I would associate a suggestion that the assumptions of science which exclude an idealistic view of the world, as well as the prepossessions against anything but solid facts and their material explanations which your studies may have engendered in your minds, are still open to doubt and refutation.

The Limitations of Science.

Vast as the sphere of science is, it is still limited in all directions. Physical science can never prove to us the existence of mind in our fellow-men, and yet that is one of our most rooted convictions. And physical science is equally incapable of substantiating that the quantity of force in the universe is fixed—the first principle without which science is impossible, and which we have to take on trust. In these and in other instances which might be adduced it is seen that our whole mental fabric is built up on beliefs, lying deeper than science, in regions into which, with all its modern acuteness and instrumental aids, it cannot penetrate. These regions are called metempirical, but it is not on their shadowy immensities I wish for the moment to touch, but on certain unfathomable chasms that are well within the bounds recognised science, and the existence of which is inconsistent with the material hypothesis. First there is the chasm between the organic and the inorganic. Astronomical physics bring us down gently, as has been said, from the incandescent gas of a nebula to this round earth; but when we begin to examine the earth's surface, we are pulled up with a jolt at the cleft between the lifeless and the living. There is no physical theory of the origin of life, which in our experience never arises except through the mediation of life already existing. Abiogenesis is an exploded myth. Virchow's phrase, "Omnis cellula e cellula," is an axiom in biology. The volumes of Herbert Spencer's philosophy, which should have traced out the connection between inorganic and organic evolution, are, strange to say, still wanting. Darwin never entertained the notion of a mechanical derivation of life, but wrote: "It is mere rubbish thinking at present of the origin of life; one might as well think of the origin of matter"; and Lord Kelvin, notwithstanding what has been called his "forlorn hypothesis" of the meteorite, a skin-graft from another world, has declared that "the only contribution of dynamics to theoretical biology is absolute negation of the automatic origin of life." Secondly there is the chasm between the physical and the vital, for if the origin of life is wrapped in obscurity, so is its maintenance. Physiology has, in its materialistic fervour, vaunted itself on having banished vitalism and established the identity of all vegetable and animal functions with physical forces. In 1889 Sir John Burdon Sanderson, in his address to the British Association, declared that "the word 'vital,' as distinctive of physiological processes, must now be abandoned altogether"; but in view of recent researches I question whether he would to-day repeat that statement. Thirdly there is a chasm, the widest of all and the most fatal to materialism, between mind and matter. And it is just this chasm which, as young medical scientists, you are most likely to overlook, for the absolute dependence of the mind upon the brain is a presupposition of much of your work, and is obtruded on your attention in your clinical, physiological, and pathological studies. Even those of you only entering on their curriculum will be prepared to affirm that thought is a function of cerebral cortex, for the accredited proofs of that proposition are patent to all. The intelligence of animals is on the whole proportionate to the size and differentiation of their nerve centres. In the different races of mankind a correspondence is observed between mental power and brain bulk and elaboration. Sir James Crichton Browne proceeded at some length to elaborate this thesis. How, he asked in conclusion, is the ideal, whether it is in the mind innately or has been won by sore travail, to be fostered and nourished and kept alive? By all those observances and ordinances that the wisdom of ages has consecrated, and that in these hurried and indifferent days we are too apt to neglect. By the assumption of an attitude of reverence and sympathy, which will incline our ear to the whisperings of the infinite and afford us glimpses of the inner impulses by which other men shape their lives. By the practice of that self-renunciation for which our profession affords the finest scope, for in ministering to the wants of others, even at the sacrifice of our own, we mount to blessedness. Scepticism, unbelief, and deadness to the ideal are sometimes the outcome of an overweening egotism of isolation and an exaggerated notion of one's own importance, and are to be corrected by a broad survey of humanity, of the poor and toiling multitudes to whom faith in some shape still make their meagre existence good and palatable and full of meaning. And for this broad survey your profession, in its practical aspects, will afford you abundant opportunities, thus in some degree making amends for the epicurean leaven of its purely scientific study. You will witness much of tragedy and pathos in humble homes. You will contract an affectionate esteem for lowly toil, and for the patient endurance and devotion of the poor, without sacrificing your respect for the many noble qualities that mingle with the frivolities and follies of the well-born and affluent classes.

A CHURCH in Chicago has a steeple on which are lights are placed. The lamps are 225ft. above the level of the street, and produce an excellent effect.

MEDICINE, OLD AND NEW.

In his address to the students at St. George's Hospital, Dr. W. Howship Dickinson, after comparing medicine with the other learned professions, said that the medicine of the past was largely empirical, and justified in its results the sarcasms which were directed against it. But empirical as was the system, it was in operation from time immemorial, and provided many drugs which were among our most important agents. By "empirical" was meant, as the dictionary has it, "practised only by rote without rational ground." The advance of modern medicine he considered under three heads: learning that many diseases which our forefathers supposed to be under the control of medicine were not so; enlisting in our service the influences of the external world; tracing many diseases to minute organisms which formerly were unknown. The old treatment of pneumonia and typhoid was contrasted with that of to-day, and other instances were referred to in which our fathers played an active part where we were content to be passive. Much of our progress was negative, in the abandonment of what was injurious; but positive gains were to be recognised. Foremost among these was the trust we had learned to repose in external nature as exemplified by the employment of climate in the treatment of disease. The bacilli of anthrax, relapsing fever, tubercle, diphtheria, tetanus, cholera, glanders, typhoid, plague, and leprosy were exposed to view, not to mention the important discovery of the organic causes of suppuration. While these intruders from the vegetable kingdom were successively coming into view, the animal kingdom was delivering up secrets of scarcely less importance in the shape of the Filaria, the source of some of the gravest and hitherto most incomprehensible of the diseases of the Tropics, and the organic generators of malaria and dysentery. With regard to bacilli and the diseases ascertained or presumed to be caused by them, there were three ways of prevention or cure, killing or excluding the microbes; establishing immunity in the individual exposed to them; employing antidotes in the shape of the antitoxins. Looking at what had been done, and in how short a time, in tracing diseases to foreign organisms, and at the possibilities of prevention and cure which were implied, we could not but wonder and hope.

SWINE FEVER, RABIES, TUBERCULOSIS.

In his introductory lecture at the Royal Veterinary College, Prof. Sims Woodhead, M.D., said that, although we are an essentially practical people, we did not learn as much as we might from the practices of others. For example,

Swine Fever

had been a scourge for years. We had had an elaborate system of inspection, of central examination, and of compensation. He believed that we were going the wrong way to work to get rid of the disease. Into the question of compensation he scarcely felt competent to enter; but he could not help thinking that this permanent system of compensation had something to do with the continuance of the disease among us. At present, if the disease broke out in an area, the farmers were sure that their loss would not be borne entirely by themselves; and even the best of men had not the same stimulus to exert themselves to adopt preventive measures, when they felt assured of certain compensation, as they would have were they to feel that they would inevitably be involved in considerable loss if the disease should break out among their swine. Some temporary system of compensation might no doubt be just, but it should be for a period only sufficiently long to enable effective measures to be taken against the spread of the disease. In the matter of inspection, however, he held that at present, when such enormous capital was at stake, we were making a grand mistake. He did not wish for a moment to hint, even, that the men who were at present doing the work were not capable of carrying out the orders that were given to them. They were no doubt an intelligent set of men, honourable, active, energetic; but the work that they were called upon to do was not that for which they were fitted. For administrative and secretarial work let them be kept in their present position; but for the actual inspection of buildings, of animals—whether dead or alive—he maintained that no one but a thoroughly qualified veterinary surgeon should be employed, and this for many reasons. Only a veterinary surgeon could understand the disease thoroughly in its many-sided aspects. The symptoms, the lesions, and the like were not always the same, and it might be years before an inspector saw every lesion and appearance that might be present in such animals; and during the time that he was gathering his experience, the latent and irregular forms of the disease were centres from which infection might be spread broadcast. An inspector who had been brought up as a soldier, or in some civil occupation not associated with scientific work, could have little knowledge of the principles of infection and disinfection, of hygiene and the like, by means of which only could the disease be prevented. He could not keep himself *au courant* with most of the recent discoveries as to the pathogenesis of the disease; he must always be behind the veterinary surgeon, and never so completely equipped. More than this, what inducement had the ordinary inspector to get rid of swine fever? He had been taken from his previous occupation to stamp out a disease by the disappearance of which his present occupation would be gone. He did not mean to say that this could weigh with the bulk of men; but there were always a few men in whatever sphere of life one moved with whom an inducement of such a kind had a certain amount of weight, even though in some instances they might be unconscious of it. In the case of the veterinary surgeon, when swine fever disappeared, he had still some other branch of his profession to fall back upon.

Rabies.

Another matter to which he would like to refer was the so far successful effort there had been made to get rid of rabies from our midst. It was not long ago that anyone advising systematic muzzling to be adopted for the purpose of stamping out rabies would have been laughed at as an enthusiast and hooted down as cruel, and no Government would have dared to carry out the behests of such an individual. Some might say that it was the practical man who had brought this about. He did not agree with this. He held that, curious as it may appear, Pasteur's researches on hydrophobia had been the means of rendering such a course as that recently adopted by the Board of Agriculture at all possible. Should there ever be another outbreak of hydrophobia, as there might be when the lessons of the last few years had been forgotten, he was convinced that no half-hearted, localised measures would be adopted—every dog in the kingdom would be muzzed at once, and the result would be that, instead of its taking two or three years to get rid of rabies, as had now practically been the case, there would not be a rabid animal left in the kingdom in six months. The Pasteur system for hydrophobia must remain in force and be of great value so long as there were rabid dogs in existence, and so long as the disease could be transmitted by the wilder animals; but in civilised countries and in those where wolves did not exist universal muzzling would do away with any necessity for the Pasteur treatment.

Tuberculosis.

Referring to the question of tuberculosis, he said that extremists of all kinds had had their say, and we were gradually coming to see that the spread of tuberculosis was not necessarily according to any one method, but that there were many forms of distribution. We had now got over what might be termed the time of panic. With the growth of our knowledge of the means of the spread of the disease had come light on the methods of prevention, and we were now even far more hopeful as regarded treatment; but withal we had come to see that it was only by the co-operation of medical men, of veterinary surgeons, of public administrators, and of those who were interested in the raising of cattle and the supplying of milk that we could eliminate tuberculosis. It was for that reason that they were so thoroughly instructed in the use of tuberculin, by means of which, as was now recognised, the most latent forms of tuberculosis might be made out. They were to show the farmers that it was to their interest to have nothing but healthy stock, they had to prove to them that some of their stock was unhealthy, and that quite apart from the danger that a tuberculous animal might be to the community, and quite apart from the fact that it was possible now and again to feed a tuberculous animal so that it might be disposed of at a fair market price, that he was dealing with the disease which might render it impossible, or, at any rate, uneconomical, to feed cattle for the market. The more serious aspect of the question—the danger to the public health—could not be demonstrated to the farmer in the same way as the less serious aspect could, and, therefore, he was not so ready to receive it; but once let him be convinced on either point and he was satisfied that there would be little difficulty in prevailing on him, first of all, to submit his animals to the tuberculin test; and, secondly, to place them under such conditions that the danger of the spread of tuberculosis might be considerably minimised.

The quantity of iron ore exported from Sweden during the first half of the present year is returned at 467,246 tons, as compared with only 363,275 tons in the first six months of 1898.

Taking as unity the intrinsic brightness of a sheet of Bristol cardboard illuminated by a standard candle at one mètre distance, that of a candle-flame itself is from 12,000 to 22,000; a kerosene lamp flame 97,000; and platinum at its melting-point, 1,008,000.

SCIENTIFIC NEWS.

The small planet which was observed by M. Jean Mascart, of the Paris Observatory, on August 26, as mentioned on p. 113, has been proved to be the same as the discovery of M. Goldschmidt, of Paris, on Oct. 26, 1854, which is known as Pomona, No. 32.

Holmes's comet (III. 1892) was rediscovered by Mr. Perrine, of the Lick Observatory, on June 11; but it appears that no one else has seen it, although it is still approaching the earth. It is considered probable that its detection in 1892 was due to some temporary increase in brightness. The period is calculated to be about 6·9 years, and another return is calculated for 1906. It is a remarkable body, because its orbit is more nearly circular than that of any other comet, and is included between the orbits of Mars and Jupiter. When Mr. Perrine picked it up on June 11 last, it was under exceptionally good conditions, very faint and difficult to observe.

Mr. J. E. Gore, F.R.A.S., has another article on suspected variable stars in this month's *Knowledge*, and says that the stars mentioned "look very suspicious, and seem deserving of further examination."

It is stated that the plans for the University of California, submitted by M. Bernard, of Paris, have been awarded the first prize. The buildings will cost more than fifteen million dollars, and will be erected at the expense of Mrs. Phebe A. Hearst.

In the course of the meeting of the International Geographical Conference at Berlin a discussion took place on the approaching German and English Antarctic expeditions. Sir Clements Markham said that these parallel enterprises would form the greatest geographical undertaking that the world had ever seen, and he confidently anticipated that the domain of human knowledge would be vastly extended by them. They would also promote good fellowship between the two nations. The hearts of all geographers rejoiced to see the countrymen of Humboldt, Ritter, and Kiepert united in this work with those of Banks, Rennel, and Murchison. Prof. Drygalski, who will be the leader of the German Antarctic expedition, gave details of its scientific and other equipment. Dr. Nansen also spoke, and expressed strong doubts as to the existence of a great continent in the Antarctic regions. He congratulated the German nation on its co-operation with the English, and expressed the opinion that it would inaugurate a new era of exploration.

The Gresham lectures on Geometry will be delivered by Mr. W. H. Wagstaff, M.A., on Oct. 10, 11, 12, and 13; on Law, by Mr. G. H. Blakesley, M.A., Oct. 17, 18, 19, and 20; on Rhetoric, by Mr. J. E. Nixon, M.A., Oct. 31, Nov. 1, 2, and 3; on Divinity, by Rev. H. E. J. Bevan, M.A., Nov. 6, 7, 8, and 10; and on Astronomy, by Rev. E. Ledger, M.A., Nov. 14, 15, 16, and 17. The Music lectures will be delivered by Sir Fredrick Bridge, Mus.Doc., Oxon., on Oct. 24, 25, 26, and 27, the first at Gresham College, and the other three at the City of London School.

The death is announced of Dr. Theodore Puschman, professor of medical history at the Vienna University in his 56th year. Prof. Puschman, an authority in his department, was known in England through the translation into English of his "History of Medicine in Vienna during the Last Hundred Years." He was a frequent contributor to the medical annual published by Profs. Virchow and Hirsch.

Dr. Alexander Wallace, who had distinguished himself in the study of botany and entomology, died on Sunday at his residence in St. John's-terrace, Colchester, at the age of 70. He received his professional training at St. Bartholomew's Hospital and at Oxford, where he took the M.B. and A.M. degree in 1858, having been elected a member of the Royal College of Physicians, London, the preceding year, and in 1861 proceeded to the M.D. degree. He was for a time Physician to the Metropolitan Free Hospital, and the St. Pancras and Northern Dispensary, and he was a member of the Entomological Society of London, Acting Physician to the Essex and Colchester Hospital, and a member of some of the learned societies. He was well known and deservedly popular in sporting circles, taking

special interest in cricket, for which he gained his "blue" when at Oxford. In later years he attained no less distinction in tennis.

The medical schools opened on Monday, and some notable addresses were delivered, the more important of which will be found in another part of the paper. In her address to the students of the London School of Medicine for Women (Royal Free Hospital, Gray's Inn-road), Mrs. Garrett Anderson, M.D., referring to a much-debated subject, said:—There can be no doubt that the experimental method of teaching is the true one, whether much or little of any subject is wanted as a foundation for the scientific study of medicine. This method in physiology does not necessarily include vivisection. At this school there never has been any vivisection. The tissues of many animals retain their vital properties for some little time after death, and also after all power of receiving sensation has been destroyed. The study of pathology, or the causes and effects of departures from health, ought, if possible, to precede work in the hospital wards. The student should know what disease is before she attempts to recognise it in individuals. All honest quackery is based upon complete ignorance of pathology—dishonest quackery on the conviction and the hope that the patient is completely ignorant of it also. In studying how to investigate the meaning of symptoms in a patient the best rule is to look at everything and to guess at nothing. In the words of Sir William Gull, "We make many more mistakes by not looking than by not knowing."

It is asserted that the "open-air" treatment for consumption has been attended with much success at the North London Hospital for Consumption, Hampstead Heath, as, out of 183 cases since January last, 43·7 per cent. have left the institution to return to work. It is not stated whether they were "cured."

A fatal result attended the trial on Saturday last of a new "flying machine" in a field at Stanford Hall, the seat of Lord Braye, near Market Harborough. The contrivance is the invention of Mr. Percy S. Pilcher, who has for a considerable time been making experiments with the object of devising such a machine. It appears that Mr. Pilcher had given several years to the study of flying machines, and had from personal acquaintance with Mr. Hiram Maxim so realised the difficulties to be overcome that he manufactured a machine on the lines of that designed by Herr Lilienthal as being, in his opinion, the nearest to perfection. The machine, with which he had previously made several successful ascents, resembled a great eagle. The two wings were covered by about 170ft. of cloth, and the tail, or rudder, with its sails, was fixed about 2ft. from the main body of the machine. The frame itself consisted of bamboo, with wires like the ribs of an umbrella. The weather on Saturday was most unfavourable for such a trial. Rain fell heavily up to 2 p.m., and gusty winds followed. After several ineffectual attempts to start, a signal was given about twenty minutes past four, and Mr. Pilcher rose slowly in the machine until he had travelled about 150 yards and had risen to a height of about 50ft. or 60ft. Then a sharp gust of wind came, and the tail of the apparatus snapped. Instantly the machine turned completely over and fell to the earth, Mr. Pilcher being underneath the wreckage. As will have been seen in the newspapers, Mr. Pilcher, unfortunately, succumbed to his injuries.

The veteran aëronaut Mr. Henry Coxwell, writing to *The Times*, says that balloons have their tender and vulnerable parts, and that they may be destroyed by marksmen who know how and where to strike with precision. He says:—"If the officers who have been sent out to South Africa with the aëronautical section should rely with undue confidence upon the safety of their balloons against 'rifle fire and field artillery,' I beg to remind them that one war balloon at Santiago was brought down by the splinters from shrapnel, and that holes made by bullets may, under certain conditions, cause a hasty descent, though I freely admit that it depends entirely upon where the envelope is perforated. To my mind, after an aëronautical experience of nearly 60 years, the risks to be encountered over the heads of sharpshooters who may be provided with suitable weapons, having ample swing, exact elevation indicators, and perhaps a ripping long-range messenger to send forth for destructive objects, should not be lightly pooh-poohed because dynamite shells in mock battle on a trial drop should have reached the ground with terrible effect."

The buoy which was found recently, and was believed to be the "North Pole buoy" to be dropped by Andrée as he passed over or near the North Pole, was examined at Stockholm, but nothing definite was learned. According to a Reuter telegram, "At the examination of the buoy Capt. Svedenborg, who was present at the ascent of the balloon, stated that the ring of the buoy did not seem to be made fast. The buoy, therefore, could not have been let down by means of a cord. The buoy was then opened. First of all the copper cover fixed to the rim underneath the buoy was sawn off, and some sea sand fell out. A copper head, with a tube of the same material attached, was then taken out. Inside this was some water. The copper tube was then sawn off. In the lower part of the tube was an indiarubber plug, and on it a little sand. Inside the tube was a coating which seemed to resemble paper, but which a microscopical examination showed to be growth of algæ. Prof. Nathorst declared that the buoy could not have been carried from the Pole to King Charles Island. Capt. Svedenborg expressed the opinion that the buoy had been thrown out empty. Prof. Montelius said it had not been shown that the buoy had been thrown out empty. Prof. Nordenskjold said that a search would be made next year at King Charles Island." It appears from further telegrams that the substance "resembling paper" proved to be algæ.

Another wonderful discovery is reported from Vienna—this time in connection with rapid telegraphy. It is asserted that the new apparatus—the invention of two Hungarian engineers—will send over twenty words a second, and it is further asserted that in the presence of the representatives of the German Ministry of Commerce and others, a number of telegrams were exchanged between Budapest and Berlin, and it was found that the average rate of wiring with the new apparatus was 22 words per second, giving 1,320 per minute, and over 79,000 per hour. The new apparatus is a marvel of ingenuity. The messages are first perforated on a slip of paper by a kind of typewriting machine. These signs are then transmitted at lightning speed over the wires and received as a photogram at the other end, where they can be read and prepared for delivery with the utmost ease and celerity. The inventors, Messrs. Pollak and Virag, have, it is asserted, made a discovery which will produce many changes in telegraphy. Instead of forests of telegraph lines now seen stretching in all directions, one single wire between each station will amply suffice for the most pressing emergency. Blocking of lines will cease, while the cost of telegraphic service will be considerably reduced. It will be advisable to take this item of news with an "open mind." Further experiments are to be made soon between Budapest and Vienna.

A rather important memoir has been presented to the Paris Academy of Sciences by M. Considère. It is important to engineers, architects, and builders, and refers to experiments on the variations in volume of Portland cement resulting during the setting. The expansion of prisms of cement were studied by M. Considère for two months, comparisons being made between loaded and unloaded prisms whilst under water. It was found that the expansion increased regularly, but were much less with mixtures of cement and sand than with pure cement.

Electric signalling on railways seems to have been developed in America if the following statement is true. It is stated that the signalling on the whole of the Pennsylvania railroad system is now operated electrically. When a train passes a signal bridge it closes an electric circuit which moves a signal semaphore to the "danger" position. When the train passes beyond the next bridge a circuit is opened and the signal indicates that the block from which the train has just passed is clear. Finally, when the train passes beyond the third bridge, another signal arm on the same post drops, showing the driver of an approaching train that there is nothing on the next two blocks ahead. It is not stated, however, whether signalmen are dispensed with altogether. The idea is comparatively old, but the details have not been explained.

The new International Code of Signals for use by the mercantile marine will come into use shortly—that is, if owners and masters of vessels will adopt it and use it. An official of the Board of Trade is reported as saying that a "code on the Morse system, for the use of ship-masters who may desire to signal at night, is embodied in the new book of 'International Signals,' which will presently come into use. The adoption of the system will be purely optional, and it will rest with owners to say whether their ships shall be fitted with the necessary appliances or not. A special knowledge of the Morse principle will, of course, be necessary, and it does not follow that those who control the signalling stations of the coast will adopt the suggestion. With a general use of such a code at night the advantage would, I am sure, be very great, especially as a means of warning vessels against impending danger."

It is announced that the Bristol Docks Committee intend to recommend a dock extension scheme to the City Council which, if carried out, will enable the largest steamers to enter Portishead.

The French Minister of Marine has signed an order for the immediate construction of four new submarine boats at Rochefort on a new plan which is not that of the *Narval*. There will be no effort to multiply vessels of the *Narval* type until entirely conclusive results have been obtained from the trial of that boat. The plans of the vessels, which will be named *Farfadet*, *Gnome*, *Korrigan*, and *Lutin*, have been prepared by M. Maugras, first-class naval engineer. The *Journal's* Toulon correspondent telegraphs that M. Goubet hopes to make preliminary trials shortly in deep water with a submarine boat propelled by oars alone without the use of electric power. By this primitive means he expects to obtain a speed of four knots.

USEFUL AND SCIENTIFIC NOTES.

It is stated that the use of steel ties for experimental purposes on the New York Central Railroad has not given satisfactory results. They are durable, but are hard to line; the ballast shakes away from them, and they give a rattling sound from the stone ballast and from the bolts. Some are said to have proved so unsatisfactory that they are now being removed and replaced with oak ties.

The yield of rubber trees has been estimated by experts to be as high as 3lb. yearly from the sixth year. A leading authority does not consider that trees should be tapped before their ninth year, and says that 1lb. of rubber, say 2½lb. to 3lb. of milk, is a good annual yield. The milk may be extracted twice each year, during the rainy season, about two months after its commencement, and again towards its close, the best time being when the tree has dropped its leaves, and when the sap is most abundant and active.

Prize for Life-Saving Apparatus.—The Board of Trade have been informed by the Foreign Office that a prize of 100,000fr. has been founded by the heirs of the late Mr. Anthony Pollok, of Washington, to be awarded during the Universal Exhibition, Paris, 1900, to the inventor of the best apparatus for the saving of life in cases of maritime disaster. The prize is open to universal competition. This sum is now in deposit with the American Security and Trust Company of Washington, D.C., and will be paid over to the successful competitor when a decision shall have been rendered by an appointed jury and formally communicated to the Secretary of State of the United States through the Commissioner-General of the United States to the International Exhibition of 1900. The juror selected on behalf of the Government of the United States is Lieut. William S. Sims, U.S.N., Naval Attaché of the Embassy of the United States at Paris. In considering the award the jury will be governed by the following conditions:—(1) The total amount of the prize may be awarded to a single individual on condition that the invention is of sufficient practical value and importance to justify the proposed award; (2) should several persons enter inventions of equal value, the jury, as it shall consider right and just, may award a portion of the prize to each; (3) should none of the inventions entered be of sufficient value to entitle it to the prize, the jury may reject any and all of them, but at the same time shall be empowered to indemnify competing inventors in such amounts as may be deemed advisable. The instructions to competitors will be issued in due course by the jury, with the sanction and approval of the authorities of the French Exhibition. These will be distributed upon application. Correspondence, however, may be addressed to the members of the jury at Paris, or to Mr. Charles J. Bell, president of the American Security and Trust Company, No. 1,405, G-street, Washington, District of Columbia, U.S.A.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE REPORT OF THE SAVILIAN PROFESSOR FOR 1898—THE GREAT GLOBE AT SWANAGE—THE AGE OF THE EARTH—LUNAR CRATER NEAR TIMOCHARIS—STAR MAGNITUDES—THE TELESCOPE—THE DIPLEIDOSCOPE—POETRY OR PHYSICAL FACT?—THE DELUGE—THE MOSAICAL DAY—LIGHT (AND DARKNESS?) IN A NEBULA—THE "AUTHORITY" OF THE ROYAL ASTRONOMICAL SOCIETY—BICYCLES AND PERAMBULATORS—THE NINTH SATELLITE (?) OF SATURN.

[42896.]—The annual report of the Savilian Professor to the Visitors of the University Observatory at Oxford follows on somewhat familiar lines, the measurement and reduction of the plates for the Astrographic Catalogue constituting its most prominent feature—586 plates out of the 1,180 required have been measured, and 525 of them completely reduced. Incidentally I may remark that Prof. Turner has found that he sometimes gets between 300 and 400 stars on a plate 2° × 2° with only 20 seconds exposure, and that with three minutes exposure in the region of this area, whose centre was in R.A. 19h. 43m. and 29° North Declination, no less than 2,440 stars were measured. To avoid having an unnecessary number of stars on the plate, it has been found necessary to reduce the time of exposure. As the result of the laborious investigations carried out by Prof. E. C. Pickering, of Harvard, it has been found that with a photographic doublet lens large fields are obtainable sensibly free from optical distortion. This being so, the Savilian Professor regards the scheme of the Astrographic Chart with its hours' exposure of plates embracing regions only 2° by 2°, is more or less a waste of time and labour, and has indefinitely postponed the taking of these long-exposure plates. The rest of the report may be summarised by saying that the great dome is so leaky that it is to be replaced by a new one costing £440, and that Prof. Turner continues to insist on the urgent necessity for a residence at the Observatory. One reason given for this is its unprotected state; in illustration of which it is mentioned that several windows have been broken by bullets from catapults. Whether undergraduates are suspected of this gross misuse of an ancient weapon, or whether it is supposed to be the work of the ubiquitous British boy, is not mentioned. In conclusion, I must not omit to mention the valuable addition to the Observatory Library, in the shape of the books of the late Mr. George Knott, F.R.A.S., which have been aquired from his executors.

Can any brother-correspondent furnish me with information concerning the great globe at Swanage? A friend of mine has sent me a photograph of it, unaccompanied, however, by any details or explanation. From certain data cut on a slab on a wall in front of it, it would seem to have been erected for some astronomical purpose, and hence I am curious to know its history, and the specific object for which it was constructed.

As I can scarcely be accused of any disposition to depreciate or undervalue mathematics, I have no hesitation in expressing my gratification at the direct way in which Sir Archibald Geikie has joined issue with Lord Kelvin in his admirable address on Geology delivered at the meeting of the British Association at Dover. As I have had occasion to remark before in these columns, too many people are apt to imagine that because the equations of a great mathematician are irrefragable, that hence the conclusions which they were framed to establish must be equally indisputable, wholly ignoring the fact that *everything depends upon the soundness of the data on which they are founded.* Viewed in this light, and considering our curious ignorance of the solar temperature and of the rate and method of the sun's cooling, Lord Kelvin's calculations, however elaborate and ingenious, seem very little better than worthless as furnishing a categorical determination of, or even probable guess at, the real age of the earth.

As I am far away from my own home and observatory, I am in no position at present to reply to "R. P." (letter 42839, p. 134) on the question as to the existence of his small crater near Timocharis. I will look for it on my return.

As by "the greatest magnitude star" I presume that "Silverplume" (letter 42840, p. 134) means the smallest star visible in his 2·85in. achromatic. I may say that he ought to be able, with a power of 120 or upwards, to glimpse, by fits, on a moonless night, a star of the 11·5 magnitude. For the reason given in my previous paragraph, I cannot furnish him with such a list of stars as he asks for, but can only supply one of a few of the brighter ones. Of the first magnitude Aldebaran and Altair, β Geminorum, 1·1; Regulus, 1·4; α Persei, γ Orionis, and β Tauri, all 1·9; α Arietis, 2; ζ Orionis, γ Geminorum, and α Hydræ, 2; Polaris, γ^1 Andromedæ, and κ Orionis, 2·2; β Cassiopeiæ, and η Canis Majoris, 2·4; α Ceti and α Leporis, 2·7; γ Pegasi, γ^2 Ceti, η Tauri, and ϵ Persei, 3·0; β Trianguli, γ Persei, and ζ Persei, 3·1; δ Andromedæ and ξ Geminorum, 3·4; ι Ceti and ϵ Cassiopeiæ, 3·6; μ Andromedæ and γ Tauri, 3·9; ν Geminorum, 4·0; o Piscium and ξ^1 Ceti, 4·4; ϵ Piscium, 4·5; δ Piscium, 4·6; 20 Ceti, γ^2 Andromedæ, and 6 Cancri, 5·0; 51 Geminorum, 5·4; 67 Ceti, σ Arietis, and η Cancri, 5·5; ω^1 Tauri, 5·8; 99 Tauri, 3 Cancri, 19 Sextantis, and 55 Leonis, 6·0; 28 Tauri, d^2 Cancri, and p^2 Leonis, 6·2; 3 Arietis, 16 Tauri, A^2 Tauri, 3 Geminorum, 8 Geminorum, and 36 Sextantis, 6·5; 83 Cancri, 6·6; 11 Tauri, 35 Virginis, and 94 Virginis, 6·7; γ^1 Ceti, 6·8; 34 Sextantis, 7·7. This is as far as I can carry the matter in the absence of the "Harvard Photometry," which, of course, I have not with me here. As I have spoken of Aldebaran and Altair as being of the *first* magnitude, I may just add that stars brighter than the two mentioned have fractional magnitudes assigned to them. Thus Arcturus is said to be of the 0·0 magnitude, Capella and Vega both 0·2, Rigel 0·3, and Sirius (the brightest star in the heavens) − 1·4.

I cannot answer query 96684 (on p. 144) for the simple but sufficient reason that I have only the number of the English Mechanic for the current week at the place whence I am writing, and have not the slightest idea what Mr. Clarke's letter (42784) was about.

Certainly "Tempus" (query 96695, p. 144) can obtain the time within two or three seconds with the dipleidoscope—but only at apparent noon on a sunny day.

I scarcely remember a more disingenuous disputant than Mr. Garbett (vide letter 42875, p. 158). My reference was to Psalm cxiv. 3 and 4; in the latter of which we read: "The mountains skipped like rams, and the little hills like lambs." Now, either this is a statement of physical fact or it is not. "The earthquakes that accompanied the exit of the Israelites from Egypt" have their existence in the imagination of your correspondent only, for assuredly the Bible says not one syllable about them. The evil fashion of making blatant assertions in the hope that their readers will not trouble to check or verify them, is one which cannot be too strongly condemned. Any one must be childishly ignorant of the very rudiments of geology and palæontology, who can believe that bone caves (such for example as Kent's Hole at Torquay) were filled with the remains we find *stratified* in them in a few weeks, months—or, for the matter of that, thousands of years either.

Mr. Rouse, who follows him, in letter 42876, apparently errs through crass ignorance alone. Whom does he expect to believe that the shells found at an altitude of 15,000ft. on the Pamir Mountains were deposited by the legendary Noachian Deluge? And how does he correlate the alleged salvation of one man and his wife, that of the seven men and seven women, the re-creation of both men and brutes by Nanabusha, &c., with the tradition preserved in Genesis? But I must do him the credit of admitting that he simply errs apparently from knowing nothing whatever of science, natural or physical.

Mr. Hardy (letter 42877, p. 159) may rest assured that the compiler of the story from the account or accounts of the Elohistic and Jehovistic narratives of the Creation which have come down to us in Genesis, believed that the visible universe was created in seven literal days of 24 hours each, and that that narrative was not left to deceive mankind until Mr. H. was raised up at the end of the 19th century to reveal its nature and true significance to mankind. Why, I thought that we were commanded to rest on the seventh day, specifically because "in six days the Lord made heaven and earth, and rested on the seventh day." If this was Mr. Hardy's "cosmic" one, I can only complain that I, for one, have failed to enjoy so long a period of rest, and alas! how many poor creatures there are who would have been only too thankful for it!

It would be a mere waste of time to notice letter 42878, p. 159, further than to say, in connection with its concluding paragraph, that if, as is practically certain, the new star which appeared in the Great Nebula in Andromeda in 1884 was immersed in the nebula, it would enjoy a perpetual light of vastly inferior brilliance to that of its own self-luminosity, and not have any evenings at all.

In Mr. Wood's letter (42895) on "The Mistakes of Authorities," on p. 163, he refers to "An example. . . . . furnished in the *Monthly Notices* of the Royal Astronomical Society, Vol. LVII. p. 73." But as he does not give the slightest hint as to the nature and character of this example, and I have no means of access to the R.A.S. publications at the place whence I am writing, this conveys little or nothing to my mind. When, however, your correspondent talks of "errors possibly sanctioned by that learned body," it may be as well to inform him that the authors of papers which appear in our *Monthly Notices* and *Memoirs* are alone responsible for any statements they may contain, and that the Society *quâ* Society does *not* sanction officially either their statements of fact or possible mistakes. By the bye, a sentence seems to have dropped out of Mr. Wood's communication altogether; for in the sentence beginning: "In *Nature*, Vol. V. p. 422," he speaks of "Observations pertaining to this subject." What subject?

I may tell "Rota" (query 96759, p. 168) that legally perambulators have no more right on a footpath than bicycles, both being wheeled carriages, but that the police wink at their presence. The Highway Act contains the information your querist needs. I have before now invoked the aid of the police to remove a perambulator when the footpath has been obstructed by two of them being driven abreast.

It happened, oddly, that a very short time since, an old friend of mine, a well-known astronomer, in writing to me, asked substantially the same question as that put by Mr. Hindawser (in query 96773) on p. 169; but I could only tell him as I now tell my querist, that from the day that the announcement of the alleged discovery of a ninth satellite to Saturn was made down to the instant of this present writing, I have heard nothing whatever more about it. If my memory serves me, its discoverer pronounced that it must either be a ninth attendant on the ringed planet—or something else; the former for choice. Dickens speaks of "Theatrical stars, who come out—and go in again," an example, apparently, followed by "Phœbe."

A Fellow of the Royal Astronomical Society.

α LYRÆ: TO MESSRS. ESPIN AND ELLISON.—ϵ LYRÆ.—LIGHT POINTS ON THE MARE CRISIUM: TO MR. GOODACRE.

[42897.]—May I, as a small telescopist, express my gratitude to Mr. Espin for his interesting data and diagrams about α and ϵ Lyræ in his letter No. 42873? These objects are beautifully situated just now for the amateur's evening hours, and the information so kindly tendered by Mr. Espin is just what I wanted, in common, no doubt, with many other owners of small telescopes. Though with apertures much below 4in. we can hardly follow him into the regions of the Debilissima, yet the other objects are not out of our reach, as I can assert from my own experiences, for on Sept. 27, about 10 p.m., when the air was beautifully clear after the thunder-shower which had passed over London, I succeeded in distinctly glimpsing the companion to Vega with power 50 of my 3¼in. Gregorian by Short, making sure about it by estimating its P.A. and distance exactly as now given by Mr. Espin, without any previous knowledge of its whereabouts whatsoever; and on Sept. 30 I glimpsed it again with the same power. This I owe to an excellent advice most kindly given me by Mr. Ellison—viz., to use low powers for faint *comites* to bright stars. In the same way I have now succeeded in seeing the companion to Polaris, though before it resisted all attempts with high powers. I am sure I have Mr. Ellison's sanction in repeating his most useful hint for the benefit of others, knowing what a delight this amiable and experienced observer takes in assisting students with inferior instrumental means.

As regards the other object dealt with by Mr. Espin, ϵ Lyræ, the two doubles must certainly be within reach of small achromatics, as my Gregorian divides them both neatly. The 10th-mag. star between them, not depicted by Mr. Espin, is conspicuous, but of the Debilissima I have as yet seen none. The mystery surrounding the supposed fainter *comites* of Vega, *seen* by so many experienced observers in common with Mr. Ellison, and *not* seen by equally great observers in common with Mr. Espin, seems very fascinating. My further enlightenment on this subject will, I am sure, interest all who delight in gazing at that incomparably beautiful sun "Vega."

I should like to take this opportunity of asking Mr. Goodacre, or anyone else, for kind information about the following observation on the moon. On Aug. 22, at about 10 p.m., 1½ day after full moon,

I noticed, in very clear air and with p. 135, on the southern part of the Mare Crisium, a number of faint points of light, perhaps a dozen or more. On looking more intently, these points appeared to be crossings or bends of still fainter lines of light, running parallel and cutting one another in almost regular rhombs. They were plainest in the south-eastern part, gradually dying away towards west, and not visible northwards of Picard. Any explanation will be gratefully received.

C. H. Stielow.

THE GROUP ε LYRÆ.

[42898.]—The Rev. T. E. Espin will find a diagram of this group, accompanied by an exhaustive historical account up to that date, in the *Observatory* for Dec. 1880, by the late Mr. Henry Pratt, of Brighton, and Mr. J. Gledhill, of Bermerside. Two of the stars shown in Mr. Espin's diagram, preceding the Debilissima, appear to be Lamont's stars, marked H and I in Mr. Pratt's diagram, in which there are also some stars following the Debilissima that seem to be missed by Mr. Espin, one of them (H) being seen by the late Mr. H. Sadler and myself independently.

Belfast, Sept. 30. Isaac W. Ward.

[42899.]—In the *Astronomical Register* for December, 1864, is a drawing of this group by Dawes, which agrees very fairly with that of Mr. Espin. It represents the group as seen at Admiral Smyth's Observatory (apparently) in 1833. In Mr. Dawes' drawing a star is given north preceding Mr. Espin's No. 5, which is not in Mr. Espin's sketch. The rest of his stars correspond with Mr. Espin's. There is a sketch by A. Hall in Chambers' "Handbook," 4th ed. Vol. III. p. 42, which differs somewhat from both. R. J. Ryle.

VARIABLE STAR OBSERVATIONS, SEPTEMBER, 1899.

[42900.]—T Cassiopeiæ has been declining for the last five months, and is now nearly at minimum brightness. It was observed 11·3 magnitude, September 27.

R Aurigæ. This star has gone down more than five magnitudes in four months. The light curve being very regular, on September 28 it was 12·4 magnitude, and for the next two or three months will be a very faint and difficult object. The minimum will probably occur in November.

T Aurigæ. The place of this variable is again coming into a convenient position for observation. It was looked for on September 26, and no trace of the star could be seen, though the air was very clear. On February 12, 1892, this star was 3 6 magnitude, and now it has completely disappeared.

S Coronæ has gone down about four magnitudes during the last seven months, and was 11·8 magnitude September 26. It was small, faint, but well defined, and is getting toward a minimum.

R Ursæ Minoris has of late been unusually faint, and was 10·4 magnitude on September 26—this is the faintest record since observations began, Nov., 1891. The entire light-range of this star is less than two magnitudes.

T Draconis passed a maximum, 8 0 magnitude, August 16. The interval since the previous maximum, July 2, 1898, is 410 days.

S Cygni having now been invisible for five months, the reappearance may be looked for during October.

Instrument in use 6·4in. equatorial refractor. Weather has continued favourable, and observations been made on sixteen nights. C. E. Peek.

Rousdon Observatory, Lyme Regis.

THUNDERSTORMS.

[42901.]—Noticing some letters in "Ours" recently relating to lightning phenomena, I think that perhaps the following may interest your readers.

During a thunderstorm which occurred one day in August of last year, a gamekeeper took shelter in a cart-shed adjoining some other farm buildings situated upon the top of a hill in the parish of High Beckington, N. Devon. At a distance of about 15 yards, and under the spreading branches of a tall elm-tree, a number of fowls were clustered together, sheltered by a bank and some elder-bushes. The keeper was looking at the poultry, when a vivid flash of lightning occurred, followed instantly by a crash of thunder. Simultaneously he received an electric shock, which he describes as "though someone had struck him violently over the knees." He then noticed that two of the fowls were lying dead upon the ground, and several others a few feet distant were seen to "spin round and round and flutter on the ground"; but they speedily recovered. That evening I had the unique experience of dining off a pair of fowls killed by lightning.

I visited the scene immediately after the storm, and what struck me as remarkable—knowing that an electric discharge always follows the line of least resistance—was that neither the elm-tree nor the adjacent buildings were struck, and that the fowls were killed beneath foliage which escaped injury. Singed feathers upon the dead birds marked the course of the electric discharge.

Could this have been a secondary discharge due to induction, the primary flash occurring between clouds immediately overhead?

R. Greenwood Penny.

[42902.]—There was a thunderstorm here (Dublin) on the afternoon of the 30th ult. I noticed while watching the lightning that the smoke from the chimneys was crossing the street in the opposite direction from the clouds. After a time there was a change in the direction of the smoke, which seemed to move in the same direction as the clouds. On this change the thunderstorm ceased, except for one long peal several minutes later. I shall be glad to know if anything similar has been noticed elsewhere. W. H. S. Monck.

ABSOLUTE ZERO OF TEMPERATURE.

[42903.]—There have been numerous references to the above in letters lately, and the arguments supposed to establish the existence of the zero have been put forward more or less completely. Now, I ask, is an absolute zero conceivable? Can we possibly imagine such a degree of cold that it can be no colder? I contend that it is as impossible as to conceive of time, a time before which was no time at all. Has anyone gone to the other extreme and put a limit, or fixed an *absolute maximum* of heat? It would seem quite as logical. "J. M. W." (letter 42894, p. 162) says the absolute zero can be looked upon "as a point where all motion of the molecules and atoms ceases," and goes on to say "and consequently as a temperature below which we cannot go." Does this follow as a consequence at all? I cannot see the connection. Would it not be as truthful to say that at a temperature of so and so everything with which we are acquainted exists in a state of gas, *therefore, nothing can be one degree hotter?* "Fahrenheit" based his thermometric scale on a supposed absolute zero, bringing it into a good deal of ridicule, and making it meaningless. Will not the same fate overtake those who assume the latest "zero," found a scale upon it, and say that ice melts at 273·14 "absolute"?

Perhaps it is my obtuseness that prompts these questions, or it may be that a "little knowledge, &c.," according to the old saying; but may I ask if this latest theory bears examination, and satisfies such men as your correspondents "F.R.A.S." or W. H. S. Monck? F. J. G.

GENIUS AND HEREDITY.

[42904.]—On p. 152, Prof. Axenfeld's theory that all men of genius are first-born sons is mentioned; and the list of great names which follows seems to afford great corroboration. On testing the hypothesis, however, one finds it somewhat delusive, for many eminent men have not enjoyed the advantages of primogeniture. Thus, amongst those who were not, I think, the eldest sons were Dalhousie, Clarendon, the Pitts, Walpole, Wilberforce, Gladstone, Bach, Bellini, Mozart, Cherubini, Wagner, Schubert, Calvin, Butler, Taylor, Milman, Chateaubriand, North, Montaigne, Beaumont, De Quincey, Coleridge, Scott, Boyle, Humboldt, Bacon, Franklin, Thackeray, Sheridan, Tennyson, Van Dyck, Rembrandt, Sherman, Washington, Wallace, Peter the Great, Wellington, and Napoleon I. Indeed, it appears to me that the hypothesis would be quite untenable were it not that men of genius who never had any brothers or sisters are included amongst the "first-born." One is obliged to admit, however, that these other children must have been nonentities, because they weren't even born.

J. Dormer.

THE RAT AS A PROPAGATOR OF DISEASE.

[42905.]—When the Health Officer of Manchester recently proposed, as a precaution against plague being introduced by means of vessels from the Mediterranean, that rats should be extirpated, the proposal was in certain quarters derided. These attempts to ridicule the suggestion do not, however, seem to have found an echo in Bombay, where the evidence in favour of what may be called the rat theory is regarded as quite unassailable. The subject is referred to in some of the Indian papers to hand by this week's mail, and it is mentioned in support of the Manchester official that in Canton the local authorities paid large rewards for the destruction of these unpleasing rodents, 20,000 of which were as a consequence accumulated outside one gateway alone. I am told by a gentleman who has made a profound study of the plague, and who has intimate personal experience of one of the Bombay epidemics, that no possible doubt can exist as to the mild manner in which the disease first presents itself. There is, it appears, one type of plague known as *Pestis benignans*, the virus of which is not of sufficient strength to endanger human life until a generation of rats has been killed and a generation of men mildly attacked. This is followed by malignant plague, when all but a few of the sufferers are carried off. Then comes the period of decline, the various stages covering in the case of the three Bombay epidemics just thirty weeks—from October to April.

I suppose we are all familiar with the old wives' notion that the advent of rats to a house is the precursor of death? I wonder if superstition in this case, as in so many others, rests on a misunderstood fact? Alec.

TOOL-GRINDING MACHINE.

[42906.]—It is possible this is the only one on the market, and that Mr. Ilsley is an independent inventor. If sold cheaply, it may have a ready sale.

I wish, however, to point out that it appears (to all intents and purposes) in Vol. XX., at p. 21. I made one then in wood, and have used it occasionally during the last 20 years, adding to it a device to prevent the stone wearing through unequal pressure. I now grind entirely by hand, and without guide, unless for slide-rest tools, when I sometimes use the block suggested by "J. K. P." No. 7.

MILLWRIGHT'S WORK.

[42907.]—Figs. 58, 59, and 61 (p. 150) exhibit a defect in design which is only too common. I allude to the bevelled ends of the set-screws.

Though less important, perhaps, for loose collars than when employed to fix work through which power is transmitted, as a matter of principle, the end of a set-screw should always be turned cylindrical for a distance, say, $\frac{1}{16}$th greater than the depth of a corresponding cylindrical hole in the shaft. When properly fitted, there is no tendency to wedge the screw out as in the common plan, and there is no comparison if, as is sometimes the case, any power has to be transmitted through the screw-point.

Here again, however, would be bad practice: a screw-point should not be used to prevent rotation under such conditions, but merely to prevent sliding, the rotary force being transmitted by a key.

Glatton.

LEVERAGE OF THE LOCOMOTIVE DRIVING-WHEEL.

[42908.]—The last three lines of the article with this title (see p. 154) are incorrect. A locomotive piston is *always* moving in one direction, though at varying velocities, in relation to the ground—including the dead centres. Glatton.

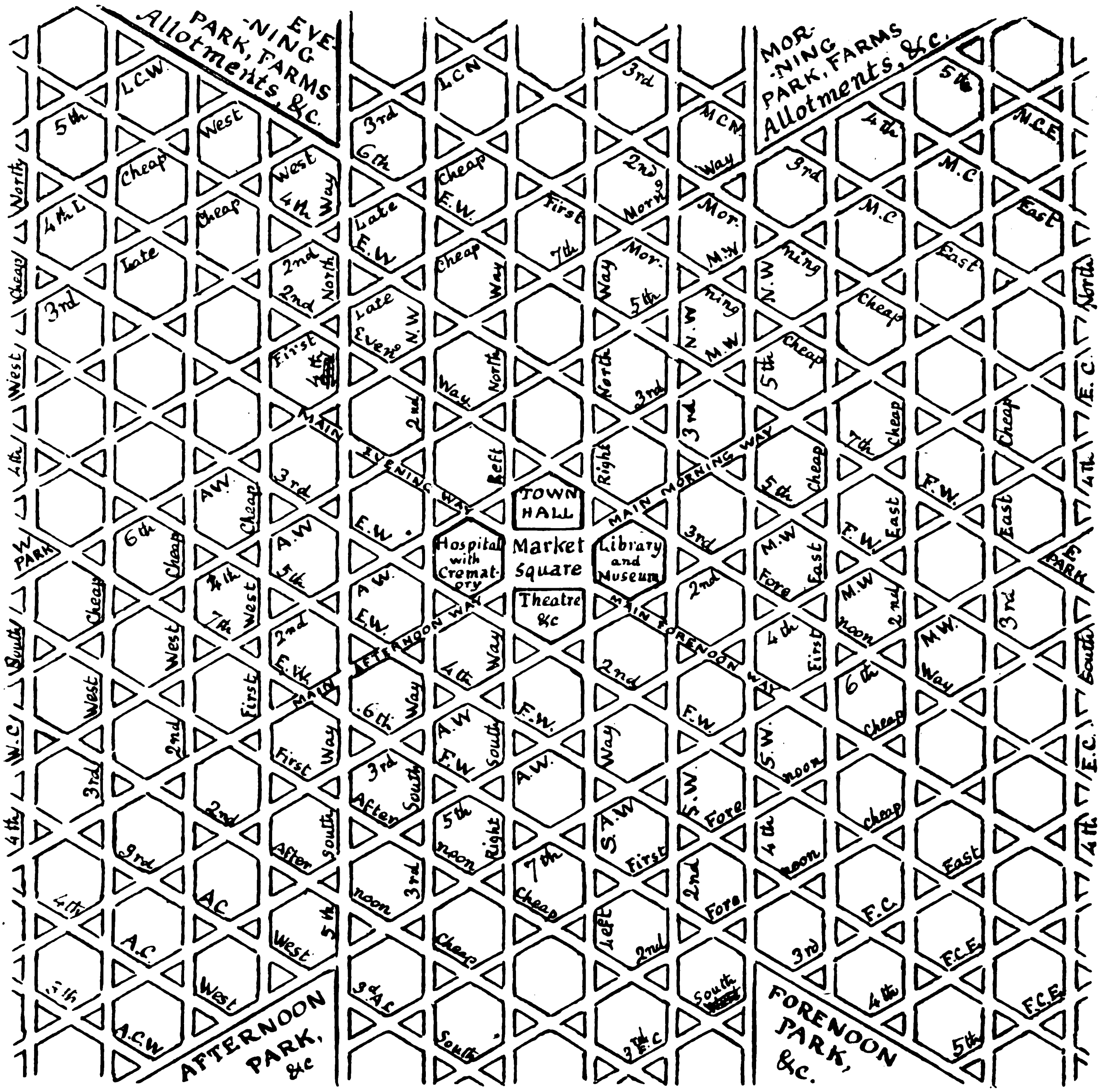
COLE'S BICYCLE BRAKE.

[42909.]—Please allow me to thank Mr. Burton for his expression of approval of my bicycle brake, and for his kind suggestion of improvement. I cannot, however, say that it commends itself to the judgment of The Inventor.

IMPROVEMENT OF HOWARD'S "GARDEN CITY."

[42910.]—Mr. Edward Howard's book called "To-morrow" gives a scheme for purchasing about 6,000 acres of land, and building on 1,000 of them a model city for 32,000 people, which is never to increase, but be confined to a circle of 2,480 yards diameter. A railway incloses this circle, and immediately within it are sites for factories, about 50 yards deep and above four miles long. Within them the dwellings form a town about half a mile deep, surrounding a park of 145 acres. In the very centre of all are six detached buildings, not planned but marked town-hall, concert-hall, library, museum, theatre, and hospital. They are thus far removed from the town, but six roads called *boulevards* lead from their centre to its railway boundary. Five circular *avenues* cross them, and there are 12 minor *roads* and 18 *streets*, cutting up the dwellings into blocks of some 8 or 10 acres apiece. The two boulevards shown are named after Columbus and Newton; the two roads after Shakespere and Milton; and the three streets after Kelvin, Edison, and Froebel.

To the whole arrangement of the city, thus turned inside outward, and to the naming and all details, I have the strongest objections, and submit a widely different plan. Any railways or canals ought, I think, to run *through* the city instead of *round* it. They should be in its thoroughfares, of which he really plans only three. If its size be as unalterable as an old fortified city, the public buildings would be better on the six gates of entry; but I think limited cities are of the past, and that modern ones should be free to expand. The parks should be outside, between the expanding arms, which may very well be six in number, the town being not allowed to spread in all directions, but only like a six-rayed star. Then the thoroughfares should be universal, every road extending all through. But I oppose every curved road, making all rooms wedge-shaped as in our "crescents." Circular streets were never



in any old city, I believe; and Victoria-street, Westminster, was planned circular, but reduced in building to two straight lines. If roads were only straight, and in only two directions, as in most American towns, an obvious improvement, making them a "Garden City," would arise if we think the chequers coloured like a chessboard, and then take up the white and place them on the black squares, leaving the white mere gardens, and giving every house the benefit that those in London squares have now. This would specially improve those towns, whose streets run to the sub-cardinal points, as Boulogne and some few English towns on the old Watling-street and Fosse Way. Fronts looking north-east and north-west get the sun every day, even in mid-winter. But most English cities have been led by their large churches to face near the cardnai points, so that the north fronts get no sun in the winter half-year. They do not front mathematically to the cardinal points, though the ancients saw the advantage of this, for Silchester is oriented exactly.

But the advantage of turning an angle northward applies to blocks of any form, therefore to hexagons when the roads have three directions. Hence one of these three ought to be meridional, and the others inclined 60° thereto. The two north faces thus escape indeed any sun in December and part of January, but still have all the sun that roads in three directions allow. We thus exclude east and west roads in our latitudes—that is, the colder half of the world. I am not speaking here of the warmer half, or latitudes below 30°, as very different rules would there apply; but here the general direction of buildings' lengths should be meridional, each face getting sun half the day at all seasons. Roads crossing then at angles of 60° leave only two forms of blocks, hexagons and trigons. Now every smaller block or trigon I would make only garden. If its sides be 225ft., the perpendicular may be called 195ft., and the area over half-an-area. Surround this with roads of 52ft. I take multiples of 13 because they so nearly approximate the perpendicular to a trigon of 15. The hexagon for building has then sides of 285, a width approximating 494, and area nearly five acres. If railways enter the town, the roads containing them might be 65ft., adding 13ft. for them, or for canals 26ft.; otherwise I hold 52ft. ample for each road, with footways and sunk front area to the building, which is never on both sides. Having said why a town should grow unlimitedly, but only in six directions, the north and south rays have an even number of roads, or an odd one of hexagon blocks. I have drawn them only five, but the other rays six.

In the centre, two trigons are absorbed in a rectangular market square, of 598ft. by 345ft.; but if canals entered, they might here form a tank. The portions of hexagons, north and south, of near four acres, are for the town hall and the theatre, the latter having room also for baths and wash-houses. The whole hexagons east and west are for a library and museum one side, and hospital with crematory on the other. A model city can have no burials. The four adjoining trigons can be covered as markets, or bazaars if an Asiatic plan is adopted.

The naming of roads is of primary importance, the modes now prevalent in Europe being mischievous. Streets in Paris are named after great Frenchmen, and occasionally even foreigners, as Columbus and Newton. In London we can only substitute huge landlords, their country estates, usurious employers, or even great rascals as Roupel and Paul. Mr. Howard would imitate the Parisian mode, but such names as Newton-boulevard, Shakespeare-avenue, and Milton-street give nobody the least hint where to find them. My notion is that an address should enable a citizen with a map before him to put his finger on the spot. As we have no streets—that is, carriageways between buildings—we have to exclude that name. Roads that lead out towards other towns I would call *ways*, and name their six directions as North, Morning, Forenoon, South, Afternoon, and Evening as leading towards the sun at those hours. The central Morning, Forenoon, Afternoon, and Evening ways are called main; those to the right of them 2nd, 4th, and 6th; to the left 3rd, 5th, 7th. As there are two main North and South ways, they are called Right and Left.

Now another name than Way is needed for the roads that terminate in Parks. The Saxon word *Cheap*, meaning a market, has named many towns, and two London streets. We might name those eastward, 1st, 2nd, 3rd, &c., East Cheaps; those westward, 1st, 2nd, &c., West Cheap. Those toward the Morning, Forenoon, and Afternoon parks I would call Morning, Forenoon, and Afternoon Cheaps; but as Evening Cheap would have the initials of East Cheap, I prefer to call them *Late* Cheaps. Every road is now named, and with different initials, except the bits connecting north and south ways between the main ways. These we might call Long and Short East and Long and Short West. The East and West Cheaps beyond the second are divided by the parks into North and South. Similarly the Morning cheaps, beyond the third, are divided into North and East; the forenoon ones into East and South; the Afternoon into

South and West; and the Lite cheaps into West and north

Though we have no carriage streets, or ways between buildings, each hexagon, having all its inner buildings meridional, the courts for lighting them may resemble footway streets, entered at their north and south ends. This will be so at least where the hexagon consists of dwellings, not of factories. Those adjoining the main ways, that have railway or canal, will be factories. Where there are schools, these courts will serve as playgrounds. Now it becomes important to limit the heights of buildings, except at the six corners, which might be allowed any height as towers. Round any court, we might allow once and a half its width; but the north end higher, and the south limited always to 10ft. The four outer fronts of a hexagon, looking east, west, and north might be allowed 30ft.; but the bits blocking the south ends only 10ft. The backs of these would then be the only walls getting no sun.

Sept. 29. E. L. Garbett.

USEFUL AND SCIENTIFIC NOTES.

To produce 1lb. of ice requires an amount of energy equal to about 4¾ tons lifted 10ft. high.

IN France cement has been employed for years past in the protection of iron railway bridges from the fumes of locomotives. In Austria a protective wash made with Portland cement and a small proportion of sharp sand is used.

Igniting a Jet of Hydrogen.—C. G. Hopkins describes a method by which a jet of recently generated hydrogen can be ignited with absolute safety and without loss of time. As soon as the action begins, collect the escaping gas in a test-tube, and, when the latter is thought to be full of pure gas, remove it 2ft. or 3ft. from the generator, and ignite the hydrogen in it; then immediately attempt to light the jet of hydrogen with the hydrogen flame contained in the test-tube. If the gas is explosive, it will explode in the test-tube, and leave no flame. If, on the other hand, a flame remains in the test-tube with which the jet can be ignited, it is certain that the gas in the generator is no longer explosive. By adopting the precaution, therefore, of never lighting the hydrogen jet except with the hydrogen flame obtained as described above, absolute safety can be insured. Attempts may be made to ignite the jet by this method as often as thought proper, and if the hydrogen is properly generated, the gas will be ignited in less than a minute.—*Journ. Am. Chem. Society.*

Bacteria as Destroyers of Masonry.—Bacteriology has shown how we may count alike upon friends and foes amongst the myriads of bacteria known to us. The friendly species, however, are decidedly in the ascendancy, but comparatively few pathogenic organisms having been isolated and recognised. Recent researches have shown how important is the *rôle* of the bacterium in many industrial processes, especially where the production of articles of food is concerned. Ascertained facts would seem to teach that bacteria after all may serve us as tiny engineers who can perform stupendous work when associated in myriads so long as they are placed under a favourable environment. The disposal of sewage by purely bacterial agencies, which under suitable conditions convert an offensive material into simpler and innocuous materials, is perhaps the best case in point. But the disintegrating action of bacteria, though perhaps an indirect one, must, according to recent observations, be reckoned with as a source of mischief. At first sight it would seem hardly possible for bacteria to be concerned in the breaking down of a stone wall, yet such would appear to be the case according to some ingenious observations directed to the nature of the decay of cement. The gradual disintegration of the cement-mortar used in water-supply reservoirs is one of the serious troubles met with by water engineers, and a trouble which so far they have not been able to avoid with any measure of practical success. Hitherto this action was supposed to be the result of the solvent property of carbonic acid and other mineral substances commonly present in a water-supply. The cement gradually disintegrates and becomes a kind of mud which slowly detaches itself. This strange process is due to the action of none other that that bacterium known as the nitrifying organism. An examination of the mud shows it to be teeming with these organisms. The organism, however, cannot flourish in the absence of nitrifiable pabulum. In its presence, however, nitrous acid is produced which leads most probably to the disintegration of the cement lining of the water reservoir. The nitrifying organism is the one upon which so much depends in the purification of sewage and effete matters. On this account its growth should be encouraged, and, it is curious, therefore, to find that the organism appears as an objectionable factor in the attempt to supply and store an abundance of pure water for drinking purposes.—*Lancet.*

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96295.]—**Bookcase (U.Q.)**—"Amateur" need not go to the expense of a box made with partitions. Go to a wine-merchant and get a dozen empty champagne cases; cost is generally 4s. 6d. a dozen. These cases are made of willow wood and dovetailed in a rough sort of a way, and are of a very handy size for packing books, and very strong. It is best to remove the wire nails from the lids to replace with screws, as they will serve many times. Then wrap each book up in a newspaper and pack tight. Any empty space, fill with newspaper rolled tight. WILLIAM GATRELL.

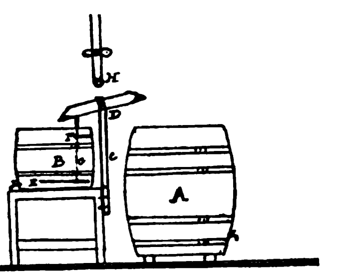
[96297.]—**Reflected Object (U.Q.)**—Put a long-focus convex spectacle-lens at B, and receive the image on a piece of ground glass which has been slightly oiled and rubbed off. But with a ½in. tube this will give a very narrow angle, so it would be best to make a funnel-shaped opening in the wall. To get the objects in focus at different distances you will need to make C movable back and forth. To observe image, either exclude light from room, or hang a black curtain over C and pop your head under as the photographer does.

WILLIAM GATRELL.

[96374.]—**Lamp for Firing Tube Motor.**—This is just the thing I am wanting; but would "Monty" kindly explain method of setting same, running, of course, to burn petrol?

W. E. PITCHER.

[96423.]—**Filtering Rain-Water.**—I inclose a rough sketch of a tilting apparatus as suggested by "M. T.," on p. 118. A is the rain water-butt to contain clean water. B is to collect the first of the rainfall in, which will be contaminated by the dirt of the roof and pipes. To the stand of cask B is secured an upright C, directly under the delivery nozzle H, and to the top of C is fastened a V-shaped holder, in which a V-shaped shoot D is pivoted to deliver the water to either cask. To the inside of



cask B a bracket F is fastened, through which the upright G works, which has at the lower end a float E secured. In dry weather the cask B should be kept almost empty, and then, on rain falling, the supply will first be emptied into B, until the float E automatically tilts the shoot, when the cleaner water will be collected in A. I have not seen the previous notes on this matter, but probably some such method is the one adopted. Of course the quantity B is to contain will depend on the roof surface; shortening G at its upper end will allow for different quantities.

JAS. W. NEWMAN.

[96430.]—**Spots on Negatives (U.Q.)**—They are probably caused by pouring an energetic developer slowly on plate; or perhaps there is a spot on the ruby glass of lamp that is defective; or perhaps a bottle has been interposed between the red light and developing-plate, and so caused the concentrated red light to exert an unequal action on the plate. Adding the accelerator to the developer in the dish, or a warm finger applied to the plate whilst developing would also cause the spots. WILLIAM GATRELL.

[96439.]—**Quadratic.**—The "little boys" referred to by "Ontario" are certainly smart, and the fact that they can easily reduce his equation to a biquadratic suggests the probability of their perceiving that it cannot, for that very reason, be a quadratic at all. They also might be assumed to know (*a*) that $9m^2 - 45$ is not necessarily a square number; (*b*) that its root, even on that assumption, is not necessarily $3x - 3$, for it might be $3x + 3$, or $3x - 5$; (*c*) that the values of m and x obtained from these false premises do not necessarily satisfy the original equation, for we can only affirm that $x = 6$ after testing the equation by it, and not before. The indeterminate equation $a^2 - x - 3 = 0$, which Mr. Donnithorne substitutes for the original, could not lead to any solution other than by trial, and is quite inadmissible. As "Ontario's" friend has not made good his assertion, we must conclude that he has by this time discovered his error.

West Norwood. HENRY T. BURGESS.

[96439.]—**Quadratic.**—"Ontario's" mathematics are not good, although somehow he gets the correct value of m and x. The square root of $9m^2 - 45$ is, algebraically speaking, not $3m - 3$, either with or without a remainder. We require to find the numerical value of $\sqrt{9m^2 - 45}$, which is to be a whole number. This may be put in the form $m\sqrt{9 - \frac{45}{m^2}}$. Now the only square number represented by m^2 which will divide 45 exactly is 9, so that the terms under the radix represent 4, and the whole expression = 6. Suppose, however, that the expression had been $\sqrt{16m^2 - 351}$. This may be put in the form $m\sqrt{16 - \frac{9 \times 39}{m^2}}$. Now if we put $m^2 = 9$, the expression becomes impossible; but it may be put in this form, $\frac{m}{2}\sqrt{16 \times 4 - \frac{4 \times 9 \times 39}{m^2}}$. Now make $m^2 = 36$, and the whole reduces to 15.

Bath. M.I.C.E.

[96503.]—**Shire.**—Generally speaking, the word "shire" is applied to an artificial division of the land for administrative purposes, whilst those counties which do not have this suffix are survivals of petty kingdoms which have not been subdivided.

J. DORMER.

[96555.]—**Equation.**—In my solution, p. 163, I see that the fraction $\frac{182}{945}$ is not in its lowest terms; divide both numbers by 7, which gives $\frac{26}{135}$; using this instead of the other, we get easier numbers to deal with, and the result of the quadratic equation for y will be less unwieldly.

Bath. M. I. C. E.

[96555.]—**Equation.**—I simply suggested to Mr. Harding the easiest mode of obtaining a solution of his equation because the strict algebraical process was extremely involved and irksome. But since he desires the latter, I now give it. Substituting letters for the known quantities, we have—

$$\left.\begin{aligned} a x^2 + b y z &= p \\ b y^2 + c x z &= q \\ c z^2 + d x y &= r \end{aligned}\right\}$$

Put— $$y = m x, \quad z = n x,$$

then— $$x^2 (a + b m n) = p \ldots\ldots\ldots\ldots \text{(i.)}$$

$$x^2 (b m^2 + c n) = q \ldots\ldots\ldots\ldots \text{(ii.)}$$

$$x^2 (c n^2 + d m) = r \ldots\ldots\ldots\ldots \text{(iii.)}$$

From (i.) and (ii.) by division, we get—

$$p (b m^2 + c n) = q (a + b m n)$$

and—

$$n (p c - b m q) = q a - b p m^2.$$

$$\therefore n = (q a - b p m^2) \div (p c - b m q).$$

From (ii.) and (iii.) by division, we get—

$$q (c n^2 + d m) = r (b m^2 + c n).$$

Whence, substituting the above value of n in the last equation, we obtain, after the necessary reduction, a biquadratic in m, from which we at once get n, and therefore x, y, z, since—

$$x = \sqrt{(p \div a + b m n)}.$$

If Mr. Harding experiences any difficulty in solving a biquadratic, I shall be most happy to assist him, but I apprehend this will not be the case.

West Norwood. HENRY T. BURGESS.

[96558.]—**Injector.**—Without entering into special details, it may be explained that the injector works by the steam coming into contact with cold water, when it is condensed and, rushing in to fill the "vacuum" so-called, acquires so much momentum that it forces the water into the boiler against the pressure. It is much the same as trying to pump boiling-hot water. When the plunger in that case makes a sort of vacuum, the hot water does not follow, because it becomes vapour, and fills the pump-barrel, so that the plunger simply works low-pressure steam — not solid water. Query 96634 seems to be of a similar nature; but the question has been answered many times, and is explained in any work on the injector. N. F. J.

[96601.]—**Telescope.**—To magnify 60 times with distinctness and sufficient light, your object-glass must have 60 times the diameter of your pupil—say, 5in., or near 6in. for 70 times. The same power applied to celestial objects may not need half this width of glass. The distance at which houses can be seen over sea is often much further than geometry makes it appear, reckoning the earth's diameter 7,920 miles. Thus I have often seen the objects on Beachy Head from the cliffs of Boulogne, 58 miles off. They are not 150ft. high, nor Beachy Head above 500, and a straight-line view would not reach 44 miles. E. L. GARBETT.

[96619.]—**Electric Organ.**—As you seem still determined to connect your two organs by electricity, I should advise you to insert a query in "Ours" addressed to Mr. Bottone or other good electrician, I do not feel confident that my reply in the matter would satisfy you; for although I have experimented at times in electric-organ work, I am afraid

I am hardly competent to advise in the matter. If you adopted tubular pneumatic action, I am afraid there would not be room in the American organ for the pallet-box or motors, and then you must remember that your bellows in that instrument are exhaust bellows. How do you propose to blow the two organs at the same time? That will be rather a serious question. The work I referred to is "A Practical Treatise on Organ Building," by F. E. Robertson, C.I.E., and published by Sampson Low, Marston, and Co. The price is 31s. 6d., which is rather a high figure, but the book is well worth it. But as I stated in answer before the articles originally appeared in the ENGLISH MECHANIC, in "The Organ," by Hopkins and Rimbault, there are very good chapters on electric-organ work with diagrams. This is also an expensive book; but if you like to advertise your address in the Address column of "Ours," I will write you, as I know where a cheap one (second hand) is for sale.

DIAPASON.

[96631.]—**Eight Queens Problem.**—I used to think, with others, that the solutions of this problem were exceedingly numerous; but seeing it down again as a query in the "E. M." I tried to discover systematically all the solutions. As a result, I find that there are certainly only twelve different solutions. The four given by Mr. Webb (Sept. 22) are only four versions of one arrangement of the queens —the fourth on the list I give below. In fact one has merely to twist the board round so that every edge becomes in turn the bottom edge, to get these four. Mr. Webb might have mentally turned the board over, and, treating it as transparent, put down four other versions. Thus there are eight versions for every arrangement. Mr. Tupman's is the sixth on the list, and Mr. Bucknell's are the eleventh, eighth, second, first, third. A simpler notation than Mr. Bucknell's is the following:—Take the board as consisting of eight columns and eight ranks; speak of a queen according to her column, thus—first queen, second queen, &c. Then to express any arrangement it is sufficient to write down the ranks of the first, second, third, &c., queens as digits of a number: for example, 2 5 7 1 3 8 6 4 would mean that first queen is in rank No. 2, the second in rank No. 5, and so on. Having discovered all the ways in which the first queen is in the first rank, all those in which she is in the second, in the third, and in the fourth, one need not go further; for in any case in which she is in a rank above the fourth, we can, by turning the board over so that what was at the top edge is now the bottom, reduce her rank to one below the fifth; for example, in the arrangement whose number is 7 4 2 8 6 1 3 5, the first queen would on turning over the board appear in the second rank. The following list gives the twelve arrangements:—

(1)	1	5	8	6	3	7	2	4
(2)	1	6	8	3	7	4	2	5
(3)	2	4	6	8	3	1	7	5
(4)	2	5	7	1	3	8	6	4
(5)	2	5	7	4	1	8	6	3
(6)	2	6	1	7	4	8	3	5
(7)	2	6	8	3	1	4	7	5
(8)	2	7	3	6	8	5	1	4
(9)	2	7	5	8	1	4	6	3
(10)	3	5	2	8	1	7	4	6
(11)	3	5	8	4	1	7	2	6
(12)	3	6	2	5	8	1	7	4

If anyone finds an arrangement not included in the above he will be rewarded—with thanks. H. O.

[96631.]—**The Eight Queens Problem.**—It seems odd there should be 12 solutions of this with the common board, as I can only make one with a board of 49 squares or of 36. With a board of 25 there are two; with 16 only one, and with less than 16 none. The Russians give a queen a knight's move, and this makes the problem impossible with 8. A query is, Can nine Russian Queens be placed on a board of 81, or 10 on a board of 100? E. L. G.

[96633.]—**Green Water.** — Rather indefinite. The water, it appears, turns "green" after a week; but how many bathers have used it during that time? The water should be sent for analysis to an expert—say, two gallons, when it is first pumped into the bath, and two gallons when it becomes to "get green and turbid." Some of the water with the "vegetable growth" should also be submitted to the analyst. I do not see how anyone can give a useful answer without specimens of the water at the various stages. M. T.

[96642.]—**Irritation.**—If you go to your druggist for a penny packet or box of prepared fuller's earth, ask him to put it into a clean mortar and add as much gum myrrh in powder as will be picked up upon a sixpence and half as much powdered nut-gall and well triturate it up for you, then hand it over to you. Now when troubled take as much as will be picked up on a sixpence. Wet with clean cold water to about the consistency of cream, and apply when wanting. Use no greasy ointment; it only makes matters worse. If it is as kind to you as it has been to me you will have cause to be thankful. I can likewise recommend it for piles. JACK OF ALL TRADES.

[96647.]—**Knife-Handle Cement.** — If the ordinary mixture will not do, it might be worth while to try plaster of Paris mixed with alum-water, or, as the handles are metal, perhaps a mixture of white-lead and putty would answer. Try the plaster of Paris and alum-water, which dries comparatively slowly. If that, or the other, does not answer, might try jeweller's cement; but that is, of course, affected by water of high temperature. Perhaps the mixture of lime, in powder and slaked, mixed with very fine sand and a little litharge, and kneaded up with linseed-oil would be found effectual. Take, say, two parts of the lime powder, one part of fine sand, and just a "pinch" of litharge comparatively, and mix up with boiled linseed-oil. Would take some time to harden. Report results, please, if tried. METOPS.

[96647.]—**Knife-Handle Cement.**—If you make the tang hot in a fire or over a lamp, fill the hole with powdered alum, then force your tang into it, it will never come out unless you use extraordinary violence.

JACK OF ALL TRADES.

[96650.]—**Trick Matches.**—The following is the usual recipe given for the above:—Take 1 part of glue, and allow it to soak in 5 parts of water. Melt the glue at as low a temperature as possible, and while still hot stir in 1 part of fulminate of mercury. Apply the composition to the matches, while it is warm. If you cannot obtain the fulminate from the chemist (which is most likely), it can be made as follows:—Dissolve some mercury in strong nitric acid, and while the solution is still hot (due to the strong chemical action) add some alcohol. In a short time effervescence takes place, and the fulminate is precipitated as a white crystalline solid, which, when dried, explodes violently on heating or percussion. J. STRACHAN.

[96658.]—**Rheumatism.**—What is meant by "keroseine oil." Is it the common lamp oil petroleum, which is probably not pure oil, or is it a special preparation of the chemist purified for internal use? ADAMS.

[96669.]—**Mercury's Mass.**—Harkness (1891) gives mass of Mercury

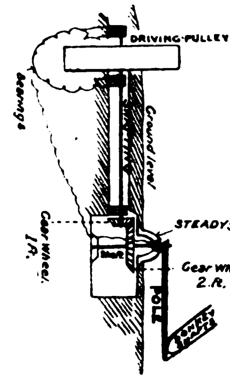
$$= \frac{1}{8{,}374{,}672 \pm 1{,}765{,}762} \text{ of sun's mass.}$$

From this I find (taking diameter of Mercury at 3,000 miles), mean density (water = 1) = 4·00, or about the same as that of Mars (3·95). If we take Barnard's value of the diameter of Mercury—viz., 2,765 miles—the density of the planet would be a little greater than 4·00. J. E. GORE.

[96677.]—**Voltage.**—It is hardly possible to give "Ivanhoe" any useful information in the limited space which can be devoted to that end in these columns; but as his query betrays a very slight acquaintance with the properties of an electric current, I would recommend him to peruse some elementary textbook, and thoroughly master "Ohm's Law. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96694.]—**Circular Saw.**—I think this sketch



will give you a good idea, and also be cheap.

G. BARTON.

[96679.]—**Dynamo.**—To MR. AVERY.—I fear "Dudley" has rather overestimated the possibilities of his dynamo. The normal output of a machine of the size illustrated, if built with cast-iron carcase and drum armature, would be 30 watts at 2,800 revs.; it might be possible to get 50 watts for a short time, but would lead to injurious heating. For a 100-watt 10-volt machine the dimensions should be:—Armature, 2½in. diameter by 3in. long, 12-teeth cogged drum; fields, 6in. high by 7½in. wide by 3in. deep; pole-pieces, 2in. high by 1½in. of winding space; thickness of yokes, 1in.; distance between yokes and pole-pieces for wire, 1in.; armature winding, 10oz. No. 16 S.W.G.; fields, 3lb. No. 17 S.W.G. in shunt; speed, 2,400 revs. for 10 volts 10 ampères. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96690.]—**Dynamo.**—For a machine of the Lahmeyer type, and of the dimensions given, the following will be the correct windings to obtain an output of 65 volts 2 ampères at 2,400 revs.:—Armature, cogged drum 16 teeth, wound with 12oz. No. 24 S.W.G.; fields wound with 3½lb. No. 25 S.W.G. It would be impossible to get 1½lb. of wire on this armature, and much more so to get 10lb. or 13lb. on the fields (as advised in one reply to this query), nor is it in the least necessary; for the Lahmeyer will give an output equivalent to any other type of machine with but half the amount of copper in its construction.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96698.]—**Scene-Painting.**—Use canvas on rollers or wood frames. Colours in powder by the pound or less can be obtained cheaply at an oil and colourman's. Mix with water into a thin liquid and add about an equal quantity of size, after having dissolved it over a slow fire. Apply the colour thinly and before it has time to congeal, which it does when quite cold. When congealed, it can be rewarmed; but a good plan is to keep a bucket of size liquid on a fire whilst at work, and add to the colours as needed. Remember the colours dry much lighter than when first put on, and keep them strong accordingly. Use the biggest brush you can.

BARMSTA.

[96700.]—**Flow of Water from Cistern.**—In the case of water being discharged through an orifice in its base, the water flows through the orifice because the upward pressure of the orifice (equal to the atmospheric pressure) is less than the downward pressure (equal to the atmospheric pressure together with the weight of the water above the orifice). Hence it is evident the higher the column of water above the orifice the greater the velocity of flow. Now the time of discharge is inversely proportional to the velocity of flow, and the velocity of flow is, as just shown, a function of the head. In fact, $v = c_v \sqrt{2 g h}$ where v is the velocity of flow, h the head, g the acceleration due to gravity, and c_v a coefficient of velocity depending on the form of orifice. The velocity of flow is not, however, constant during the process of emptying, for the head gradually becomes less and less, so that in order to compare the time of emptying in the two cases mentioned in the question the formula—

$$T = \frac{\Omega}{c\, w} \left\{ \sqrt{\frac{2 H}{g}} - \sqrt{\frac{2 h}{g}} \right\}$$

must be used; where T = time of emptying, Ω = area cistern floor, c = a coeff. of discharge depending on shape of orifice, but generally about ·97, w = area orifice, H = head at start of discharge, h = head at time T. Thus if T_1 is time without 10ft. pipe, and T_2 time with 10ft. pipe, disregarding the time taken to empty pipe itself—

$$\frac{T_1}{T_2} = \frac{\sqrt{H}}{\sqrt{H} - \sqrt{h}} = \frac{\sqrt{3}}{\sqrt{13} - \sqrt{10}} = \frac{1{\cdot}73}{{\cdot}47} = 3{\cdot}69.$$

Hence it should take more than 3½ times as long to empty tank in the first manner than it takes to empty it in the second manner. This is neglecting the time taken to empty the pipe itself and the extra resist. of pipe, but both errors should be small. If the pipe was long and of a large bore, the time taken to empty it would be $\frac{1}{c}\sqrt{\frac{2H}{g}}$, H being its length. The time of discharge in the second case would be the same as the time taken to discharge the first 3ft. of a cistern 5ft. × 4ft. and 13ft. deep through a similar hole in its base.

C. W. J.

[96702.]—**Glue.**—What is the object of this query? For what purpose is the glue to be used? That is the subject of importance. A little nitric acid mixed with the glue might answer, or possibly some plaster of Paris would be of more use. It entirely depends on the purpose to which the glue is to be applied, and that is not stated by the querist. T. L.

[96702.]—**Making Glue Insoluble in Water.**—The advice given by "Regent's Park" will, I think, cause the querist some loss of equanimity (and of glue) if followed, as it would result in rendering the glue specially hygroscopic, and extra soluble in water, which is just the opposite to the effect desired. Obviously, the well-known effect of bichromate of potash in rendering gelatine (i.e., glue) insoluble and non-hygroscopic after exposure to light is what is needed; the glue will never swell or dissolve again, even in hot water. But it must be a good glue, a clear, light-coloured sort, which will take up a large proportion of cold water on soaking. Dissolve the potash bichromate crystals in about the proportion of ½oz. weight to a pint of water. When all dissolved, and if in hot water, wait until quite cold, break up the glue into small chips, and, in the dark, let it soak and swell for a day or two in the solution. Pour off the solution not absorbed, and warm the jelly (not boiling it) until the excess of water is evaporated, and the glue as thick as needed for its work, and, still in the

dark, or by gaslight, or in a dimly-lighted room, use the glue as intended, and put it out in strong daylight to set, for some hours. It will get more insoluble daily, but if not sufficiently so, use stronger solution of bichromate. Thinking that numerous photo. men would reply to this query, I refrained; but I hope this may prevent the querist from spoiling his glue and temper by mixing glycerine with the former, as advised by "Regent's Park."

GERARD SMITH.

[96704.] — **Polishing Ivory.** — Your correspondent "Regent's Park," in his reply to this question, has omitted to mention the best and most usual method of polishing ivory—namely, by whiting and water mixed to the consistence of cream, and applied on a thin rubber of folded rag. For full instructions, see Holtzapffel's "Turning and Mechanical Manipulation"—a standard work —Vol. IV. p. 474 for plain turning, and Vol. V. p. 21 for ornamental work.

DROOB.

[96713.]—**Test for Arsenic.**—Wall-paper may be tested for As as follows:—Take a fairly large piece of the paper, so as to include all parts of the pattern; cut it up and put in flask with small quantity of dilute hydrochloric acid, warming up nearly to boiling-point. Now take a small piece of perfectly bright and clean copper foil and suspend in flask by means of a piece of thin platinum wire. After boiling for some time, remove copper, and rinse repeatedly with water to get rid of all acid. On no account handle the copper with the fingers. If there be much arsenic present, the copper will be coated a dark steel colour after the lapse of a short time. If no discoloration appears, the paper may be accepted. Assuming that discoloration has appeared, the copper should now be placed in a short test-tube, loosely stopped at the mouth with cotton-wool, and the bottom heated in the Bunsen flame. A sublimate will appear on the cooler part of the tube, and should be examined under the microscope, when, if small octohedral crystals appear, arsenic is present.

Ipswich. B.Sc.

[96713.]—**Test for Arsenic.**—In the replies to this query on page 167 it should be stated that the accidental inhaling of the arseniuretted hydrogen gas evolved will probably prove fatal. Several instances are recorded of deaths from inhalation of a very small bubble of this gas, which none but a practised chemist should meddle with.

J. P. WRIGHT.

[96723.]—**Electrical.**—To MR. BOTTONE.—Without mentioning any particular make of arc lamp, which would be invidious, it may be fairly stated that any good arc lamp that would run with from six to eight ampères at 50 volts pressure would suit you. In this case two such lamps placed in series could take the place of 12 incandescent lamps, and would necessitate no change in the wiring, except, of course, that the branch wires leading from the mains must also be able to carry at least 12 ampères. Unless specially made, or fitted with special resistance coils, you would not be able to use a single arc lamp in place of six incandescents, and even were you so to do you would incur great waste.

S. BOTTONE.

[96725.]—**Geometrical Progression.**—Let the first number be x, and the common factor also x, then by the common formula—

$$\frac{x\,(x^5-1)}{x-1} = 62, \text{ and } x^5 = 62\left(\frac{x-1}{x}\right)+1$$

$$\frac{x^2\,(x^{10}-1)}{x^2-1} = 1{,}364, \text{ and } x^{10} = 1{,}364\left(\frac{x^2-1}{x^2}\right)+1$$

But $$x^{10} = (x^5)^2$$

$$1{,}364\left(\frac{x^2-1}{x^2}\right)+1 = 62^2\left(\frac{x-1}{x}\right)^2 + 2{\cdot}62\left(\frac{x-1}{x}\right)+1$$

Subtracting 1, and $\div$ by $62{\cdot}2\ \frac{x-1}{x}$

we get $$11\left(\frac{x+1}{x}\right) = 31\left(\frac{x-1}{x}\right)+1$$

$$\text{or, } 11\,(x+1) = 31\,(x-1)+x$$

$$\therefore 42 = 21x, \text{ and } 2 = x$$

The numbers are therefore 2, 4, 8, 16, 32. We may also treat 32 as the first number, and ½ as the common factor, which obviates the necessity for making the latter identical with the former.

HENRY T. BURGESS.

West Norwood, Sept. 29.

[96725.]—**Geometrical Progression.**—

$$a + ar + ar^2 + ar^3 + ar^4 = 62 \ldots\ldots (1)$$

and— $$a^2 + a^2r^2 + a^2r^4 + a^2r^6 + a^2r^8 = 1{,}364 \ldots (2)$$

where a is first term of the "G. P.," and r is the common ratio. Dividing equation (2) by equation (1), we get—

$$a - ar + ar^2 - ar^3 + ar^4 = 22 \ldots\ldots (3)$$

Adding equation (1) to equation (3), we get—

$$2a + 2ar^2 + ar^4 = 84.$$

i.e.— $$a + ar^2 + ar^4 = 42 \ldots\ldots\ldots (4)$$

Subtracting equation (3) from equation (1) we get—

$$ar + ar^3 = 20 \ldots\ldots\ldots\ldots (5)$$

Multiply equation (5) by r, and subtract from (4), then—

$$a = 42 - 20r.$$

Substituting this value of a in equation (1), then—

$$42 + 22r + 22r^2 + 22r^3 + 22r^4 - 20r^5 = 62. \quad (6)$$

And also substituting the value of a in equation (3), then—

$$42 - 62r + 62r^2 - 62r^3 + 62r^4 - 20r^5 = 22. \quad (7)$$

Adding equations (6) and (7)—

$$-40r + 84r^2 - 40r^3 = 84r^4 - 40r^5 = 0.$$

$$\therefore 10 - 21r + 10r^2 - 21r^3 + 10r^4 = 0 \ldots (8)$$

Unless $r = 0$ (but it is not).

$$\therefore (5 + 2r + 5r^2)\,(2 - 5r + 2r^2) = 0.$$

$$\therefore (2 - 5r + 2r^2) = 0, \text{ or } (5 + 2r + 5r^2) = 0.$$

(This last equation may be neglected.)

$$\therefore (2 - r)\,(1 - 2r) = 0, \ \therefore r = 2 \text{ or } \tfrac{1}{2}.$$

And because $a = 42 - 20r$, $\therefore a = 2$ or 32—

$\therefore$ series is 2 . 4 . 8 . 16 . 32.—Ansr.

Lancaster. J. SHAW.

[96725]—**Geometrical Progression.**—Let the numbers be a, ar, ar^2, ar^3, and ar^4,

Then— $$a\,(1 + r + r^2 + r^3 + r^4) = 62 \ldots\ldots (1)$$

And— $$a^2\,(1 + r^2 + r^4 + r^6 + r^8) = 1{,}364 \ldots (2)$$

Therefore— $$\frac{a^2\left(\frac{r^{10}-1}{r^2-1}\right)}{a\left(\frac{r^5-1}{r-1}\right)} = \frac{1364}{62} = 22$$

Therefore— $$a\,(r^5+1) = 22\,(r+1) \ldots\ldots\ldots (3)$$

Also from (1) $$a\,(r^5-1) = 62\,(r-1)$$

Therefore— $$2a = 84 - 40r$$

Or— $$a + 20r = 42 \ldots\ldots\ldots\ldots (4)$$

But "a" and "r" are integers,

Therefore— $$a = 2 \text{ and } r = 2$$

And the numbers are 2, 4, 8, 16 and 32.

A. O. S.

[96725.]—**Geometrical Progression.**—If n numbers are in G.P., their sum being S, and the sum of their squares Σ, it is easily shown that $\frac{(r+1)\,(r^n-1)}{(r-1)\,(r^n+1)} = \frac{S^2}{\Sigma}$, where r is the common ratio, and the first term is given by $a = S \times \frac{r-1}{r^n-1}$. If $r = 5$, the first equation becomes—

$$(S^2 - \Sigma)\,(r^4 + r^2 + 1) = (S^2 + \Sigma)\,r\,.\,(r^2+1).$$

$$\therefore (S^2 - \Sigma)\,(r^2 + 1 + r)\,(r^2 + 1 - r) = (S^2 + \Sigma)\,.\,r\,.\,(r^2+1).$$

$$\therefore (S^2 - \Sigma)\left(1 + \frac{r}{r^2+1}\right)\left(\frac{r^2+1}{r} - 1\right) = S^2 + \Sigma$$

For brevity write—

$$\frac{r^2+1}{r} = x,\ S^2 - \Sigma = Q,\ S^2 + \Sigma = P.$$

$$\therefore \left(x - \frac{1}{x}\right) = P,\ \therefore\ x^2 - \frac{P}{Q}x = 1 \ldots\ldots (i.)$$

A quadratic to find x, and putting $\frac{r^2+1}{r}$ equal to the roots of this equation, we have another quadratic to find r, whence a can be determined from the equation $a = S \times \frac{r-1}{r^5-1}$. This is a general solution applying whether the five quantities are fractional or integral, and gives the solution for any given values of S and Σ. In the example given $\frac{P}{Q} = \frac{21}{10}$, which gives $x = \frac{5}{2}$, or $-\frac{2}{5}$, whence $r = 2$ or $\frac{1}{2}$ (the other two values of r are imaginary), and $a = 2$ or 32. These two solutions give the same five numbers—viz., 2, 4, 8, 16, 32.

C. P.

[96726.]—**Induction Coil.**—To MR. BOTTONE.—For a core 6in. long, ⅝in. diameter, the heads should be 2¼in. diam., ⅜in. thick. Having fitted these on and drilled the holes for the primary wire to pass through, dress the iron core with one layer of silk ribbon laid on spirally. Fasten down with a stitch, and varnish over with shellac. When dry, coil on two layers of No. 20 d.c.c. Baste with hot melted paraffin wax. Now procure a sheet of thin ebonite about 1/16in. thick, 5¼in. wide, and 7in. long. Soften this by holding it at a little distance in front of a glowing fire, and rapidly wrap it tightly and evenly round the wound primary. Tie it round with tape so as to retain it in position until cold and hard again. Remove tape, drill hole in one edge for passage of beginning of secondary, then wind on 8oz. No. 36 silk-covered wire in perfectly even and close layers, interleaving each layer with one turn of paraffined paper. Each layer should diminish by about ⅛in. at each end. It will not be advisable to sectionise so small a coil. For full instructions for building large coils in sections see my book "Radiography." A suitable condenser will consist of fifty sheets of tinfoil 2in. by 4in., interleaved with paraffined paper. The two ends of condenser are connected to contact screw and vibrating hammer respectively.

S. BOTTONE.

[96732.]—**Paint.**—1. If you were to buy your paint of a house-painter, or that is, have it mixed to order, you will get over the difficulty, as so many colours and tints are used in house-painting. Perhaps it would interest you to know that hundreds of tints in use have no white lead in them because of it destroying the colour one wants to get. 2. "Elementary Decoration," illustrated, price 2s., from Crosby Lockwood and Son, 7, Stationers' Hall-court, London, E.C.

Bromsgrove. HOUSE PAINTER.

[96732.]—**Paint.**—Both "Poor Man" and "Anxious" can easily make their own paint with white lead, boiled oil, turpentine, and driers, or "terebene"—a very convenient liquid driers. Put these ingredients into a tin-pot, and twirl a brush round between the hands till all are incorporated. Plenty of books on subject. See advts. for such. Experience is necessary for good work.

HOUSE PAINTER.

[96732.]—**Paint.**—"Poor Man" does not say so, but I presume he wishes to put a fresh coat of paint on something that has been painted before. The first thing to do is to get off all dirt, removing any nails or scutcheons of locks, door-plates, &c. If any places are greasy, remove grease with turpentine. White-lead may be taken to be the body of all paint, as flour is the body of pastry, cakes, &c. For the first coat, take as much white-lead as you require, and add gradually enough of the following to make it of the right consistency: three half-pints of turpentine and half-pint boiled linseed-oil; then add a tablespoonful of patent driers. If you require it coloured, get the stiff colour, and mix it in with the white-lead. When the consistency seems about right, get an old woman's stocking, slit stocking up the seam, stretch stocking over an old can, and tie it around the can. This is to filter the paint through. Help it through by brushing, and continue till all is filtered. The paint is now ready for use. This coat will dry somewhat dull-coloured. For the next coat, mix the white-lead and colour with boiled oil 2 parts and turpentine 1 part. A little driers must be added. These two coats will be found quite sufficient, and the last coat should dry with a nice gloss. About four days—more or less, according to season—should elapse before applying second coat.

WILLIAM GATRELL.

[96733.]—**Gas and Oil Engines.**—The trunk form of piston, as now generally adopted in gas and oil-engines, is used in order to save weight, to have as few working parts as possible, and to cool piston by having front end of cylinder open to the atmosphere. Double-acting cylinders for gas-engines have not proved successful in practice, owing to the great difficulty of keeping the piston and piston-rod (which is surrounded at the moment of explosion by burning gases at a temperature of about 1,600° C.), sufficiently cool to allow of lubrication.

H. F. L.

[96733.]—**Gas and Oil Engines.**—Because the piston would "bind," as there is no "crosshead" interposed between crank and piston; being generally single-acting, there is no necessity for this. There is a wide difference between gas or steam, the latter not requiring compressing, which is necessary with gas for effective working.

LINER.

[96733.]—**Gas and Oil Engines.**—Since gas and oil engines are nearly all single-acting, it is only necessary to have one end closed. The trunk piston suits this admirably, doing away with the piston-rod, and greatly economising space and amount of material used in the bedplate. The double-acting cylinder has been tried, but not with very great success or economy. There are only a few in use.

THISTLE.

[96734.]—**Nerve in Tooth.**—Arsenious acid powdered in very small quantities—say one-fifteenth to one-fortieth grain. Some use it dry, but most generally it is bought in a kind of paste ground up with creasote, oil of cloves, carmine, morphia, cocaine, &c. It requires expert skill in application, as the least bit of arsenious acid will cause rapid necrosis of any living tissue it comes in contact with.

WILLIAM GATRELL.

[96734.]—**Nerve in Tooth.**—Creasote is generally employed for this purpose. A little pledget of cotton-wool twisted round the end of a fine stick, is moistened with the creasote, and inserted into the hollow of the tooth.

S. BOTTONE.

[96734.]—**Nerve in Tooth.**—To destroy the nerve of a tooth means to lose the tooth itself very

soon. Why not see a good dentist and save the tooth?

West Didsbury. M. COLE.

[96735.]—**White Paint.**—The dry white lead (carbonate) kneaded with linseed oil, say 8lb. of oil to 100lb. of lead. Thin with turpentine to milk-white fluid, stir all well together, then set aside for a day or two, at end of which time a large share of the oil with some turpentine will be free of lead on surface; pour this off. If washed sufficiently by this, add to the washed lead a little rubbing varnish of light shade—say 1 gill to a quart of softened lead. This gives bending and drying qualities. Stir well; if too thick, add a little turpentine. Two coats over light ground should make a solid foundation. REGENT'S PARK.

[96735.]—**White Paint.** — Vide my reply to query 96732, and you will see that all you require is boiled linseed oil, as you have the other ingredients. WILLIAM GATRELL.

[96735.]—**White Paint.**—To make your paint for glasshouse, use for first coat half turps and half linseed-oil mixed with white lead to the proper consistency for use. Very little driers is needed for white, say 1lb. driers to 10lb. of white-lead. If you intend giving three coats use same paint as for the first. Do not put the first on too thick. Last coat use all linseed-oil or half boiled-oil and half turps. Just a little blue in the last coat is preferred by some.

Bromsgrove. HOUSE PAINTER.

[96736.]—**Crystoleum.**—There is a lot of information in back numbers about this. Various makers give special names to their preparations; those used in the inquiry are, I think, made in Lancashire—but Canada balsam will be found best of all for the purpose.

West Didsbury. M. COLE.

[96738.] — **Gas-Heating Soldering-Iron.** — Take a piece of iron gaspipe, say, about 6in. long and about ¾in. bore; screw both ends; on one end screw a cap, on the other a connection for rubber tubing; drill a number of ⅛in. holes about ⅜in. apart. Drill a hole, or holes as required, near connection, and as far from last hole to prevent lighting back. Fix on bench by some means, and rig up a suitable stand for soldering-iron.

GAS-FITTER.

[96738.]—**Gas-Heating Soldering-Iron.**—The best way is to use a small gas-stove and two irons, one on stove while other is used. This is far better than the self-heating ones. You can get a gas-stove that will do for 1s. or so, and make a cover of sheet iron lined with asbestos board ⅛in. thick.

West Didsbury. M. COLE.

[96740.]—**Electrical Contrivance for Deaf Person.**—To MR. BOTTONE.—What is usually sold for this purpose is simply a telephone, when, of course, the transmitter must be fixed somewhere near the minister in the pulpit. But, practically, I have found this arrangement of little or no service, if the user is really deaf. S. BOTTONE.

[96741.]—**Heating Room by Electricity.**—I should advise the querist to communicate with Messrs. Crompton and Co., of Chelmsford, who make all kinds of heating appliances on the system devised by Mr. Dowsing, the heat being developed by passing current through a network of high-resistance wires imbedded in a special enamel. Or Mr. Bowden might apply to Mr. G. Braulek, of 217, Upper Thames-street, E.C. A simple form of radiator would merely consist of a set of "recstene" resistance-coils inclosed in perforated iron case, and warmed up to a "black heat" by passing current through them. If the querist will state the voltage and ampèrage of his dynamo, also the dimensions of the apartment to be heated, further assistance would probably be forthcoming. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96741.]—**Heating Room by Electricity.**—This can be done economically only when you can get current for nothing. It is, of course, possible to heat a room by electricity, just as it is possible to cook a dinner with £5 notes.

West Didsbury. M. COLE.

[96742.]—**Bore of Cylinder.**—The bore of the cylinder will depend on the stroke and the pressure developed in cylinder by the explosion of the gases. To find the horsepower of gas-engine—

Let— P = mean pressure as found from indicator diagram.
L = length of stroke.
A = piston area.
n = no. of explosions per min.

Then— $$\text{I.H.P.} = \frac{\text{PLA}n}{33{,}000}$$

The oil-engine is found in a similar manner.

THISTLE.

[96743.]—**Wimshurst.**—To MR. BOTTONE.—No; the oppositely charged sectors would discharge across to one another. S. BOTTONE.

[96744.]—**Celluloid.**—Articles made of celluloid can be stuck together by means of a cement made by dissolving celluloid in amyl alcohol. This can be bought ready-made under several fanciful names, as "Zapon," &c. S. BOTTONE.

[96744.]—**Celluloid.**—Dissolve 25 parts shellac in 25 parts spirit camphor; add alcohol, 90 per cent., 100 parts. Fine celluloid shavings dissolved in 90 per cent. alcohol. REGENT'S PARK.

[96744.]—**Celluloid.**—Can be joined by a cement of celluloid dissolved in acetone. The C. can be bent when heated in hot water; but be careful not to over-heat.

West Didsbury. M. COLE.

[96745.]—**Flagstaff Problem.**—The letters in your question seem to be slightly mixed: you have taken A to mean the elevation of the highest point of the tower, and also the distance of the first observation from the base. Let the height of the tower be m, the length of the flagstaff l, suppose the first observation to be made at a distance b from the tower base, and the second observation at a distance c further on. Let the elevation (at the first position) of the top of the tower be A, and the top of the flagstaff a. Then the elevation of the top of the flagstaff in the second position is $\frac{a}{2}$. As a and A are complementary, tan. a = cot. A.

$$l + m = b \tan. a = b \cot. A$$
$$m = b \tan. A$$
$$\therefore l = b(\cot. A - \tan. A) = b\,\frac{1 - \tan.^2 A}{\tan. A}$$
$$= 2b \cot. 2A.$$
$$l = b(\tan. a - \cot. a) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$
$$l + m = b \tan. a = (b + c) \tan. \frac{a}{2}$$
$$\therefore c \tan. \frac{a}{2} = b\left(\tan. a - \tan. \frac{a}{2}\right) \quad \ldots\ldots (2)$$

Eliminating b from (1) and (2)—

$$l\left(\tan. a - \tan. \frac{a}{2}\right) = -c \tan. \frac{a}{2}(\tan. a - \cot. a)$$

Putting in the value—

$$\frac{\sin. a}{1 + \cos. a} \text{ or } \frac{1 - \cos a}{\sin. a} \text{ for } \tan. \frac{a}{2}$$

$$l\,\frac{1 - \cos. a}{\sin. a \cos. a} = -c\,\frac{\sin.^2 a - \cos.^2 a}{\cos. a(1 + \cos. a)}$$
$$= -c\,\frac{-\cos. 2a}{\cos. a(1 + \cos. a)}$$
$$\therefore l = c \cdot \frac{\sin. a \cos. a}{1 - \cos. a} \cdot \frac{\cos 2a}{\cos. a(1 + \cos. a)}$$
$$= \frac{\sin. a}{1 - \cos.^2 a} \cdot c \cos. 2a = c \operatorname{cosec}. a \cos. 2a.$$

C. W. J.

[96745.]—**Flagstaff Problem.**—(i.) If h be the height of the tower—

$$\frac{h}{a} = \tan. A, \quad \frac{x + h}{a} = \cot. A$$
$$\therefore \frac{x}{a} = \cot. A - \tan. A = 2 \cot. 2A$$
$$\therefore x = 2a \cot. 2A.$$

(ii.) The distance a being unknown—

$$\frac{h}{a} = \tan. A, \quad \frac{h}{a + c} = \tan. \tfrac{1}{2} A.$$
$$\therefore a \tan. A = (a + c) \tan. \tfrac{1}{2} A,$$
$$\therefore a = \frac{c \tan. \frac{1}{2} A}{\tan. A - \tan. \frac{1}{2} A} = c \cos. A.$$

Substituting this value in the result of (i.), we have—

$$x = 2c \cos. A \cdot \cot. 2A = \operatorname{cosec}. A \cos. 2A.$$

C. P.

[96746.]—**Grammaphone.**—Examine the connection between the stylus lever and the diaphragm, and see whether they are separate. If not stuck together, of course the voice would suffer. The cement used is ordinary beeswax. Berliner's name sounds like a German, but I have not the pleasure of his personal acquaintance, so cannot say where he was "raised." It sounds awfully conceited to say so, but you should read my articles on the Grammaphone in the last volume of "Ours." You will find everything you ask about mentioned in them. The diaphragm is usually mica, but celluloid will answer. R. A. R. BENNETT.

[96749.] — **Electro - Magnets in Series.** — Either of two things may be the matter:—(a) the iron of the cores may be of very different magnetic quality, or (b) in one of the magnets the coils may be short-circuited somewhere, and the current does not pass through the whole number of turns.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[96749.]—**Electro - Magnets.** — It is highly probable that the core of one of them is of hard iron; better test.

West Didsbury. M. COLE.

[96753.] —**Acceleration.** — Acceleration is expressed in velocity per time-unit, hence the time-unit must be mentioned twice. Assuming 25kils. per hour means 25kilo. per hour per hour, the velocity v at the end of any distance s is given by the fundamental dynamical formula—

$$2fs = v^2$$

Hence in this example—

$$v = \sqrt{2fs} = 20\sqrt{2} = 28{\cdot}28\text{kilo. per hour.}$$

C. W. J.

[96753.] — **Acceleration.** — Any textbook on mechanics will show that $v^2 = 2fs$, where f is the acceleration, and s the space passed over; in this case—

$$v^2 = 2 \times 25 \times 16.$$
$$\therefore v = 20\sqrt{2} \text{ kilomètres per hour.}$$

B. W. LOVEJOY.

[96753.]—**Acceleration.**—25 kilo. per hour = $\frac{625}{9}$cm. per second.

$$v^2 = u + 2fs$$

where— v = final veloc.
u = initial veloc.
f = acceleration.
s = distance travelled.

$$v^2 = 0 + 2 \times \frac{625}{9} \times 1{,}600{,}000\text{cm.}$$
$$= \frac{3{,}200{,}000 \times 625}{9}$$
$$= \frac{2{,}000{,}000{,}000}{9}$$
$$v = \frac{4.473}{3}\text{m. per sec.}$$
$$= \frac{4.473 \times 3}{250} = \frac{13\,419}{250}$$
$$= 54 \text{ kilos. per hour.}$$

THISTLE.

[96753.]—**Acceleration.**—With the usual formula $S = \frac{1}{2}ft^2$ and $v^2 = 2fs$; with our units of space and time as 1 kilomètre and 1 hour, we have $t = \frac{4}{5}\sqrt{2}$, and $v = 20\sqrt{2}$ kilomètres per hour.

C. P.

[96754.]—**Problem.** — Let x^s be the value of prize. Then, if number of bound volumes be y, the number of unbound volumes for same money will be $(y + 10)$. Therefore, $\left(\frac{x}{y}\right)^s$ is cost of one bound volume, and $\left(\frac{x}{y + 10}\right)^s$ is cost of one unbound volume. Therefore, $\frac{x}{y} - \frac{x}{y + 10} = 6$. But if half the volumes are bound and the rest unbound, $\frac{y + 4}{2}$ are bound, and $\frac{y + 4}{2}$ are unbound, and cost of $\frac{y + 4}{2}$ bound vols. is $\left(\frac{y + 4}{2}\right) \times \frac{x^s}{y}$, and cost of $\frac{y + 4}{2}$ unbound vols. is $\left(\frac{y + 4}{2}\right) \times \left(\frac{x}{y + 10}\right)^s$, and total cost is x shillings.

$$\therefore \quad \frac{y + 4}{2} \times \frac{x}{y} + \frac{y + 4}{2} \times \frac{x}{y + 10} = x.$$
$$\therefore \quad \frac{xy + 4x}{2y} + \frac{xy + 4x}{2y + 20} = x.$$
$$\therefore 2xy^2 + 8xy + 20xy + 80x + 2xy^2 + 8xy = 4xy^2 + 40xy.$$
$$\therefore \quad 80x = 4xy. \quad \therefore y = 20.$$

and $\frac{x}{y} - \frac{x}{y + 10} = 6$. $\therefore \frac{x}{20} - \frac{x}{30} = 6$. $\therefore x = 360$.

Consequently, the number of unbound volumes which could be got for 360s (the value of the prize) is 30; or 12 bound volumes and 12 unbound volumes could be got.

Lancaster. J. SHAW.

[96754.]—**Problem.**—Let—

x = number of volumes all bound, then—
$x + 10$ = number of volumes all unbound, and—
$x + 4$ = number of volumes half-bound and half unbound.

Next let— y = price per volume unbound,
then— $y + 6$ = price per volume bound.

Now, since the value of the books is the same in each case, we get—

$$x(y + 6) = y(x + 10) = \frac{(x + 4)}{2} + \frac{(x + 4)(y + 6)}{2}$$

From the first two we get, by clearing—

$$3x = 5y, \text{ or } x = \frac{5y}{3}.$$

By clearing No. 3 and substituting the value of x we get the following quadratic in y—

$$5y^2 - 3y = 108.$$

Solving, we get, therefore—

$$y - \tfrac{3}{2} = \pm \tfrac{21}{2}.$$

Therefore— $y = 12$, or -9,

the positive value being only available. Therefore,

by substitution, we get $x = 20$. Therefore the required numbers of volumes are:—20 vols. at 12s. + 6s. (or 18s.) per vol. = 360s. = £18; 30 vols. at 12s. per vol. = 360s. = £18; 24 vols., 12 at 18s. and 12 at 12s. = 360s. = £16.—*Q.E F.*

INDUCTORIUM.

[96754.]—**Problem.**—Let x = value of prize in shillings, and y = number of books, if all are bound.

Then— $\frac{x}{y}$ = value of bound volume,

and— $\frac{x}{y} - 6$ = value of volume unbound,

and, from the terms of the question, we have also—

$\frac{x}{y+10}$ = value of volume unbound.

$$\therefore \frac{x}{y+10} = \frac{x}{y} - 6 \text{ ....(1)}$$

$$\therefore xy = xy + 10x - 6y^2 - 60y.$$

$$\therefore 6y^2 + 60y = 10x.$$

Or— $3y^2 + 30y = 5x$ ....(2)

Again— $\frac{y+4}{2} \times 6 + (y+4)\frac{x}{y+10} = x.$

Or— $3y^2 + 30y + 12y + 120 + xy + 4x$
$= xy + 10x$, or from (2).

$$5x + 12y + 120 = 6x.$$

Or— $12y + 120 = x$..............(3)

$$\therefore y + 10 = \frac{x}{12}$$

Substituting this result (1) we obtain—

$$12 = \frac{x}{y} - 6$$

$$\therefore \frac{x}{y} = 18s. = \text{value of bound volume,}$$

and— $18y = x.$

Then from (3)— $12y + 120 = 18y.$

$\therefore 6y = 120$, and $y = 20$. $\therefore x = 18y = 360s.$

Hence value of prize is 360s. = £18.
Number of bound books = 20.
Number of unbound books = 30.
Number if half are bound = 24.
Value of bound volume = 18s.; ditto unbound 12s.

J. E. GORE.

[96754.]—**Problem.**—Let x represent the prize in shillings, and y the value of an unbound book.

$$\therefore \frac{x}{y} = \frac{x}{y+6} + 10, \text{ and } \frac{x}{y} = \frac{x}{y+3} + 4.$$

Here the only solution is $x = 360$, $y = -18$. There is, therefore, no solution to the original question, the conditions being impossible as ordinarily understood, and this is obvious; for if $2n$ represents the number of unbound books he can buy with his prize, then—

$2n - 10$ bindings are worth 10 books
$\therefore \quad n - 5 \quad$ „ „ 5 „
but— $\quad n - 2 \quad$ „ „ 4 „

Therefore by subtraction -3 bindings are worth $+1$ book. The algebraical solution gives: Prize, £18; value of an unbound book, -18 shillings; number of books he can buy -20 unbound, -30 bound, or -24 half-bound. The only interpretation we can give to this result is that the books are already in his possession, but are so far an impediment that he is willing to give 18s. each to have them removed, provided he is allowed 6s. for each binding taken away. If he uses his prize in getting rid of these books, he can dispose of 20 unbound, 30 bound, or 24 half-bound; that is, the number of books he will have left will be 10 more if he disposes of unbound instead of bound books, and 4 more if he gets rid of half-bound.

C. P.

[96754.]—**Problem.**—Let x = value of the prize in shillings; y = price of a single unbound book in shillings. Then numbers of books purchased, none bound $= \frac{x}{y}$; numbers if all bound $= \frac{x}{y+6}$; numbers if half-bound $= \frac{x}{y+3}$. Hence from the question—

$$\frac{x}{y} - 10 = \frac{x}{y+6} = \frac{x}{y+3} - 4$$

Multiplying out, we have—

$$5y^2 + 30y = 3x$$
$$6y^2 + 18y = 3x$$

Hence— $12y = y^2$, and $y = 0$ or 12.

The value 0 would not apply to the question, hence—

$$y = 12 \text{ and } x = 360.$$

The value of prize is £18, and the numbers of books obtained is 30, 20, and 24 respectively.

C. W. J.

[96754.]—**Problem.**—Let xy be the amount of the prize in shillings; y the cost of a bound volume in shillings. So that x would be the number of bound volumes obtainable. Then, since $y - 6$ is the cost of unbound books, and $y - 3$ average cost of books of which half are bound, we have—

$$xy = (y - 6)(x + 10) = (y + 4)(x - 3).$$

Therefore— $10y - 6x = 60$
$\quad\quad\quad\quad 4y - 3x = 12$

Therefore— $2y = 36$ and $y = 18$ shillings.

Also— $18x = 12(x + 10).$

Therefore—$x = 20$ and $xy = 360$ shillings.

The prize is £18; and it would buy 20 bound volumes, 30 unbound, or 12 of each kind.

A. O. S.

[96756.]—**Ornamental Blocks.**—Don't use paste, but gum the paper with best quality gum arabic. Allow to dry, then moisten the surface of gum and apply the silk. It will not then strike through. Rubber cement is sometimes used.

West Didsbury. M. COLE.

[96758.]—**Sharpening Files.**—Acid methods are no good, and very expensive. The following will not resharpen, but will enable you to get some more work out of your files. Boil the files in an iron pan in water to which you have added a pound or two of soda, a little caustic soda or potash, and a bit of soap. They want boiling for 15 to 20 minutes, and then rinsing in warm water, and then, using a good file-card, you can get the teeth cleaner by far than dry.

WILLIAM GATRELL.

[96759.]—**Bikes and Prams.**—This is a matter of by-laws in most cases. There is (or was) one street in Brighton where perambulators were not allowed on the footpath.

West Didsbury. M. COLE.

[96761.]—**Ginger-Beer Plant.**—This is no "Mrs. Harris," but a very tangible reality. It looks very much like large grains of rice. You put it into a bottle, and add a solution of sugar and some ginger. The only part the plant plays is to cause fermentation. It turns out excellent ginger-beer. I do not know its scientific name.

R. A. R. BENNETT.

[96761.]—**Ginger-Beer Plant.**—Is *Mycoderma saccharomyces*, and is quite distinct from other torula and bacteria. I used to grow it largely. When healthy it occurs as large roundish white grains, resembling raw tapioca. It is extremely interesting to cultivate, as all the phenomena of propagation by fission, as they occur in the bacteria, can be studied by the naked eye. It grows freely in a solution of sugar flavoured with ginger, giving rise, at the same time, to a very pleasant ginger-beer. To succeed in its cultivation, dissolve ¼lb. light-coloured moist sugar in one quart of water. Add to this ½oz. of crushed ginger; place in any wide-mouthed glass vessel (a 4lb. plum-jar will do very well), add to this about two tablespoonfuls of the ginger-beer plants, and allow the whole to stand in any warm place (not in direct sunlight, which kills the plants), at a temperature from 60° to 80° Fahr. In twelve hours the liquor will be ready to drink. Keep muslin over top of jar to exclude dust, &c. From time to time remove excess of plants that have grown, and renew the ginger.

S. BOTTONE.

[96761.]—**Ginger-Beer Plant.**—Many years ago, when quite a lad, I saw one of these "plants," and tasted the ginger-beer it produced. On the kitchen mantelpiece was a wide-mouthed glass jar, holding some 60oz. of water, and at the bottom was the ginger-beer plant. It had the appearance of a wet piece of wash-leather, and appeared to be agglutinated. "Ex nihilo," &c., and Mrs. G. B. P. did not make omelettes without eggs, for I was informed that when the liquid had been drunk till near the bottom the vessel was filled up with cold water, and some sugar added, and about once a week some ginger. I drank a glass of the "brew," and found it fairly good. The flavour was not so good as the "brewed" old-style ginger-beer; but there was evidently some CO_2. I was informed that the "fungus" was purchased at Covent Garden Market, and it would be interesting to know if it can still be had there. Perhaps some of the *habitués* of the Market will kindly say?

WILLIAM GATRELL.

[96761.]—**Ginger-Beer Plant.**—The substance known by the above name occurs in white, jelly-like lumps, of varying size from a pin's head to a plum, which possess the property, when introduced into a sugar solution containing ginger, of transforming it into an acid effervescing liquid, ginger-beer. The substance was investigated some years ago by Prof. Marshall Ward, who found it to consist essentially of a *Saccharomyces*, *S. pyriformis*, and a *Schizomycete*, *Bacterium vermiforme*, together with numerous other micro-organisms, some of which were probably casual intruders. Marshall Ward proved experimentally that the two species named were the only essential ones necessary to produce the fermentation, since he could only bring about an effect like that produced by the ginger-beer plant when he induced a fermentation by them together. His experiments point to the view that the yeast and bacterium live together in a state of true symbiosis, forming an organisation like a lichen. For further particulars about this matter, which does not in the least savour of Mrs. Harris, consult Marshall Ward's paper in *Philos. Trans. Roy. Soc.*, Vol. CLXXXIII. B. p. 125.

A. PRICE, B.Sc.

[96763.]—**Salicin.**—Is a glucoside from the willow (Salix species), having the composition $C_{13}H_{18}O_7$. Under the influence of ferments it splits up into grape-sugar and saligenine.

S. BOTTONE.

[96764.]—**Charging Accumulators.**—TO MR. AVERY.—The plant necessary to do this would consist of a No. 1 Lahmeyer dynamo and some source of motive power, such as a small oil or gas-engine or a water-motor. Or possibly Mr. Weldon would find it more convenient, and less expensive, to get two sets of accumulators, and send one set to be charged at the address below whilst the other is in use. If Mr. Weldon will give me a call, I shall be pleased to advise him personally.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Park-street, Tunbridge Wells.

[96767.]—**Wireless Telegraphy.**—TO MR. BOTTONE.—Yes; but you must arrange a spark gap between the balls of the prime conductors and connect the transmitter balls to the *outsides* of the Leyden jars on the Wimshurst. The relay recommended by me will do nicely. Your coherer appears to be rather long in the tube, and this is not an advantage, as there is a larger mass of filings to be moved. On the relay circuit two dry cells are usually sufficient; but if your relay is not very sensitive, you may use more. In fact, you may put on as many cells in series as will just not actuate the relay when the wave is not sent. One good cell is ample on the bell circuit. It wants considerable knack in turning and stopping to get intelligible signals with the Wimshurst; still, it can be done. About 1½in. spark between the main discharges, and ¼in. between the three balls of the transmitter should be sufficient. Your wings are correct.

S. BOTTONE.

[96768.]—**Ironmould in Copper.**—If you make a paint with oil, or a distemper with water of the mineral known as magnesite, or petrifite, and do your copper with one (or two if requisite) coats, you will get a smooth, adherent, and clean covering capable of bearing great heat, much more than boiler heat.

REGENT'S PARK.

[96768.]—**Ironmould in Copper.**—If your cast-iron washing-copper is sound, get a tinker to come in and tin it for you. He will have to scour it out with fine sand, and when it is perfectly clean and brilliant, will heat the copper from below, and tin it by the aid of a rich tin-solder, assisted by salammoniac, and rubbing round with tow.

S. BOTTONE.

[96771.]—**Wall-Papering.**—What "Paper" suggests is the proper thing to do, only he must be sure and damp the canvas well and paste it down well at the edges and it will dry tight as a drum.

WILLIAM GATRELL.

[96771.]—**Wall-Papering.**—Fill up cracks with magnesite or other cement, or canvas, as you fancy, and paper over.

REGENT'S PARK.

[96771.]—**Wall-Papering.**—Yes, the best way for you to paper your partition is to paste strips of calico over them, allowing them to come over the cracks about 3in. each side. Well stretch, and nail the edges down with small copper tacks; iron ones will rust through. Let the calico get fairly dry before you paper over or your paper will be darker where it is so long drying. Before sticking on strips of calico size boards with ½lb. size to three pints of water, boiling.

Bromsgrove. HOUSE PAINTER.

[96774.]—**Isle of Man Steamers.**—The P.S. *Mona's Queen* was built by the Barrow Shipbuilding Company in 1885. Her dimensions are as follows: Length (b.p.) 320ft., breadth 38ft., depth moulded 15ft. 1n., depth of hold 14ft. 6in., gross tonnage 1,465 tons, and net 525. She is fitted with two pairs of compound oscillating engines, having one high-pressure and one low-pressure cylinder acting on each crank; each of the high-pressure cylinders are 50in., and the low-pressure each 88in. in diameter, the stroke being 6ft., I.H.P. 5,000. The *Peveril*, which has been recently sunk in collision off the Manx coast, was built in 1884. She was 207ft. long, 26ft. beam, and 13ft. deep. Her gross tonnage was 595, and nett 243. Her engines developed 1,100I.H.P. The *Tynwald* was built in 1891. Her length is 265ft., breadth 34ft. 6in., moulded depth 14ft. 6in. Her gross tonnage is 946. On the Liverpool run she carries from 800 to 900 passengers. Her engines are triple-expansion, and the cylinders are 22in., 36in., and 57in. respectively; stroke 3ft., pressure 160lb. per sq.in. She is twin screw, and maintains a sea-going speed of from 18 to 19 knots. I.H.P. about 5,000.

RED ADMIRAL.

[96772.]—**Probability.**—I think "Scorpio" is wrong in assuming that the chance of getting nine

heads "at least once" in 512 groups is nearly certainty. It appears to me to lie between $\frac{3}{5}$ and $\frac{3}{4}$. In each group the chance of getting "nine heads" is $\frac{1}{512}$, and the chance of not getting nine heads is $\frac{511}{512}$. In the case of 512 groups, the respective probabilities that a group of nine heads will occur never, once, twice, three times . . . . . 511 times, 512 times are given by the successive terms in the expansion of the binomial expression $(\frac{511}{512} + \frac{1}{512})^{512}$. Therefore the chance of getting a group of nine heads—

(1) at least once is $1 - (\frac{511}{512})^{512}$.

(2) exactly once is $512 (\frac{511}{512})^{511} (\frac{1}{512})$, or $(\frac{511}{512})^{511}$.

"Scorpio" will notice that the chance of getting the nine heads "exactly once" very slightly exceeds the chance of never getting them at all. The chance of getting two groups of nine heads is about one-half of the chance of "one" or "none." The chances of three, four . . . . groups diminish very rapidly. Of course, in the general question, the chances are—

(1) at least once is $1 - \left(\frac{n-1}{n}\right)^n$

(2) exactly once is $\left(\frac{n-1}{n}\right)^{n-1}$

A. O. S.

[96772.]—**Probability.**—The probability that the event happen is $\frac{1}{n}$. Therefore, the chance that it fail is $\frac{n-1}{n}$. If each trial is an independent event, the chance that it fail n times running is $\left(\frac{n-1}{n}\right)^n$, and the probability that it happen at least once in n trials is $1 - \left(\frac{n-1}{n}\right)^n$. The chance that it happen at the first trial, and fail in the remaining $n - 1$ trials is $\frac{1}{n} \times \left(\frac{n-1}{n}\right)^{n-1}$; and this is evidently the chance that it happen only at an assigned trial (say at the nth trial), out of n trials. These probabilities are dependent; therefore the chance that it happen at *some* one trial out of n, and no more, is n times the above, or $\left(\frac{n-1}{n}\right)^{n-1}$. This is the same as the chance that the event fail $n - 1$ times in succession, which is clearly the case, for it matters not at what stage we suppose the one success to occur. In the example quoted by "Scorpio," (i.) becomes—

$$1 - (\tfrac{511}{512})^{512} = 1 - \log.^{-1} 512 (\log. 511 - \log. 512)$$
$$= 1 - \log.^{-1} \bar{1}\cdot 56526 = \cdot 6325 \pm$$

and (ii.) becomes—

$$(\tfrac{511}{512})^{511} = \log.^{-1} \bar{1}\cdot 5661099 = \cdot 36822 \pm$$

"Scorpio" will therefore see that these chances are by no means the certainties he supposed, being roughly $\frac{5}{8}$ and $\frac{5}{14}$, say 5 to 3 on the first event, and 9 to 5 against the second. Suppose x is the number of trials required to give a probability of 100 to 1 that the first event will happen, we get $1 - (\frac{511}{512})^x = \frac{100}{101}$, which gives $x = 2360 \pm$, so that more than two thousand trials would be required. "Scorpio" will notice that (i.) is not the same as the chance that we get at least nine successive heads at least once in 9×512 tosses. C. P.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last W. Gatrell has replied to 96295, 96297, 96430.

96355. Eccentric Wheels, p. 538.
96360. Lightning Flash, 539.
96361. Force Pump, 539.
96363. Silvering, 539.
96368. Refraction of Cut Diamonds, 539.
96369. Pleating Machine, 539.
96370. Decauville Car, 539.
96376. Organ, 539.
96380. Blue Enamel, 539.
96384. Softening Horn, 539.

96507. Lawn Tennis, p. 46.
96511. Brazing Lamp, 46.
96514. Dry Cleaning, 46.
96516. Heat Consumed in Mechanical Work, 46.
96517. Clarifying Methylated Spirits, 46.
96525. Phonograph Shaver, 46.
96527. Fish Plate, 47.
96532. Geometric Solution, 47.
96534. Dental Chair, 47.
96535. Flagstaff Stays, 47.
96548. Bent Timber, 47.

Electricity has been used in some places for glass-making. With the electric arc, a pot of glass can be melted in a few minutes.

QUERIES.

[96776.]—**Wickless Paraffin Lamp.**—My lamp, "Primus No. 5," persists in burning with a smoky flame, and on unscrewing the top portion I find there is a hard scale formed inside the tube, which doubtless causes the trouble by obstructing the oil passages. I should like to know if there is any way of removing this scale, say by soaking or boiling in some solution which will not injure the metal?—Steelyard.

[96777.]—**Balloon.**—Having what is thought a new arrangement for aërial navigation, I should like to try some experiments, and should be glad if any of your correspondents could give the following information? What sized balloon (cigar-shaped, filled with coal-gas) would lift a weight of 1lb., and what material should the balloon be made of?—Aerial.

[96778.]—**Barometer.**—Having omitted to screw up bucket at foot of the tube of a mercurial barometer before taking it on a sea-voyage, the mercury now so fills the tube as to prevent weather indications. Will someone state by what means a normal condition could be restored, or will it be necessary to send it to an expert?—S. Durant, St. Croix.

[96779.]—**Boiler.**—Would Mr. Allinson or some engineer friend say if copper tube would do instead of brass? Also, what gauge should it be (working pressure 75lb., tested 150lb.)? How do you keep the proper water level? I should think it wants constant attention. I intend trying to make mine self-regulating. Can this be done in practice? It seems easily done on paper.—Aston.

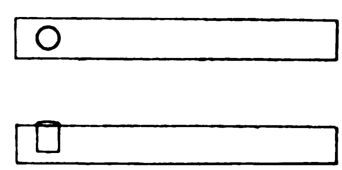
[96780.]—**Irish Degrees.**—(1) What Irish universities confer the degree of Mechanical Engineer? (2) What subjects are necessary to obtain it? (3) Of what practical use is it in the mechanical world?—A Subscriber.

[96781.]—**Electric Lighting.**—Could Mr. Bottone or other readers tell me if, when running a 50-volt 4amp. shunt-wound dynamo, I should require a pilot lamp, or not? Please explain the use of a pilot lamp? Also, what would be the result if a lamp or two were suddenly switched off or on, as required? Would a resistance coil be an advantage, or not? Kindly give size of the best wire to use for a resistance coil made clock-face pattern, with a hand to alter from 1 ohm upwards? Kindly say feet to 1 ohm, then I can make according?—E. M.

[96782.]—**Magneto Ignition Gear.**—Would someone kindly give sketch and particulars for making a "magneto ignition gear" for a two-cylinder 4H.P. horizontal petrol engine? If coil is necessary, size of that as well?—W. E. Pitcher.

[96783.]—**Motor.**—Would some kind reader give sketch of tube ignition to a Dion motor which I have? I note there is a hole for sparking-plug, which I shall not use, as the inlet and exhaust pipes would foul. Also, what arrangement can I make to prevent compressed gases escaping at ignition-hole? Also, in starting carburettor, is it necessary to warm the petrol?—Aeria.

[96784.]—**Grate Front.**—I want to make a pattern for a stove grate front with vertical bars, and I want to have the holes left right through in the top rail of the casting, as per sketch, and about three-parts through in the



bottom of same, so that I can thread some pieces of round iron through for bars. Perhaps some kind reader will kindly help me?—An Old Subscriber.

[96785.]—**To "Monty."**—Will "Monty" please say whether burner (96374) makes a loud noise or not? Also, can he give design of one suitable for common petroleum which will give less noise than the usual "Etna" lamp?—F. M.

[96786.]—**Motor-Car.**—Will "The Writer of the Articles" please say what diameter of wheels, size of spokes, and what width of pneumatics are suitable for a motor-car to carry four persons?—F. M.

[96787.]—**Gas Battery.**—Will some reader be kind enough to give me a few particulars about gas batteries? I have a sort of notion that they are composed of carbon electrodes immersed in some gases; but what the gases are I don't know. Also, what current and voltage will they give?—L. B.

[96788.]—**Railway Waggons.**—Would some reader give full detailed dimensions of a G.E.R. coal-waggon?—Loco.

[96789.]—**Sundial.**—Would some astronomical reader kindly inform me as to the method of drawing a sundial showing time of sunrise and sunset, and a dial giving the time of rising and setting of the moon?—Achernar.

[96790.]—**Hot-Air Engine.**—Is it possible to get or make a hot-air engine for a boat about 14ft. long? What power ought it to be, also what dimensions? Would it be more reliable and easier to make than an oil-engine?—R. W. E.

[96791.]—**Dynamo.**—Could any correspondent kindly inform me as to the winding of the armature of following dynamo (undertype)? Magnets 3¾in. by 3⅜in. by ⅜in.; armature (cog drum) 3⅜in. long, 1½in. diam., six slots ⅜in. deep by ⅜in. wide, to be wound as Gramme ring. Magnets wound with 10 layers (600 turns) of ·036 d.c.c. What influence would winding armature with wire double the size have on voltage and current, and what is the correct size of wire for armature with present winding of magnets to give about 15v. 5a.?—A. S. Hooppell.

[96792.]—**Dynamo and Engine.**—I have a 4N.H.P. vertical engine with 3ft. flywheel; also dynamo with 6in. pulley. The engine runs about 160 revs. per minute. I have also got a 10 to 12N.H.P. engine. I want to make a little change. What size pulley will I want for counter-shafting to run dynamo 20ft. from 4H.P. engine, and how can I find out what size dynamo pulley and what size flywheel for large engine, as I intend getting large dynamo? If I shift the small dynamo to large engine, which has a very large flywheel, 5ft. to 6ft., how can I calculate the speed and size to put on, as I have some spare ones? About how much will dynamo cost to light 50 to 60 lamps? Any information will greatly oblige.—Foreman.

[96793.]—**Speed.**—How can I give a rough guess of speed of engine without speed indicator?—Foreman.

[96794.]—**Bluing.**—How can I obtain the steel blue colour on iron as seen on the furniture of sporting guns?—T. Gallyon.

[96795.]—**Varnish and Stain.**—I should feel obliged if someone could give me a recipe for a good varnish, and state how I should use it? It must be hard, durable, and brilliant. I have tried a good number of varnishes, but some would not stand the wet, and others cracked and chipped off?—Varnish.

[96796.]—**Marine Condenser.**—I have a 1½H.P. vertical multitubular boiler which I intend putting into a boat for sea and harbour use, but am told that it is absolutely necessary that a condenser be used in order to clear the water of salt, muddy sediment, &c., before it enters the boiler, otherwise both the boiler and the engine will soon be entirely ruined. Will someone please tell me the kind of condenser that is required, its mechanism, and how it works? Also the size, weight, and probable cost of same?—Old Colonial.

[96797.]—**Motor-Tricycle.**—Is there any way of constructing a motor-tricycle to pass a somewhat narrow doorway of a private house? Could trike be turned on its beam-ends for this purpose with safety? This is the only drawback that deters me from making a motor-cycle from the excellent description now being given in "Ours." How would a steel liner do for the cylinder instead of boring?—Mechanic.

[96798.]—**Gelatine.**—(1) Can gelatine be dissolved in any liquid besides water without losing its property of solidifying or cooling? If so, name of solvent will oblige. (2) Can anything be mixed into liquid gelatine to make it dry waterproof without affecting its transparency?—Experimentalist.

[96799.]—**Acetylene Gas.**—Will a friend help Cape Colonist out of Queer-street? Some time past I asked how much carbide it would take to generate gas sufficient to fill a five-gallon nourishing tank? I forgot to ask if the gas-tank should be filled with water; if so, will the gas mix or go through the water? A friend of mine tells me that as soon as the gas generates it will force through pipe into gas-tank, strike the water, and end in a blow-up, as there will be a greater pressure in gas-tank. I don't wish to be blown to Pretoria.—Cape Colonist.

[96800.]—**Acetylene Carriage-Lamps.**—Could any reader kindly tell me how to make generator suitable to fix and burn in ordinary carriage-lamps? A sketch would be greatly appreciated.—R. Colin H.

[96801.]—**Pump.**—Could any reader inform me of the best, cheapest, and simplest pump for country use (well 40ft. deep), to throw water to top of house, 25ft. from surface—in all 65ft.—to pump about 100 gallons a day, and where pump could be obtained? I shall be obliged for all information, as it is for a countryman's use.—Thomas Ball.

[96802.]—**Lights in Observatory.**—What kind of light is used in observatories for reading the circles, &c.? Chambers recommends a bull's-eye lantern, covered with red silk or paper. I have one, burning colza-oil; but I find a difficulty in reading printed matter with it. Will some fellow-reader of "ours" who owns an observatory kindly advise?—Oculus.

[96803.]—**Equatorial Adjustment.**—I should be glad to learn what is the matter with an equatorial mounting which gives correct declination when the telescope is on the west side of the pillar, but is between 3 and 4 minutes too low when the instrument is on the east side. After repeated adjustments, I fail to eliminate this error. The mounting—German style—is by one of the best firms in the kingdom, but is thirty years old. May the difficulty arise from unequal wear on the declination axis?—Oculus.

[96804.]—**Hertzian Waves.**—Will some brother reader kindly tell me where I can find a simple account of Hertz's experiments with oscillators (rings and plates of metal)? I have seen Lodge's "Work of Hertz," but that is too technical and advanced. What I want is full particulars of his early induction experiments which led up to the wonderful signalling through space.—H. B.

[96805.]—**Geological.**—Through the crown of the Thanet chalk, about half a mile from the sea, in the greensand, at about a thousand feet deep, the Corporation of Margate have bored, and found water; but it is reported to be salt water, and they are abandoning the costly and hopeful experiment. Will some of "ours," posted in geology, say where else has salt water been found in the greensand, or how its presence below 1,000ft. of chalk is to be accounted for?—W. L. S.

[96806.]—**Ram Supply.**—Would any reader kindly send me a rough sketch of the most efficient ram that can be made with a 2ft. fall, to throw up a ¾in. or 1in. column of water, about 2½ft. above the level of the ram supply? I want to know the proportionate sizes of drive pipes, valves, and air-chamber. Is it possible to do it with a lower fall than this even?—H. C.

[96807.]—**Motor-Cycles.**—I have followed with great interest the able articles that have appeared on this subject, and argue that details for the construction of sparking coil have not been given. Perhaps "The Writer of the Articles" can see his way to fill the gap, as no doubt many situated as I am would be glad to construct their own coils?—J. P.

[96808.]—**Dynamo Switchboard.**—I have just received my 69th volume from the binders, and on p. 42 Mr. Bottone sends a sketch showing how the accumulators, &c., are arranged, and adds that particulars of

working will be found in his book, "How to Manage the Dynamo." I have this book, but cannot find the slightest reference; so perhaps he will kindly give details of using the switches, &c., there sketched, and oblige.—A Subscriber since 1866.

[96809.]—**Bacilli.**—In works on bacteria, where measurements are given, I frequently see the letter "μ" used. For example, where speaking of lactic acid ferment, it is stated the bacilli is "$1 - 1{\cdot}7\ \mu$ by ${\cdot}3 - {\cdot}4\ \mu$." What is the μ or its measurements? Again, in works on organic bodies when submitted to the polariscopes—say, for example, a certain solution of starch—it is stated: "Its specific rotatory power is for $[\alpha]_j = 222{\cdot}0°$; $[\alpha]_D = 200{\cdot}4°$." What is the meaning of $[\alpha]_j$ and $[\alpha]_D$?—Grateful.

[96810.]—**Finder.**—Will some reader be kind enough to tell me what is the best material to use for the cross wires of a finder telescope, and what is the most effective method of fixing them to the brass frame that carries the wires? I have tried human hair, and tried to fix them with sealing-wax; but the former stretches, and the latter fails to hold them.—N. Maclachlan, Routenburn, Largs, N.B.

[96811.]—**Converting Objective.**—Would Mr. Caplatzi kindly tell me whether a 1/10 water-immersion objective can be used as an oil-immersion without further alteration by the makers, and whether such alteration, if necessary, can be cheaply effected? Is cedar-oil used because its refractive index approaches most nearly to Canada balsam or to glass? The objective is a Swift.—T. H. M.

[96812.]—**Winding ½H.P. Motor.**—To Mr. Bottone.—Will you please tell me the best quantity of wire, and sizes of same, to wind a ½H.P. set of castings as a motor to run on a 50-volt circuit, upright type of fields, each limb 2in. square, winding space 4in. on each, to take laminated ring armature 4in. diameter by 2in. long, 12 cogs? How much current will this motor consume at 50 volts, and will same give ½H.P.? I am also making dynamo. Please state size and quantity of wire for same to give 15 volts and about 10 or 12 ampères? Simplex type, cast in one solid piece soft iron, to take laminated drum armature 2¾in. diameter by 4½in. long, with eight cogs. Should I wind armature with two sets of wire in each space for an eight-part commutator, or with single coils for a four-part commutator, as recommended by you in your book on "The Dynamo"? What advantage shall I get if I wind for eight-part commutator, as your mode of winding seems much simpler? How many ampères can I expect at 15 volts? Also speed to run same, and H.P. required? I have your book on "The Dynamo."—Old Reader.

[96813.]—**Oxidised Steel and Iron.**—By what process is the black surface popularly termed "oxidising" produced on iron or steel? I mean such as is seen on the steel cases of watches sold under the name of "oxidised steel."—Gerard Smith.

[96814.]—**Acetylene.**—Will any reader kindly oblige by answering the following questions? (1) What size of burner will be required to give an 8c.p. light? (2) What weight of carbide will be required to supply the above per hour? (3) Acetylene is said to be readily soluble in alcohol. Does the solution thus formed burn with a luminous flame?—J. S.

[96815.]—**Malleable Castings.**—I keep a small foundry, and want to make a few malleable castings. Will some reader say how I am to go about it? What pig-iron should I use, and what grades, if more than one? Can I melt in an ordinary cupola with fan blast? Should there be coal-dust in the moulding-sand, as for ordinary castings? What kind of furnace should I have for the annealing, and how long does the process last?—Malleable Novice.

[96816.]—**Musical Box.**—Will someone kindly tell me what is the cause of a barrel musical box scratching and whistling whilst it is playing? I fancy it is the pins scraping the comb. Is this right? I have been told it cannot be taken out without it going to Paris. I have thoroughly cleaned all the parts, &c., but it squeaks as badly as ever. Should be obliged for any information as to cause.—S. R., Bromsgrove.

[96817.]—**Electric Bell.**—Will one of your readers tell me the reason of the following? I put a bell up with two Leclanché cells to ring it from front door, which it did very well, and then a week after I heard it did not ring, and had only done so for a few hours; so I went and had a look at the battery, and was amazed to find it all full of crystals. I put two new cells, and then found out that the wire was short-circuited through an overdriven staple. Would that cause it, or was there something in solution? I may say the zinc rods were rotted clean away.—S. R., Bromsgrove.

[96818.]—**Square Thread.**—I wish to cut some ⅝in. square threads, 8 threads per inch. As the hole will only be ⅜in. diam., a tool in the lathe to give necessary depth will be very weak. For a depth of 1in. could they be tapped? If any reader having tackled such a job would reply, I should be glad.—B. A. R.

[96819.]—**Coil, Transmitter,** &c.—To Mr. Bottone.—Some little time ago you gave instructions in reply to a query of mine as to how to use a 1in. spark coil in connection with a Marconi transmitter as follows: A half-pint Leyden jar coated 2in. up on either side of transmitter, outside coatings of jars connected with each other, knobs of transmitter connected to brass knobs of Leyden jars, and knobs of Leyden jars to secondary terminals of coil (with a tapping key intervening). I have connected my coil up this way, but on pressing key I cannot get any spark. I have the contact-breaker screwed up tight, so as not to vibrate. I should be glad if you will kindly say where I am at fault? The coil appears to be in good working order, giving a good spark. In wireless telegraphy does it matter if the transmitter is, say, 10 or 12 yards from vertical wire, connected thereto by an insulated wire, or should the vertical wire be connected direct to transmitter without branch wire?—A. M. L. S.

[96820.]—**Sand-Blast.**—I should be pleased if any reader would give a few instructions for making apparatus for sand-blasting purposes on a small scale. I have plenty of power at my disposal.—Blast.

[96821.]—**Ignition.**—Would some friend give me dimensioned sketch of Bunsen and chimney to heat ½in. ignition-tube? I want burner to stand perpendicular with chimney, instead of horizontal. Does it work as well thus? I want to use as little gas as possible with efficiency. Please give internal diameters and lengths to chimney and burner, and size of air-holes and gas-nipple.—Joyce.

[96822.]—**Flashlight for Interiors.**—Having to take photos. of (or in) rooms about 12ft. to 16ft. square, I should like to know what apparatus I should want so as to be able to take them in a few seconds? It takes me now sometimes an hour, as I have to stop my lens down to F 32, and sometimes F 45. If magnesium is used, how much should I have to burn?—Optical L.

[96823.]—**Wimshurst.**—I purchased about twelve months ago a Wimshurst electrical induction machine, and for about a month it worked splendidly; ever since I have not been able to get a spark from it. I have always kept it in a dry room. The plates are not glass, but are black, made from a substance like papier-mâché.—Spark.

[96824.]—**Pains in Head.**—Can any of "ours" say what is the cause of the following? A friend of mine has for the last four years suffered from acute pains over and round his right eye. It comes on, lasts for not more than a minute, amd then passes off; this occurs at irregular intervals. He describes it as if the eye was being torn out, and rolling over and over in the socket. The agony is so intense that the attacks cause him to lose flesh rapidly. The local doctors are unable to give him relief, and confess they do not know the cause. He has, under their advice, had teeth drawn and his jaw scraped, but without avail. He is 58, leads an active outdoor life in bracing climate, rather intemperate, had a bad fall from a horse some years ago which cut his head open on that side and left a scar. I write because among the numerous readers of "Ours" there may be some who have suffered similarly. Any doctor's name who would be likely to cure would be gladly received.—R. W.

[96825.]—**Meteorites.**—Can any of "ours" give me, or refer me to, a more complete list of meteoric falls in the British Isles than that contained in the National History Museum Guide?—J. H. Pledge.

[96826.]—**Polishing Oak Floor.**—Can any reader tell me what to do to make an oak floor look properly dark and polished? It has been covered up with oilcloth in places and has become dull, and is worn away in others. I wish to restore it to an even bright surface, as it must have originally been. With what ought it to be treated to procure this result? Being oak, it would not, I presume, require any stain?—R. A. R. Bennett.

[96827.]—**Trepanning Bar.**—Will "J. H.," or any of your numerous readers, please give detailed sketch, dimensioned, of a trepanning bar to take out solid core of 4in. It is done, I believe, at the Arsenal.—B. A. R.

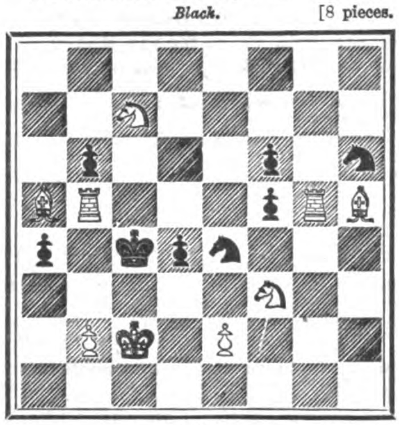
[96828.]—**Rontgen Rays.**—Can any reader give any particulars of the following, which I cut from a London evening paper?—"M. Le Bon, in the *Science Francaise*, announces that by the aid of a simple petroleum lamp it is possible to realise all the marvels of the Röntgen rays. For this experiment all that is required is a petroleum lamp, which is inclosed in a case made of sheet iron, and a fragment of any journal. This paper is placed in a wooden box, which is then so arranged that it stands close against the metal sides of the case containing the lamp. With the aid of the light the paper can be read without any difficulty."—Simon.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1695.—By C. A. Gilberg.

Black. [8 pieces.



White. [9 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Oct.* 16.)

Solution of Problem No. 1693.—By C. Planck.

Key-move, Kt-Q 5.

NOTICES TO CORRESPONDENTS.

Problem No. 1693.—Correct solution has been received from Richard Inwards, T. Clarke, E. C. Weatherley, Whin Hurst, A. Tupman, Rev. Dr. Quilter, G. W. Underhill ("The difficulty of the problem lies in the great variety of Black's second moves"), Geo. Christie ("Q-K Kt 3 would almost do, the black pawn at K 7 becoming a Kt being the only move to prevent it; the use of the same puzzled me for some time").

J. E. G.—Only solution as above.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 4, and unacknowledged elsewhere:—

Brewed Ginger.—W. Schooling.—No Sirrah.—G. A. R.—A. Clark.—J. E. Gore.—A. O. S.—B. W. Lovejoy.—Jack of All Trades.—Viri.—Primrose Hill.—Paradox.—R. T. P.—Miner.—A. Desportes.—Synosique.—R. S.—Spinster.—M. Phillips.—W.—Temperance.

Steelyard.—For information about the Turkish bath see pp. 43, 69, 113, 312 last volume. See, among other replies, one on p. 466, No. 1581, July 12, 1895; also a letter on p. 141, No. 1359, April 10, 1891.

J. M.—Bonetti's induction machine without sectors was illustrated on p. 404, No. 1526, June 22, 1894.

F. J. Norman.—The pipes should be 3in. in diameter at least, as radiating surface is required. Then, if so placed as to give a quick circulation, such a heating arrangement might answer in the South of England. See a little book published by B. T. Batsford, 94, High Holborn, W.C., on "Hot-Water Heating," by F. A. Fawkes.

W. H.—You can find all about liquid air in the back numbers. See, for example, p. 399, No. 1734, June 17, 1898; p. 423, No. 1735, June 24, 1898; p. 577, No. 1767, Feb. 3, 1899; and for the latest form of plant for making it see p. 551, No. 1793, Aug. 4 last.

S. W. A.—The articles on organ-building which appeared in Vol. LXII. and following volumes were published in a revised form by Sampson Low, Marston, and Co., St. Dunstan's House, Fetter-lane, E.C., in two volumes, text and plates, price 31s. 6d.

Anxious.—Address the query to the Admiralty, Whitehall, S.W., and you will receive full particulars. You can also obtain some useful information by referring to pp. 310, 337, 360, 380 of the last volume, which you can no doubt see at one of the free libraries in Birmingham.

G. Calver.—Fear we cannot go into that. We think ourselves from experience that it *is* more nourishing and more easily digested than white bread; but discussions about the merits of patented flours and breads so soon degenerate into mere advertisement that we have no room for them. We always eat wholemeal bread of some sort, giving the preference to that made on Dr. Allinson's formula, which many bakers in town and country work to now.

T. W. L.—The paragraph about aluminium for cooking vessels (p. 113) is given for what it may be worth. The authority for the statements made is quoted, and the results will be known later on—after experience. At any rate, the metal is not injurious to the human economy. High temperatures are necessary for the alkalis to act on the metal; but the chlorides attack it.

Enquirer.—Kerosene is the name applied to the burning oil (lamp oil) obtained from petroleum, commonly called paraffin oil.

Wind Guage.—How can anyone say what the anemometer gauges without more particulars? Probably the first dial shows the rate of the wind in feet per second, and so on, the last showing "miles per hour." But that is only a guess. Surely there is some indication on the apparatus.

E. D. P., Ontario.—The articles on "A Practical Treatise on Organ-Building," by F. E. Robertson, commenced in No. 1597, and concluded in No. 1664.

W. J. Woodhouse.—Perhaps Slingo and Brooker's work, published by Longmans, would suit, or Sir D. Salomons's "Electric Light Installations," published by Whittaker and Co. See many replies in back numbers.

Welsh.—Only by examining the wheels, using calipers, if necessary. If by "phosphorus paint" you mean "luminous paint," that has been described many times, and recently.

Optical L.—A good ordinary silver or carbon print can always be satisfactorily reproduced. It is of no advantage to send the negative, except for photo-lithography.

Ell Hay.—When you have learnt good manners, we shall be disposed to give you another hearing. The first three lines of your present communication effectually bar its insertion. You are evidently one of those half-informed persons who delight to quibble while professing to seek for information.

S. H. Cooke.—November 13. Further particulars will be given in due course in our "Astronomical Notes" at the end of this month. 2. We do not remember one. Ask Macmillan and Co., St. Martin's-street, W.C.

Rustico.—Much larger, we believe. We gave the figures as they appeared in the German paper. 2. We do not know.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

Special Notice. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

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Immisch Electric Motor 1I.H.P. horizontal type, 100 volt, 6 6 amps., shunt, drum armature, 36 sections, very compact, suit small shop or motor-car. Exchange Motor-Tricycle out of repair, or Sell.

Dynamo, overtype, cogged drum, shunt, 55 volts, 12 amps., self-oiling ring bearings, made by Leeds firm. Exchange Motor-Tricycle Components, or Sell.—J. B., 119, Oakfield-road, Liverpool.

Silver-on-Glass Speculum, 7½in. by 7ft. focus, high-class. Exchange for Pinder, 14in. to 2in., four eyepieces, and cash, or apparatus. Also wanted, a Transit Instrument, 2in. to 3in., for cash or exchange.—Carlaw, Architect, Lanark, N.B.

Gent's Bicycle, pneumatic tires, first-class make, new, cash £10, or exchange for Lathe or Scientific Instruments.—H., 19, Canonbury Villas, Canonbury, London.

"English Mechanic," 34 volumes, excellent condition. Exchange offers by letter (no Postcards) to—Books, care of Mr. Watson, Stationer, 107, Lauriston-road, South Hackney, N.E.

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Dynamo, 50 volts, nine ampères, weight 1¼ cwt., as new, cost £8 15s. Sell £4, or exchange.—Below.

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Set 4½ Ardwick Launch Engine Castings, Forgings. Exchange anything useful, sell cheap.—Particulars, Whetman, Richmond.

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The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of Screws, Bolts, and Nuts for model work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—Morris Cohen, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—Clegg, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—Jarratt, Queen-street, Leicester.

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Eyesight.—All whose sight is in any way defective should send to Horne and Thornthwaite, 416, Strand, for—

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Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—Pemberton.

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The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, OCTOBER 13, 1899.

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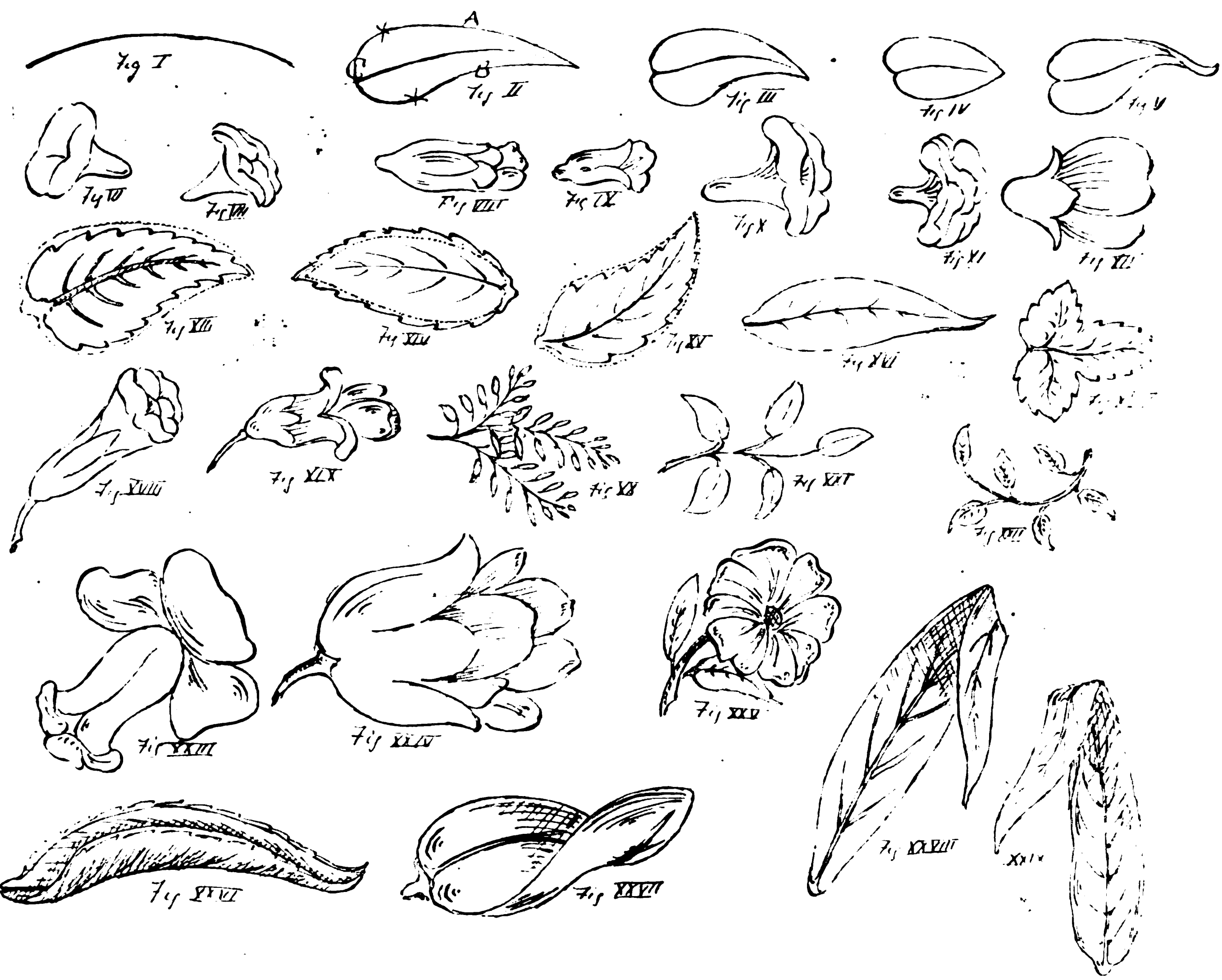
WE have but little to say by way of introduction further than to advise those who intend to take up this fascinating study, to practise well the preliminary stages of drawing with a view to the better handling of the saw.

The reader who studies the examples here set out will have a material advantage over those who, being desirous to hasten on with the cutting, leave the drawing studies till later on.



Another point of great importance to be remembered is that all, or nearly all, our work is in outline. We cannot avail ourselves of the fine touches that the pencil gives on paper; yet proper effect can be given by a few judicious saw-cuts, and the shading shown where it ought to be. We say ought, because many examples of work fairly cut are spoilt by bad shading; and we now point out an error that is unfortunately too prevalent, and that is the overcrowding of a design that would be far and away a better example if it contained less of the unnecessary detail that is worked in. Rather err on the side of insufficient, if of good quality. The charm lies in the happy medium, and good practice will assuredly bring about good results.

Our first batch of drawings will give an idea of what is wanted in the most simple form, either for cutting or drawing. Fig. 1 is the simple stem or vein of a leaf, and we have taken that as our foundation or basis. The curve itself conveys nothing in the shape of beauty, but if we add the top and bottom curves we approach a leaf form. The third curve will complete the leaf. Just a word is necessary to explain why we take the vein as our typical basis. It is for this simple reason that, in whichever direction the vein grows, the outline or contour of the leaf follows with it. Fig. 2 gives the three curves at A, B, and C, although they are seemingly segments of a circle. The use of a compass to obtain them should be avoided: free-hand work should reign predominant. With circles it is different and permissible. The other examples, which are mainly for copying purposes, call for little comment, with the exceptions of Figs. 13, 14, and 15. It will be seen that two examples have the outline dotted outside the leaf proper, the other being within, the object being to decisively show the method of outlining roughly to gain the same inclination of sweep or curve as the vein. Detail is added afterwards according to requirements.

A few words are necessary with regard to turned or twisted leaves ere we close this chapter. Ever aim at depicting the stem first: that will safely guide to the formation of the leaf. It will be easy enough to imagine the course of the vein in Fig. 26, although only just the starting is shown; but with Fig. 27 it will be readily followed, being of longer duration, only a small portion of the leaf being twisted. With abruptly-turned or overlapping leaves, as at Figs 28 and 29, the course of the vein is very distinct, showing almost the entire length of the leaves. In future studies the governing properties of the vein will be fully demonstrated, as also will the grouping of leaves, buds, &c., in their proper order; the above will suffice for this, our first lesson. The method of making the cutting appliances will occupy our attention in the next chapter.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—VI.

NEPHOSCOPES in the hands of experts prove to be the best means which have as yet been discovered for telling an observer the direction from and the velocity with which the clouds may be moving. These instruments, of which there are many different patterns, by indicating these movements of the clouds, provide valuable information as regards the vagaries of the upper currents of air, and it is from such observations as these that nearly all the present knowledge concerning the winds at high levels is derived. Now, a very few minutes spent in observing such a formation of cloud as that popularly called "Noah's Ark"—a cloud in which there appears to be a central line with offshoots or ribs—will quickly indicate that, in determining the direction from which such a cloud is coming, questions of perspective confuse the judgment; while the same difficulty will be experienced if the attempt be made to define the direction in which the central line and the offshoots are lying. It is for the purpose of eliminating these distortions of perspective that the nephoscope is employed, and, since many of these instruments are very simple in construction and are easily understood and managed, their use is to be recommended as a means of rendering the movements of the clouds more easily understood. If a very minute degree of accuracy is not required, it is by no means difficult to make a nephoscope as will serve for ordinary observations.

In its very simplest form a nephoscope consists of a circular mirror upon which are ruled

two lines to represent the four cardinal points of the compass, the lines being so drawn that they cross exactly in the centre of the glass disc. If the back of this glass be painted black, the clouds may be reflected from it, and their movements followed without distressing the sight. An ordinary observation is made by placing this mirror on a level surface some four feet or so above the ground, so that the observer may examine the reflection of the clouds without undue stooping. The cross lines on the mirror should be accurately adjusted to the points of the compass, and in making an observation the north point of the mirror may be turned towards the southern horizon, for it is the object of these observations to tell, not the direction towards which the clouds are travelling, but the point of the compass whence they are coming. Having, then, thus adjusted the mirror, the image of a small cloud or some well-defined portion or limb of a large one, should be reflected so that its image coincides with the centre of the mirror or the point where the lines cross one another. The image of the cloud should then be watched, and if it is moving at all quickly it will soon be seen to be travelling towards the circumference of the mirror, and the point at which it departs from the field of view indicates the direction from which it is coming. If the cardinal points are not reversed as suggested above, the point at which the image of the cloud leaves the circumference would indicate the point towards which the cloud is travelling, so that in this case the recorded direction would need to be referred to the opposite side of the compass, so that a cloud moving to the south-west would be registered as coming from the north-east. Moreover, the rate at which the clouds traverse the mirror affords a basis for estimating and comparing their velocities, and this much in the same way that one estimates the velocity of the clouds from the rate at which their shadows travel across the fields and the hills. For those lower clouds, therefore, whose apparent motion is so much faster than those at a higher level, a simple nephoscope constructed as above will allow of their direction and velocity being recorded, and its use serves as an admirable introduction to those more complicated methods of observation which are necessary when dealing with clouds at the highest levels.

Between the movements of the scudding clouds which traverse the sky at a high velocity, and those of the apparently slow-moving cirrus cloud which floats far above the highest mountains, there is a great difference as regards the rate at which they move across an exposed mirror, and for the purpose of observing such clouds as the cirrus certain additions to the nephoscope are desirable. It oftentimes takes the image of some of the highest clouds several minutes to journey across an inch on the mirror, and it is necessary to employ a pointer to indicate the distance which the image of the cloud as travelled in a given time. There are numerous ways of adjusting this pointer, but in all of them the object required is that it may be so fixed that its image may exactly coincide with the spot on the mirror where the lines drawn as suggested above cross one another. In one particular nephoscope a stout wire pointer about 1½in. long is fixed to the margin of a disc of metal about 2in. in diameter, the opposite side of the disc being turned flat, and covered with cloth so that it may not scratch the mirror when placed upon it. Supposing now the image of a cloud, or portion of a cloud, is, as before, reflected in the mirror so that it coincides with the intersection of the cross lines, all that needs to be done is so to move the pointer that its image also coincides with this central spot. This operation, it may be said, will be readily understood by holding a pencil at the side of an ordinary hand mirror, and moving it about until its point is exactly reflected at the centre of the glass, and it will then be understood that there may be many ways of adjusting and fixing the pointer of a nephoscope in the desired position. Supposing, then, that this adjustment has been properly made in the nephoscope, the intersection of the cross lines and the images of the cloud and the pointer will all coincide. The eyes may now be taken off the mirror, and the instrument left to itself for two or three minutes. On returning, the image of the pointer being once more made to coincide with the centre of the mirror, it will be seen that the cloud has moved away from the centre, and, as before, the distance traversed and the point of the circumference towards which it has travelled will be an index of its velocity and direction. For scientific purposes nephoscopes are adjusted to a great degree of nicety, and there is considerable elaboration as regards the pointer, the scales and lines, and circles; but, as seen above, it is possible to obtain a fairly correct notion of cloud movement by apparatus of a less pretentious character.

It is a curious fact that it was only at the commencement of the present century that the attempt was made to classify the clouds. Things so familiar as the clouds, it might have been imagined, would have been amongst the earliest meteorological phenomena to be investigated; but until Luke Howard in 1803 published his famous treatise, men were content to look at the different cloud forms without desiring to give them a name. But this psychological anomaly may be left for the consideration of the philosophically-minded. Howard did his work of naming the clouds so well that his descriptions have formed the ground-plan of every system of nomenclature which has since been proposed. So familiar are his cloud names that it need only be repeated that he introduced the three main types. The lower sheet of cloud he called stratus, the middle layer cumulus, and the upper cirrus. These are easily recognised clouds, and their names are no less familiar than the cirro-cumulus, which is the cloud popularly known as mackerel sky, and the cirro-stratus, which is equally familiar as the cloud which is responsible for the haloes which form round the sun, moon, and stars. The term nimbus is reserved for any cloud from which rain is actually falling. These are all clouds which may easily be differentiated from one another, and they are more than sufficient for an observer who is feeling his way, as it were, through the intricacies of the weather by means of observations made in his own locality. From time to time there are international congresses held in different parts of the world to discuss matters meteorological, and the meeting at Upsala in 1894 concentrated its energies on the subject of cloud-observing, and resulted in the compilation of a Cloud Atlas. In this publication are to be found the most recent suggestions for a universal nomenclature, photographs being also given, so that a specimen cloud may serve to illustrate each name. The classification is, of course, much more elaborate than Howard's; but it is to be wished that some such atlas as this might be adopted, so that cloud observations might be more comparable with one another.

It is indeed to photography that the increased interest in the clouds is due, and with its aid it is now possible to measure the height and extent of the clouds and to record their movements, and also to secure a permanent record of their ever-changing forms. In many of the photographs of clouds taken a few years ago it is not always possible to tell which is cloud and which is sky, for in some pictures the cloud is white and the sky brown or black, or vice versâ, and a little experience is required to recognise the kind of cloud that has been photographed. But this also is a matter wherein great advance has been made, and such difficult clouds as the cirrus are now photographed with clearness. By means of yellow glasses also the troublesome action of the blue sky, which has almost the same effect upon the ordinary photographic plate as white light has been overcome and its effects eliminated. Cameras have also been fitted with theodolites, and by photographing a cloud simultaneously at two stations widely separated, the height of such clouds has been determined. The records concerning such methods of research as these are, however, to be found in various reports, and anyone desiring a detailed account of the methods adopted in these most useful photographic enterprises will find full particulars therein.

Now, whether the clouds be observed with or without the aid of apparatus, it is soon borne in upon an observer that there are many different processes at work in forming them. Moreover, admirable as are many of the names which have been given to the clouds, they are nearly all merely descriptive, and only in a few cases do they attempt to indicate the processes by which the clouds are made. Thus a cloud which presents the same appearance during wet weather as in fine, is nevertheless produced by quite a different set of conditions on the two occasions, and will, moreover, float at varying levels, so that the attempt has been made to fit such clouds with names that shall indicate these varying conditions. Many of the processes of cloud formation are now reproduced in laboratories and lecture-rooms, and the most interesting of these experiments are those which show how vapour-laden air condenses into cloud, fog, or mist, when it is suddenly expanded. The researches of Aitken have also demonstrated that the kind of cloud that will be produced depends in nearly all cases upon the amount and quality or texture of the dust-particles in the air. It is said that Londoners nowadays see the sun at noon forty-five days less per year than was the case during the middle of the last century, the increase in atmospheric dust being responsible for these additional cloudy days. Even at the top of the Rigi Aitken found 700 dust-particles in a cubic foot of air, while on another occasion a similar volume of "pure" Alpine air was found to have no less than 4,200 of these dusty nuclei; and without this dust, which varies in texture at various levels, there can be no cloud.

There are numerous ways by which the temperature of a mass of air may be reduced, the most active agents being radiation, mixture, and reduction of atmospheric pressure. The height above the ground at which this reduction in temperature takes place determines also whether the vapour will condense as a minute globule of water or as a tiny spicule of ice. Thus the coronæ which form close to the sun and the moon indicate that the cloud is composed of unfrozen vapour, while those larger circles or haloes, with the accompanying mock-suns and moons, tell that the vapour froze as it condensed. Now, both these clouds are a variety of cirrus; but the one that forms the haloes is at an average of 9,000m., and is called cirro stratus; while the cloud which forms the coronæ is between 3,000m. and 7,000m. above the surface of the earth, and is called alto-stratus. These names, therefore, are intended to indicate something of the conditions in which the clouds were produced. Again, there are strong ascending currents of air rising daily from the ground, which, when they reach a certain level, condense their moisture as the familiar cumulus or woolly cloud. Further, it may happen that this cloud is broken up by strong winds into detached, quickly-moving portions, and the suggested name for these broken clouds is fracto-cumulus, a name that is meant not only to indicate the cloud form, but also that it was produced during the prevalence of strong winds. Not only, therefore, may something be learnt concerning the movements of the clouds by watching their images in the mirror of a nephoscope, but repeated observation of their changing shapes and calculations as to their height will reveal many of the circumstances under which they gained the beauty of their colouring and outline.

ORNAMENTAL TURNING.—XXIX.

By J. H. Evans.

In continuation of our studies of the spherical slide-rest, I have, after consideration, come to the conclusion that it will greatly enhance our advance if we assume that those parts already detailed and illustrated have reached the stage as therein described; this being so, we pass now to the foundation (I will term it) of the second slide. This, it will be observed, by reference to Figs. 1 and 2, is made as a separate slide, and ultimately attached to the top plate of the first slide. Reference to the illustration clearly shows that this, in like manner to all the slides connected with this slide-rest, must of necessity be somewhat limited in thickness, for the reason already explained—viz., that so many working parts have to operate within a given and limited space.

This slide, then, which is 9in. long by 4in. wide, having an interval at the centre, as shown, of about 1½. This is not of great importance as to the exact dimension given. I need scarcely say that it is simply for the passage of the nut of the main screw.

Having the forging of Fig. 1 at hand, all burrs must be removed, which is easily done with an old file; it is then placed and carefully fixed on the planing machine, care being exercised that it does not spring from the surface at any point. It is then accurately planed up all over, and ultimately scraped and surfaced until perfectly true. This is a test of the abilities of the operator, and, with a fair knowledge of how to use them, all that will be required is an accurate surface-plate, and a scraping tool correctly ground and set.

I have seen a good many different men at this particular kind of work. Some will cover the surface-plate with a substance that will fill up

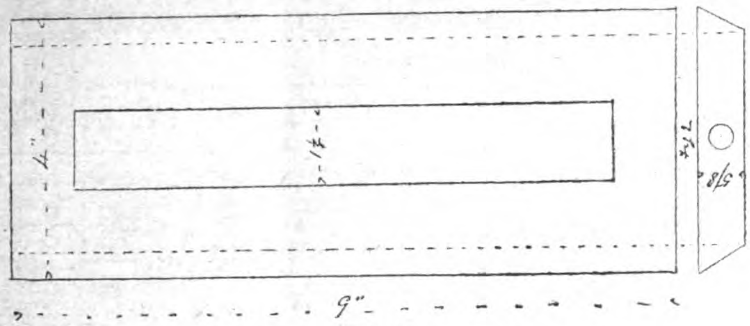


FIG. 1.

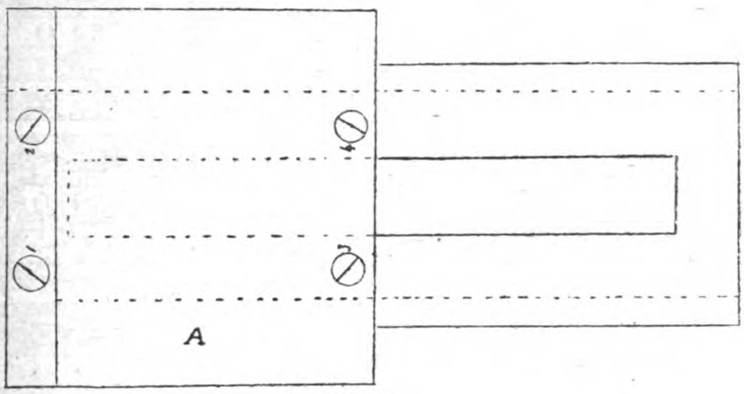


FIG. 3.

nearly all parts of the work when it is applied to the surface as a test. This is a great mistake, as it misleads the operator altogether. The less adhesive substance used the better, and the rubbing together of the work in hand upon the surface plate will at once show clearly the highest parts, which must be carefully removed until the two agree as nearly as possible. This will, no doubt, be regarded by many as a tedious and to some extent an unnecessary proceeding, but it will be found to give an ample reward in the end when the slides are put together.

We will look upon this slide so far as complete, and our next proceeding will be to fix it to the top plate of the lower, or first slide. The first thing to do will be to take the plate A, Fig. 3, which has the one side bar in the solid as shown. The slide, Fig. 1, must be fixed to ascertain the position in which to drill and countersink the four holes, 1, 2, 3, and 4. This done, the slide may be removed while the holes are prepared.

The slide is then again placed in position, with its end flush with the plate. One hole is then carefully marked off, drilled, and tapped, and the first screw got in its place; and now comes the time for the exercise of all the care we can command. On the accuracy of this slide, when fixed, much depends. It will be seen that when fixed this slide lies parallel with the lathe-bed, and should any error exist, it will, of course, be multiplied in accordance with the length of the slide, hence the caution required in fixing it.

Having the one screw in its place, the slide can be held by it to the plate while the others are got in, and when this is completed to satisfaction it is, in reality, an anxious time overcome. Although the slide is limited in thickness, there is ample room to tap a dead hole;—by this I mean the drill should not be taken through the upper surface of the slide, as it is both detrimental in appearance and creates a means of collecting grit or dirt, which might at any time mark the slide if not removed. As there is no necessity it must be avoided. If required, the bottom of the hole may be made flat by the introduction of a small D bit; but this, I think, I may safely leave to the discretion of the person who has the work in hand.

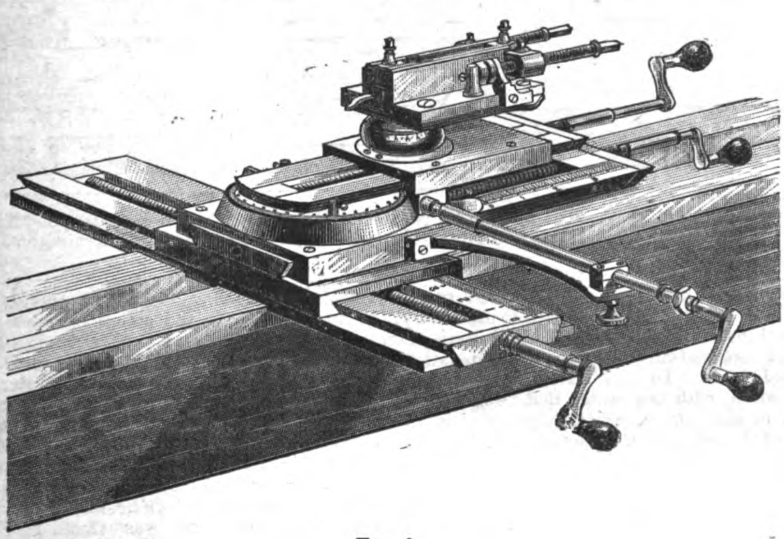
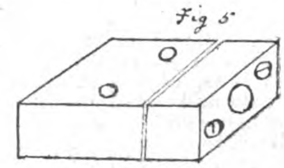


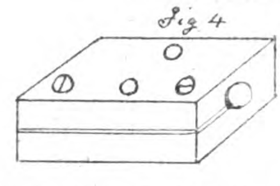
FIG. 6.

By reference to Fig. 6, which is an illustration of the instrument when finished, I think many points will become much more readily apparent and help the operator considerably—hence its introduction at the present moment. Reference at once to it shows clearly that the plate forming the slide, which works upon that we have just fixed, is exactly the same as that which is fitted to the first slide, and it will be seen that the side which has the angle attached in the solid is placed at the front, the loose strip being, of course, on the opposite side. For this there are two reasons: first, its general appearance; secondly, it is required to carry a gunmetal arm, which will be described as we come to its use and purposes.

I have suggested leaving the fitting of the main screws for one job; but I am rather inclined to think that, having these two slides so far completed, it will be a change in the character of the work if the main screws for these are fitted now.

The screws must, of course, be 10 to the inch,





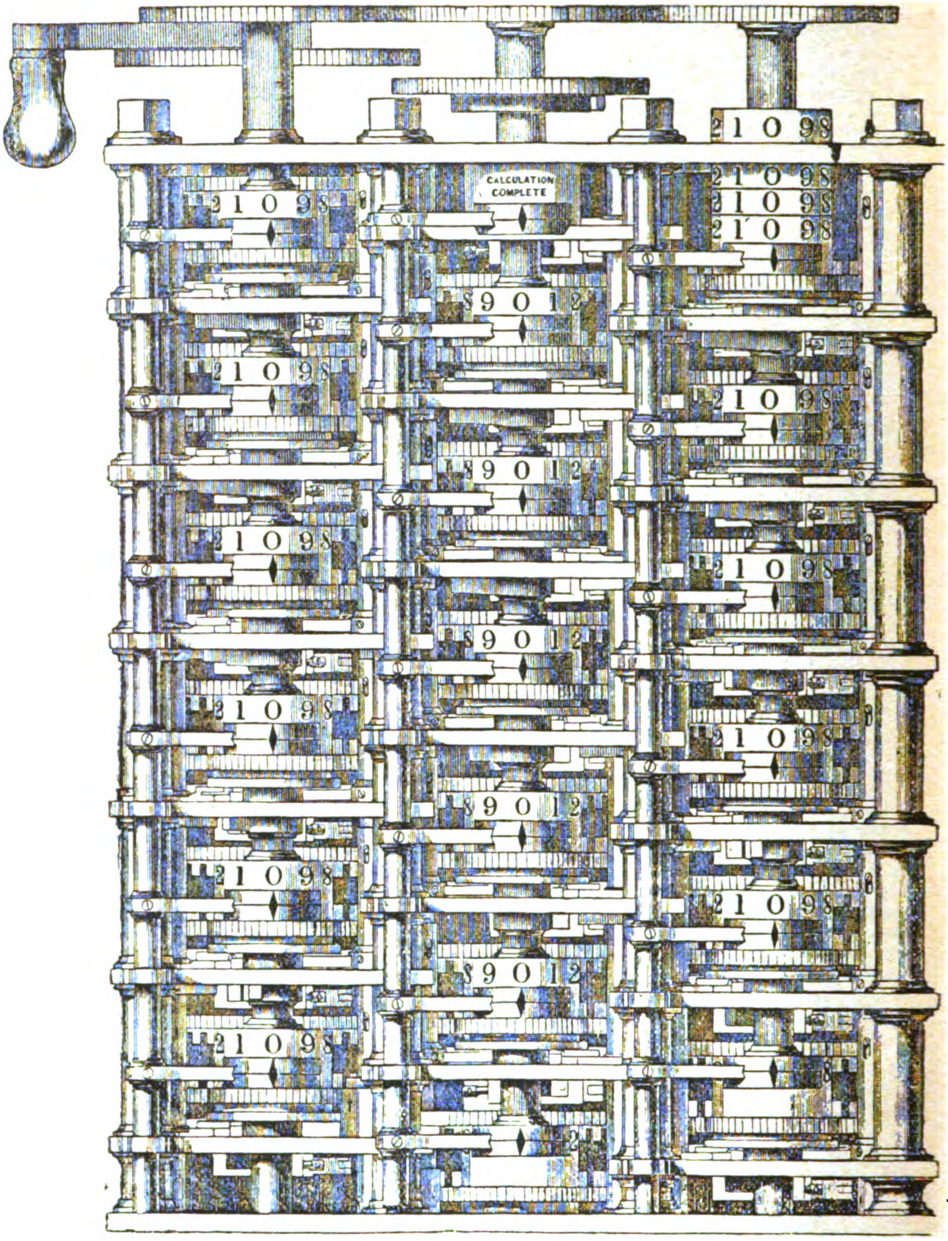
like all others in connection with ornamental turning apparatus. The first thing to do will be to carefully lay out the position and drill the holes in the slides. At the front the size of the holes must be just in excess of the diameter of the screw, while that at the opposite end will be of a size suitable to the end of the screw when turned down to the bottom of the thread. With regard to countersinking of the slide or the metal end-plate to receive the collar of the screw, I feel constrained to say that as long as either be correctly and truly done, I do not think it matters which plan is adopted. The end-plate may be made to the shape of the slide, or simply an oblong plate of suitable length to accommodate the two screws which retain it in its place. On the projecting end of the main screw, and fitted in front of the winch-handle, a micrometer is fitted, but reduced in diameter to allow the slide to pass over it, thus giving a valuable increase in the traverse of the slide, which, with the old-fashioned micrometer of large diameter, was entirely lost. While upon the subject of the main screws, I cannot do better than dwell upon the importance of fitting the nuts in the latest and best way. Having sufficient length, the nut can be made about 1⅜in. long, and the upper surface must be carefully adjusted to just touch surface of the slide, to which it has to be fixed. Having said so much, I may point out that should there be any space between the slide and the nut when it is fixed to the plate, it will draw the screw up in the centre. If very little, however, it may not be felt, especially when the nut is working at the centre of the screw; but as the slide is moved it will be found to become tight at each end. The same will result if the nut is insufficiently reduced, and has to be forced under the slide. I have seen so many amateurs in trouble in this respect, which is easily overcome, of course, if a slight reduction of the nut is all that is required. It is but a few moments' work, and I do not mind admitting that if the reverse is the case the space can be made up. Where a deal of work has been expended, I see no law in mechanics why, if by the careful addition of what is required, the work is saved, it should not be done. These little outrages are, I may say, not confined to amateur's work; however, it is a way out of a difficulty, and it is my aim to assist all I can in this respect; but with these remarks I will retire from the point, not perhaps covered with honours, but with the screw and nut working as if nothing had happened.

One more important feature—one of the most, in fact—is the necessity for the entire immunity from loss of time or back-lash in the screws; the latter being square threads render this a difficult task; unless the nuts are treated as shown in Fig. 5. Before fully detailing this, I will briefly allude to the original mode adopted for setting the nut down to the screw. Referring to Fig. 4, it will be seen that the nut is cut through one side, into the thread of the nut in which the screw works. Two screws are then fitted to pass through the upper part into the lower half, and the tightening of these compresses the nut together. So far as angular threads are concerned, this plan will effect the desired purpose of taking up the wear of the nut occasioned by long service.

We come now to that which is more suitable to the work we have in hand, and is an improvement I introduced some time ago. It must be remembered that we are now dealing with screws that are cut with a square thread, and, to effect the required regulation, the nut must be treated in quite a different way. If we consider it as shown in Fig. 5, it will be seen that, instead of the nut being cut as in Fig. 4, it is separated in precisely the reverse direction. The nut, when whole, should have the placed marked where it is to be severed, which, as seen, is just beyond the two tapped holes by which it is held to the slide. Two holes are drilled through from the front, a plain hole passing the short piece, while the screw is tapped into the other portion. It is better to drill these holes before the nut is cut, as it insures greater accuracy.

It will be at once clearly demonstrated that in the case of a screw having a square thread, which has become worn by continual service, the nut, as made in Fig. 4, would have no effect beyond tightening it round the screw, it would not reduce the back-lash or loss of time; but if we study Fig. 5 it shows that the adjustment of the two screws at the front end of the nut will take up the wear that has occurred in the square thread—that is, the side of the threads between tooth and space—and by this means all such screws can be so regulated that a perfect immunity from the usual loss of time is assured. It will be obvious to all that if, assuming the plan shown in Fig. 4 is adopted, it would simply tighten the nut on to the screw without any other effect than rendering it more difficult to detect; but the error would still exist. I have previously alluded to this, but it is such an important item that I have thought it well to now fully explain the difference between the two ways of operating upon the nuts of screws for the purpose referred to, as the whole operation envolves so little work. I strongly advise that all such screws be treated in this way. A few hints as to the winch handles will enable this part to be completed. The end of the screws should be left perfectly round, and the pipe of the handle accurately fitted. A mortise hold should be cut across the pipe or barrel at the necessary distance, and the end of the screw filed to fit the same; being thus fitted, they are true with the screw, and for such work the old-fashioned square end to the screw has been long since abandoned.

I have now given sufficient details and drawings to enable the rest as far as the second slide to be completed, and for my next will prepare the necessary information for the succeeding rotary motion, &c.



Impression from a Woodcut of a small portion of Mr. Babbage's Difference Engine, No. 1, the property of Government, at present deposited in the Museum at South Kensington.

BABBAGE'S CALCULATING ENGINES.

By Ronald Smith.

It is, perhaps, so much of a commonplace that the first inventor or originator of anything of use to mankind gets the least return that it is hardly worth while repeating. But in the case of Mr. Charles Babbage, the inventor of the Difference and the Analytical engines, better known as calculating machines, it is peculiarly distressing that in return for so much, for so extraordinary an output of brainwork, he got nothing at all. He demonstrated that the whole of the developments and operations of analysis were capable of being executed by machinery; that by mechanism a constant source of error in large numerical calculations, especially in the construction of nautical and astronomical tables, could be completely eliminated. In short, he showed how absolutely correct results could be obtained with the added advantage of economy in time. And this, curiously enough, without human intervention during the course of the operations performed by the machine. Almost needless to say this was the remarkable feature of his invention, for before his day there were calculating machines. There was that of the philosopher and mathematician Pascal, just as there have been many since, and, it may be said, that still they come. But the drawback in the earliest, as it is in the latest, always excepting Mr. Babbage's Analytical engine, is that the mechanical powers in execution require the continued intervention of a human agent. The operations of Pascal's wheelwork calculating machine, which is believed to have been the earliest of its kind, were executed from wheel to wheel by the hand. The removal of this drawback obviously depended on the discovery of a principle so general, that if applied to machinery, the machinery would acquire, as it were, the power of mechanically translating the operations indicated to it. To this Mr. Babbage devoted his attention, with the result that he invented a system of mechanism which required only the nature of the calculation to be executed, or, of the problem to be solved, to be indicated to it. The rest would be done—that is to say, all the intermediate operations would be performed—by the machine's own intrinsic power. Whether it was capable of showing a greater likeness to human intelligence may be reasonably doubted; but there can be no doubt that it was capable of showing something uncommonly like human intelligence when it was known how to order it to perform. Manifestly it could not originate anything; but, as pointed out in the translation of Count Menabrea's sketch of the analytical engine, which Mr. Babbage accepted as true, "the engine is capable, under certain circumstances, of feeling about to discover which of two or more possible contingencies has occurred, and of then shaping its future course accordingly." To the work of designing and planning the essential mechanism of his idea Mr. Babbage devoted the best part of his life, and it may be added, his private fortune, getting in return, as already stated, nothing at all.

Before offering a description of his engines, it may, perhaps, be permitted me to give a brief outline of his life, adding, as stated by his son, Major-General Babbage, that his father never himself wrote a full description of any of his machines, preferring, "while his energies lasted, to devote them to the actual progress and development of the design." Mr. Charles Babbage was born at Totness, in Devonshire, on December 26, 1791. As a boy he was early interested in mathematics, buying, out of his pocket-money, a second-hand copy of Euclid. He was found studying Ward's "Young Mathematician's Guide," when other lads of his years were studying sport. Before he went to Cambridge, where at Trinity College he was entered in his nineteenth year, he was familiar with the "Method of Differences" and the higher mathematics, starting his college career with a copy of La Crox's "Differential and Integral Calculus" in his pocket. One evening in 1812 or 1813, in the rooms of the Analytical Society, a member, seeing Babbage in a dreamy mood, with a Table of Logarithms before him, called out, "Well, Babbage, what are you dreaming about?"—to which he replied, "I am thinking that all these tables [pointing to the logarithms] might be calculated by machinery." This incident may be said to have been the starting-point of his special work, and he was reminded of it later, when it had passed from his own mind, by the late Master of the Temple.

But although the first idea of a calculating machine arose in the inventor's mind at that time, it may be inferred that the opportunity of giving practical effect to it had still to come, he in the meanwhile pursuing his college studies. He took his degree of Bachelor in 1814. Other honours followed, and while at Rome, in 1828, he was elected Lucasian professor for his own

C. BABBAGE.

University. During a visit to Paris he carefully examined the method by which the celebrated French tables had been computed under the direction of Prony. At Paris, too, he came in contact with Didot, from whom he obtained, though at a high price, a copy of his stereotyped table of Natural Sines and their Differences. The French Board of Longitude, with much kindness, allowed him to copy from the tables deposited in the observatory at Paris, the logarithms to fourteen places of figures of every 500th number from 10,000 to 100,000. This appears to have been the fairest period of his life. Well received among distinguished men, and recognised as a mathematician of brilliant promise, no intellectual feat seemed too great for his reach, or no honour worth having beyond it.

The idea of a calculating machine, though it lay dormant for some years, was not to be dismissed, and it was easily aroused on Mr. Babbage observing the almost innumerable errors in printed volumes of logarthms, in the tables in the *Nautical* and other almanacs, and in other tabular works, whose value depended entirely on their accuracy. Navigation, observation, the safety of life and property at sea depended on these tables being produced correctly, and yet they could hardly be taken up and examined without being seen to be full of errors. To design a machine that would not only produce them correctly, but would print them as well, with absolute accuracy was Mr. Babbage's object. He considered the printing of the results, without chance of error, of great practical importance. Indeed it is regarded as doubtful whether he would have undertaken to design a machine to calculate results without also designing machinery to print them. In 1829 Mr. Babbage was working on the drawings of his first calculating engine, and, on June 14th, 1822, he announced to the Astronomial Society that he had completed a machine of two orders of Differences, with which he constructed tables of square and triangular numbers. The Royal Society reported to the Treasury in its favour.

The Government, regarding the invention as of national importance, took it up and directed an advance of £1,500 to be made. Shortly after, the construction of the famous Difference engine was commenced. But troubles arising quite beyond the control of Mr. Babbage, the work was stopped in 1833 and never resumed, the Government finally abandoning the undertaking in 1842, leaving the inventor without remuneration, or even the offer of a suitable appointment. The whole of the money advanced by the Treasury, between £11,000 and £12,000, had been expended in paying the workmen and for the materials employed in constructing the Difference engine, and not one penny of it was ever put into his own pocket by Mr. Babbage. This fact was stated in the House of Commons by the Chancellor of the Exchequer. It is a curious fact in connection with the construction of the Difference engine, that one of the workmen employed by Clement, the engineer, was J. Whitworth, who, as Sir Joseph Whitworth, Bart, became a notable figure in the country. With much penetration he saw, in the construction of Mr. Babbage's engine, the advantages of solid framework, screws to fixed threads, and work to gauge, and with high intelligence developed them to his own profit and the great advantage of the country. Indeed, it is no exaggeration to say that the requirements of this engine led to a remarkable advance in the art of mechanical construction generally, and consequently the invention, apart from its own intrinsic value, was a distinct national gain.

At the stage at which the construction of the engine was stopped, the calculating part was so far completed that Mr. Babbage had a trial piece put together, and it was found to work perfectly. This piece is now in the South Kensington Museum. The second, or printing part, was never put together. In order to afford a clear idea of the calculating part of the Difference engine, Major-General Babbage, the inventor's son, to whom the engines and all the papers relating thereto were left by will, has made the following descriptive outline, which he very kindly permits me to use.

The Difference Engine.

To construct tables to eleven places of figures correctly it was considered advisable to have a machine with six columns of differences and eighteen places of figures in the result. The columns were arranged vertically; the "result" on the right hand, and the differences in order 1st, 2nd, 3rd, &c., towards the left. The mathematician was to give the proper "differences" to be introduced by hand, and the machine, being then set to work, was to produce the terms of the required table, which were to be stereotyped successively as produced on some soft material. To save time, the additions of the odd "differences" (1st, 3rd, 5th) to the result, and even "differences" (2nd, 4th) were made simultaneously first, and then the even were to be added to the odd. The mechanism was supported by horizontal frame-plates, and held firmly together by vertical rods passing through the plates from top to bottom, making the framework massive and rigid, according to the idea of Clement, the engineer who led the way in this direction with so much benefit to the art of construction. The digits 0 to 9 were displayed round the circumference of the discs, and as each figure disc with its attendant pieces was thus inclosed between two frame-plates, each division was called a "cage." The pieces are arranged on five vertical axles on each column; two are merely pivots, on which bent or shaped levers turn; three are revolving axles, to which various arms are fixed. These three axles are moved by the driving apparatus successively one at a time. The pieces in each cage being made to gauge and identical throughout, it is only necessary to describe one cage, and show how a digit in one cage is added to that in the next right-hand column. The figure discs are in the front of the machine, free to rotate on their axle. They have a spiral-tooth wheel, which is in gear with one of double the diameter behind. This wheel is called the "lower adding wheel." Above it is another wheel called the "upper adding wheel," of the same size as the other; this is in gear with the lower adding wheel in the next right-hand column. Between the upper and the lower adding wheels there is fixed on the central axis a small platform on which there is a sliding bolt free to move on the line of a diameter. This bolt always comes to rest in a position perpendicular to the front of the machine. It is shaped symmetrically at both ends, which are cut square, and on the under side near each end there is a round steel stud projecting downwards. In its normal position, when the axle is turned the bolt will not touch any part of either the upper or the lower adding wheels; the bolt remains inoperative if 0 is shown in the figure disc while addition is made in the other cages. In every other case the bolt is shot from behind, and the front end enters between two of the crown teeth projecting downwards from the upper adding wheel. This is effected by a pretty hit-and-miss arrangement. At the back of the machine there is an axle which carries fixed to it an arm in each cage arranged spirally. On each arm there is a wedge-shaped piece which acts on a similar one on another piece, which has two arms, and is pivoted loose on a fixed axle; one arm carries the counter-wedge just mentioned, and the other has a shaped end which engages the rear end of the sliding-bolt above mentioned, and shoots it in all cases except where there is 0 on the figure disc. If the figure is 0, a single-tooth camb on the lower adding wheel will be displacing the double arm and keeping it out, so that the steel wedge passes inside the counter-wedge and misses it entirely. When the bolts are shot, the central axle carrying the bolts is turned a half-circle, and the figure discs in the next column which are to receive addition immediately begin to move with it, showing the numbers one by one successively as if being counted. When the proper number has been added the bolts are withdrawn by an arrangement now to be described.

On the top of the lower adding-wheel two wedges are placed at such a distance from the centre as not to touch the steel stud on the under side of the bolt unless the bolt has been shot. In that case the thin edge of the wedge engages the steel stud, and forces the bolt back to its normal position; the bolt, though continuing its motion, becomes inoperative, and the wheels and figure disc in the next column come to rest. During this time the lower adding wheel has remained firmly locked and the digit on the figure disc unchanged. In those places in the next right-hand column where the figure disc has passed or has come to rest at 0 a click will have been heard, produced by a catch having been released, and an arm carrying a pawl pulled back by a spring. Everything having come to

rest, the axle on which the figure discs are centred is made to turn once round, and a set of arms fixed spirally on it replace the pawl arms under the catch one after the other ready for the next operation.

It should perhaps be added to General Babbage's description of his father's Difference engine, that it was designed to compute nautical and astronomical tables, and that its function being to add only, any other processes except those which it would be possible to reduce to a series of additions, were beyond its reach. Still, the more this remarkable piece of mechanism is considered the greater is the regret that its construction was stopped and the work abandoned by the Government. It is estimated that only a few hundreds—probably not more than £500—more were required to complete, at least, the calculating part, and the Duke of Wellington, who took great interest in the work, recommended its completion. But his colleagues in the Cabinet, seemed at sea in the matter, and would sanction no further outlay. So that the fact remains a lasting reproach, that an invention which astonished the scientific world of that day, which was stamped with the approval of Davy, Wollaston, and Herschel, was denied adequate assistance. Lord Rosse, in his address as President of the Royal Society, declared that he deeply regretted and felt bitterly disappointed that the "first great effort to employ the powers of calculating mechanism in aid of the hmman intellect should have been suffered in this great country to expire fruitless because there was no tangible evidence of immediate profit."

Subsequently Mr. Babbage conceived the design of his

Analytical Engine.

In 1848 he had thought out the principles of construction, and made the drawings and experiments for this his immensely greater work. Unlike the Difference engine, which tabulates only, the Analytical engine can add, subtract, multiply, or divide. All four operations can be performed at the same time or separately—that is to say, without the aid of any of the others. Consisting of two parts, the first part is the "Store," a series of columns each containing a series of wheels. The store may be three or more dimensions: it contains the variables or numbers to be operated upon, also the quantities used in previous operations and returned to the store. Each column in the store corresponds to a definite number to which it is set either automatically or by hand, and the number of digits in this number is limited by the number of wheels carried on the shaft of the column. The wheels gear into a series of racks which can be thrown into or out of gear by means of the cards to be explained presently. The second part is the mill. In this all the computations are made, consequently all the quantities to be operated upon are brought therein. In the mill, not only the fundamental operation of addition, but the combinations of addition, subtraction, multiplication, and division are performed. All the shifting, changing, carrying, and, indeed, all the processes of reckoning go on in the mill, being suitably directed therein by means of perforated cards. Every formula to be computed would consist of certain algebraical operations to be performed upon given letters as directed by the mathematician, and of certain other modifications depending upon the numerical value assigned to those letters. The law of development is communicated by two sets of perforated cards. One set, called "variable cards," are in form like the cards used in Jacquard loom weaving. By means of perforated cards used in the Jacquard system the design of any pattern to be woven is communicated to the loom. Similarly, by means of the variable cards in Mr. Babbage's system, the formula to be computed is communicated to the calculating part of the engine. The numbers (punched) on these cards are transferred to the subject of operation in the mill by a set of wires or axes precisely like the way in which the warp threads are pushed up and down in the Jacquard loom. The other set of cards, called the "operation cards," indicates, by the perforations thereon, the nature and sequence of the operations to be performed. These, on being placed in the engine, act upon the cams and clutches, which direct the gearing of the number wheels of the mill or the store. When these cards have been placed, the engine is special for the particular formula to be computed; and on the machinery being set in motion the variables or numbers required are called into the mill, and the operation is completed by the engine printing as well as computing the numerical results. The calculating power of this engine is such that, reckoning the velocity of the moving parts to be not greater than 40ft. per minute, by its means 60 additions or subtractions could be completed and printed in one minute; one multiplication of two numbers each of 50 figures in one minute, and one division of a number having a hundred places of figures by another of 50 in one minute.

It was of this Analytical engine that Count Menabrea, an eminent military engineer in the Italian service, wrote his sketch, translated by Lady Lovelace, in which he demonstrated from Mr. Babbage's invention "that the whole of the developments and operations of analysis are now capable of being executed by machinery." To the perfecting of this engine Mr. Babbage gave the most of his attention to the day of his death, October 18, 1871.

MILLWRIGHT'S WORK.—XII.

As line shafting runs at a uniform rate of speed, while machines are driven at variable rates, intermediate or countershafts are employed to produce these variable rates. These are short lines of shafting on which pulleys are fixed to transmit definite speeds, greater or less than those of the line shaft. When machines are

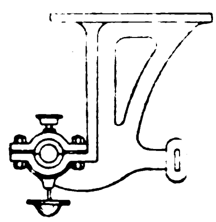


Fig. 74.

fitted with speed cones, the countershaft is fitted with similar cones. The striking gear of a countershaft is that arrangement by which the belt is shifted to fast or loose pulley, to drive, or to leave the countershaft idle.

Of countershafts of this type there are two or three principal classes, each of which finds its application in the work of the millwright. The drum on the line shaft may drive one pair of pulleys, fast and loose on the counter. Or, two drums may drive two pairs of pulleys of different diameters, one set the largest, for driving, the other the smaller for reversing, at a quicker speed, with a crossed belt. Or the pulleys may be used for two speeds of driving. The same results may be obtained by altering the positions of the pulleys, putting two of different sizes on the line shaft, and uniform sizes on the counter.

As regards arrangements of countershaft as a whole, these vary with requirements. The shafts are carried in hangers, or in wall brackets, or on floors, and these fittings, therefore, resemble those already illustrated for line shafts. Many brackets, however, have slots cast in lugs at the back, to receive the sliding fork-bar, Fig. 74, used for shifting the belts. The details of methods

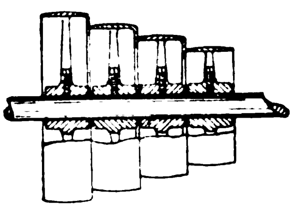


Fig. 75.

of operation vary. A very common device is that of dependent ropes, with handles, which, on being pulled, slide the fork-bar along. Frequently rigid levers are used, while many firms have their own special devices.

The shifting of a belt on the countershaft for stopping and starting machines retains its place tenaciously in English practice, notwithstanding that many friction arrangements have been offered, and are employed to a considerable

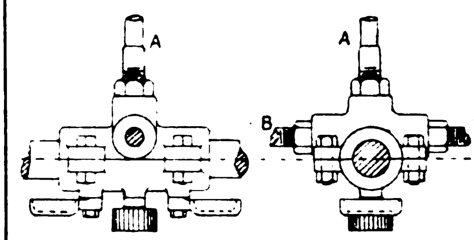


Fig. 76.

extent in place of it. Objections to the common device are more theoretical than practical. It is efficient, though clumsy. The change is a gradual one, as it should be. It is open to question whether it would be advantageous to use narrower belts in order to diminish the time of changing from loose to fast pulley. To use a narrow belt would mean a higher speed to transmit the same power. And it is well known that many machines have to be started gradually.

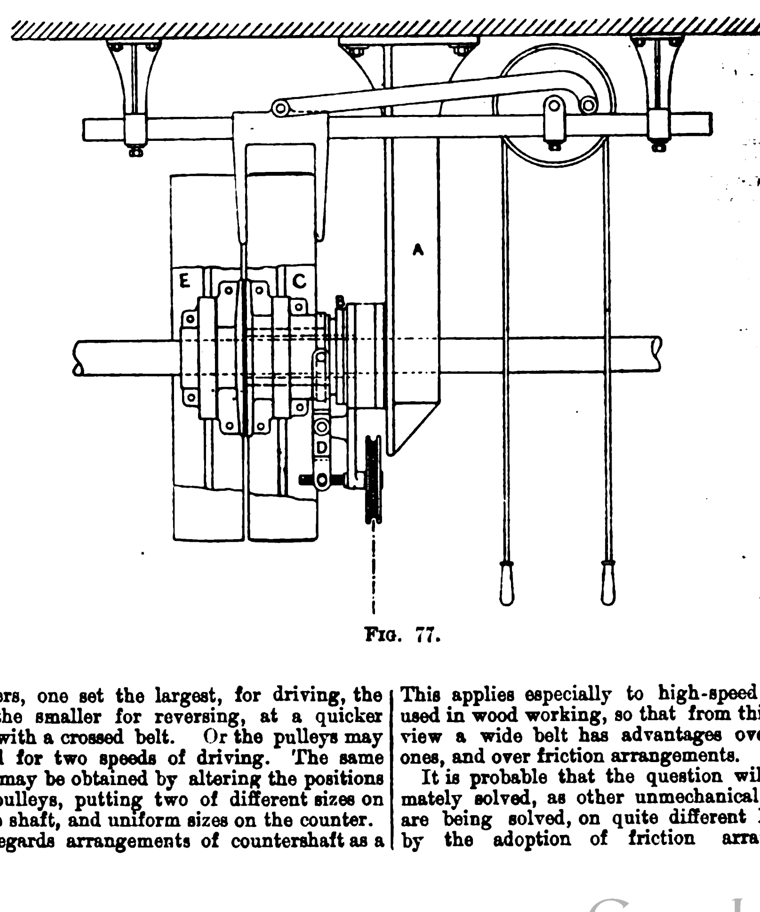


Fig. 77.

This applies especially to high-speed machines used in wood working, so that from this point of view a wide belt has advantages over narrow ones, and over friction arrangements.

It is probable that the question will be ultimately solved, as other unmechanical problems are being solved, on quite different lines; not by the adoption of friction arrangements,

ingenious as they are, but by the abolition of belting, and the substitution of motor driving.

Stepped cones as used for countershafts are generally cast solid. But they are also made up (Fig. 75) by the use of special pulleys, flanged on one side, but cast singly, and fastened side by side to the shaft with set-screws — a method which permits of ready and rapid combinations being effected at less expense than casting the cones in the usual way would involve.

The countershaft, though a very convenient device, is not indispensable. Humpage, Jacques, and Pedersen, of Bristol, have their shops arranged without countershafts by making the cone pulley loose on the main shafting. A clutch on the shaft, operated by a rod which comes down to a footstep bearing on the floor, starts and stops the pulley through the clutch. In this way the countershaft, belts, and bearings, with the beams for attachment, which increase weight and obstruct light, are avoided. This is not an experiment, since the new shops have been in operation about six years.

In this connection, note may be made of a type of adjustable bearing which has been in use for half a dozen years in these shops. It is shown in Fig. 76. It is not a swivel bearing, but is readily adjustable by means of right and left-handed screws. It is of cast iron, four diameters long, and is attached to the principals by an extension of the vertical tie-rods, a right-hand screw being cut on the extended end. A vertical rod A is screwed into a boss on the top half of each bearing, and fastened with a lock-nut. The vertical rod which carries the bearing is attached to the screwed end of the vertical tie with a long sleeve-nut, screwed right and left-handed, and fitted with lock-nuts. It is here that vertical adjustment of the bearings is provided for. Lateral adjustment is provided by casting bosses upon the sides of the upper half of the bearing, and screwing them right and left-handed. Horizontal tie-bars, B B, are screwed into these, and the outer ends of each line of these is brought through a hole in the shop columns and fastened with lock-nuts.

In laying out the shafting, one length was first brought into alignment vertically and horizontally, after which the horizontal adjustment of the others was secured by distance gauges.

The bearing itself differs from others in the fact that the lower half is the one which is removable, so that instead of lifting the shaft out, it is lowered out. Four bolts sustain the weight.

Lubrication is effected by screwing a Stauffer lubricator into the bottom. The pressure of the cap squeezes out the lubricant as required. Two drip-cups, bolted to the bottom half, receive the waste lubricant.

Croft and Perkins, of Bradford, make a special sleeve-fixing, Fig. 77, arranged to carry the loose pulley clear of the shaft, and to bring the driving-belt to rest; also a special starting and shipping gear to set the dead pulley in motion whilst the belt is being shipped.

The illustration shows a sling hanger, A, bolted to the ceiling, and carrying a cast-iron sleeve, B, clear of the shaft, and forming a carrier and bearing for the loose pulley C.

The loose pulley C has a groove turned in the boss on one side, in which a loose strap, attached to the lever D, is placed, and on the other side of the boss a flange is cast, which, covered with leather or copper on its face, is pressed by means of the lever and screw against a similar flange on the rotating pulley E, which is keyed to the shaft, thus putting the belt and loose pulley C in motion. The belt is then shipped on to the pulley E by means of suitable belt shipping gear; afterwards the pressure is released between the flanges of the pulleys, and the loose pulley C comes to rest. The same means is adopted for removing the belt from the rotating pulley E, back to the loose pulley C. J. H.

THEORY AND RULE OF THUMB.

THE winter session at St. Thomas's Hospital was openeds by Prof. Clifford Allbutt, M.D., F.R.S., Regius Professor of Physic, University of Cambridge. In the course of his remarks he said: Many deep thinkers are wont to abuse the Englishman for his stubbornness to new ideas, for his stupid distrust of abstract thought. The ordinary practical man is stubborn and stupid in this respect, yet abuse is no explanation; the ordinary Englishman is by no means a failure in life, and warped as he thus is in grain, and blind as he may be to the decrepitude of the rule of thumb, yet his prejudices are the ossified relics of true and invaluable instincts, and, like other fossil remains, may give us much light if we study them reasonably. Why, then, does the Englishman, successful in politics, successful in business, full of common sense, avoid the man of theory? Why, indeed, has he been busy in his daily conversation to degrade the very word "theory," and to confound theory with visionary speculation and with random guesswork? Indeed, it is with pain that I note some such habit even in scientific men, who, uninstructed in the meanings of language, will not hesitate to make the monstrous assertion, for example, that such and such a matter has been "raised from the position of a theory to that of a scientific fact." What such a speaker means is that the matter has been raised from the position of a conjecture or hypothesis to the position of a theory. Now a fact is something that has happened; a theory is an orderly prediction of what will happen, based upon a formulation of past facts. It is the function of a university, by sifting and testing facts, to arrange them in series whereby to point out what will happen in the further future. When I say that a university is primarily the seat of theory, I imply then that it has a prophetic function. You will demur to me that I am rather departing from an answer to the question why universities are to concern themselves with practical arts, such as medicine, say, and mechanism. It is needful, in my opinion, that they should do so, though I admit that this opinion is not yet general in Oxford and Cambridge—for one reason, concerning the graduate, that the pursuit of theory without touch with practice is apt to become intolerant, and, I will boldly add, is apt to lose its usefulness. Not only so, but without touch of its mother earth it is apt to become too Olympian, and, like the Olympians, to lack bone and blood; gradually to lose life and reality, as scholarship was losing life and reality until scholars learnt lately to dig. For another reason, concerning the undergraduate, unless he be one of the rarer spirits, who, fortunately perhaps, are few, he needs some visible bridge between the truths of abstract thought, or theory, and the needs of the art to which his life has probably to be devoted. I do not hesitate to say, for example, that the great Cambridge school of mathematics has both given and received new life since, unlocked by the labours of men such as Lord Kelvin, the prodigious value of its stores have been realised in the arts. And perhaps I ought to stay here to point out that thus the men of theory, being fed by more solid food, and the men of practice being led to see that out of solid food the most exquisite works of the mind are elaborated, a certain fusion of theory and practice in one institute is the means of the highest education. Yet a university is

Not an Educating Machine only,

it is not only a treasure-house of gathered lore, it is also a factory of new knowledge. Whatever its pretensions, a university which does not produce new knowledge is no university; whatever its humility, a technical school which creates new knowledge, even in one department only, is so far a university. The university should take up so much of the practical arts as enables it to theorise more soundly; the technical school should be conversant with so much theory as to explain the principles upon which current workmanship depends—to explain, that is, the theoretical basis of knowledge empirically obtained. For, although many great and even stupendous arts are now created by foregoing theory, yet mainly in the past the arts have preceded the sciences, and in the fine arts, at least, still precede them. The ground is now prepared for us to understand the practical man among us who flouts theoretical teaching. In the Englishman it is not a fault, but a virtue—though virtue in excess may be a fault—to have a keen and watchful sense of perturbations and contingencies. Even in dealing with nature he has empirically learned, by way of having his knuckles rapped, that general laws are interfered with so incessantly and so largely by laws of less and less generality that the general law or laws may often appear to be of less account than empirical maxims made in practice—that is to say, than the rule-of-thumb. For instance, the laws of cosmic physics, which in astronomy work under disturbances which do no more than test the validity of general laws, in meteorology are disturbed so largely and so incessantly as to make the practice of navigation and the like depend at least as much on rule-of-thumb as upon the most general laws. Day by day, indeed, rule-of-thumb is usually far more valuable to the sailor than knowledge of these fewer general laws. Now, if this be true of an art concerned with so simple a study as cosmic physics, how much more is it true of chemical and of biological practice, and how much more, again, of arts, such as politics, which deal with the incalculable factor of man himself? The Englishman, then, is by general bent an opportunist in all his arts; there is with him a continual sense of the frequency and relative extent of interferences, and by this natural bent to rule-of-thumb he has done mighty works which men versed rather in the wider sweep of more general laws could not have achieved. The failure of the opportunist is not only that he is blind to the broader principles, but that he is blind also to the truth that all secondary and tertiary perturbations are themselves of the nature of law. That a proposition may be "theoretically true but practically false" is a mischievous saw; a theoretical statement which turns out false in application is itself incomplete; its completeness had not been tested again and again by ordinary practice, or by that artificial practice which we call experiment. The moral of this homily is, then, that I would urge upon medical students to learn all their sciences, including pathology and pharmacology, at a university, and to learn the more intimate details of practice at a great hospital, such as that of St. Thomas.

SIR A. NOBLE ON TECHNICAL EDUCATION.

SIR ANDREW NOBLE, delivered the inaugural address of the session for 1899-1900 of the City and Guilds of London Institute Central Technical College, Kensington.

In the course of his address, Sir Andrew Noble said: Technical education properly considered was of the highest importance, both to them and to England. It was only its abuse that they had to guard against. One of the great abuses he took to be that technical education was often begun too early in life, that it was substituted for a general education, and a boy attempted to put his knowledge to practical use before he had learnt how to learn. Another abuse was the divorce of practice from theory and the danger of elevating practical application above scientific knowledge. He wished, therefore, to say a few words about the necessity of acquiring a sound general education before any special work was attacked, and about the necessity of basing all practical work on theoretic knowledge. He attributed the compliment which had been paid him in the invitation to speak at the opening of the session to the fact of his having been connected for many years past with the management of probably the largest engineering firm in England. That position had afforded him exceptional opportunities for observing what educational antecedents were likely to produce the best results in the engineering field. He said exceptional opportunities advisedly, for they at present employed in their various works not far fewer than 30,000 hands. Of those a large number were youths, often sons of workmen, but not unfrequently drawn from the class which he saw represented before him. He was continually asked what education he should recommend for a lad entering Elswick. He always said:—"Send your son to as good a school as you can, keep him there as long as you can, do not curtail his time of schooling, do not stunt his early intellectual growth by narrowing it down to any special study as taught at elementary schools." Science, mechanical drawing, and such like were no doubt very useful, as all knowledge was useful, in their way. These studies might prove an irresistible attraction to minds with a strong bent towards scientific subjects; but he fancied most employers would rather that a lad came to them blankly ignorant of both, so long as he had had a good education, had been taught, and had ability to think and to concentrate his attention on any subject brought to his notice. In nine cases out of ten any knowledge acquired by a boy before he was 16 could have but a slight intrinsic value. Up to that age it was not what he learned that they had to look at, but how he learned; it was the habit of discipline, of mental application, of power in attacking a subject, that were so valuable, not generally any definite piece of knowledge he might have gained. According to his experience the most valuable knowledge that a man had at his disposal was that which he had taught himself. He was not in accord with those who thought that modern languages would supersede the classics as a means of education. Men of science would remember that practically the whole of our scientific nomenclature was borrowed from the Greek and Latin languages. But, whatever might be the fate of the classics as a means, he must take up his parable against a course of education he had seen in several primary schools, where an attempt was made to teach boys, often little better than children, rudimentary chemistry, rudimentary geology, also physiology and electricity. Occasional popular lectures on these sciences might be of very great value to some boys in interesting them in these great subjects and in leading them at some later date seriously to study them; but these sciences, as taught in the schools he referred to, could have but little value in encouraging habits of thought, of application, and of mental discipline. Those men who, with fair abilities, had received a really good education, had been taught to use their minds, and who, by contact with other students, had acquired habits of application amply made up for their late start by the power of mind and grip that they brought to their work. They were fresh and keen

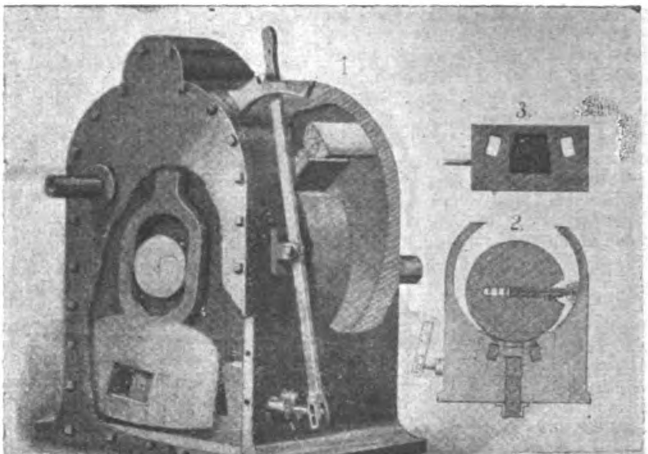
when others, who had been hammering away at semi-technical work from early boyhood, had become stale and were less vigorous, and that reflection moved him to deprecate strongly any attempt to teach seriously practical or electrical engineering in preparatory or elementary schools. As an excellent recreation such studies were no doubt to be encouraged, but to make them a systematic part of education to the exclusion of studies which had a more direct effect in developing the understanding seemed to him to be entirely wrong. He would go further and say that, even in public schools and their equivalents for older boys, what were termed engineering shops were generally a failure so far as any efficient knowledge to be gained in them was concerned. Except as a reasonable diversion for recreation hours such "shops" had, he feared, but little value, and in nine cases out of ten the hours spent in them were subtracted from the time due to more valuable studies. In his judgment the age at which a boy should seriously begin any special studies, with a view to fit him technically for the profession he might decide to follow, should not be earlier than 17 or 18.

Theoretic Knowledge and Foreign Competition.

His next point was that any practical technical instruction and any practical knowledge acquired in the workshop should be based upon sound theoretic knowledge. He was driven to enforce that question, because he found that in this country far too much weight was given to practical skill and what was the rule of the thumb, and far too little to sound theoretic knowledge. In the middle of this century English machinery was immeasurably superior to any other. To their remaining content with that state of things and to their seriously neglecting technical instruction he attributed the very much greater comparative progress that Germany, the United States, and Switzerland had made in the last 50 years; and, if he was not very greatly mistaken, they would have before many years in the East an important commercial rival in Japan, as that country was developing its manufacturing powers with an energy that was as remarkable as it was unexampled. Turning to other departments of industry, no Englishman could observe without regret how certain branches had almost altogether abandoned this country and been in a great measure left to those who had paid more attention to technical instruction. Nearly every requirement of a drawing office could be better and more economically obtained from Germany. From what source did all their pure chemicals come, their filter papers, and most of their glass apparatus? He admitted that the workmanship of many articles made in England could not be surpassed, but if they required any original or special piece of apparatus they were frequently compelled, as he had been, to go to Germany or France for their manufacture. Manufacturing progress had in Germany gone hand in hand with material progress. In the competition of manufacture this country was pressed very hard from steel to watches, from marine engines to scientific instruments. In nothing, indeed, had German manufacturers made more progress than in the making of all exact instruments. In these departments Germany certainly excelled us so far as original and inventive improvement was concerned. All this improvement he felt inclined to attribute not, with Sir William Harcourt, to any linguistic superiority, but to the far greater opportunities of technical study which were afforded in Germany. If this country was to hold its own, the older men must try to multiply these opportunities of study, and the younger men must do their part, by seeking to avail themselves to the uttermost of any such opportunities provided. Older men, like himself, whose careers were approaching their termination, could not but look with envy on the career which might be open to some of those present. It was said of the telescope, which opened to their vision infinite space, that it was balanced by the microscope, which showed them the infinitely small; but small as were those objects, the kinetic theory of gases opened up to their appreciation—he had almost said to their view—molecules whose dimensions were inconceivably smaller. It would be vain to name to them the limiting dimensions of these molecules which had been revealed to them by the labours of Maxwell, Lord Kelvin, Clausius, and others; but he had seen somewhere a statement which might be more easily appreciated. It was something like this: that though the molecules of hydrogen gas were so small that it would take about 50 millions touching one another to make an inch, they were so numerous in a cubic inch of gas at 0° Centigrade and atmospheric pressure that, if the whole of them were formed into a row, they would go round the circumference of the earth more than a thousand times. The molecules also, as they probably knew, were in violent motion. The highest velocity he had obtained with a projectile nearly reached 5,000f.s., but the average velocity of the hydrogen molecules at the temperature and pressure he had named was somewhat more. He once calculated that a few molecules, he forgot in how many millions, might exceed 50,000f.s. Modern science seemed to show that it was equally vain to seek for anything that was perpetually and absolutely at rest. He had alluded to the kinetic theory of gases because they knew more of the constitution of that form of matter than they did of any other, but, having regard to the progress of science to which he had referred, was it too much to hope that some of them would live to see a second Newton, who would give them a second Principia which should clear away the difficulties which surrounded their ideas of the constitution of matter whether ponderable or imponderable?

THE TOENNES ROTARY ENGINE.

ANOTHER rotary engine, described as a "small, compact rotary engine," arranged to utilise steam expansively, has been patented by Richard Toennes, of Boonville, Missouri, and is noteworthy chiefly for the construction of the piston and for the method employed in admitting and controlling the steam. Fig. 1 is a perspective view of the engine, with parts broken away to show the cut-off mechanism; Fig. 2 is a partial sectional front elevation; and Fig. 3 is a view of the reversing-valve. The piston of the engine is eccentrically mounted, and is provided with a spring-pressed piston-head, which consists of a shank made in parts breaking joints, and which is formed at its outer end with a pivot, on which an auxiliary head is mounted to rock, this auxiliary head being likewise made in sections breaking joints. The engine has two main ports, one of which can be used as a supply-port and the other as an exhaust-port. These ports are reversed in function when the engine is reversed.



To change the direction of the piston-motion, a reversing-valve (Fig. 3) is used, having two through-ports and an exhaust-recess or port on one side, designed, as the valve is shifted by the long lever shown in the engraving, to connect either main port with the exhaust-port. The cut-off mechanism comprises a valve superposed on the reversing-valve, and having a swinging arm extending across the engine-shaft. The arm is provided with a yoke, which is acted upon by an eccentric on the shaft to cut off the steam and allow it to work expansively. The steam can be cut off at ¼, ½, or ¾ of the piston-stroke. In lubricating the cylinder, piston, and bearings, oil is fed only at three places. With the exception of the shaft, no moving parts are to be seen on the outside of the engine-casing.

A MARITIME PIGEON-POST.

WITH regard to the moot point as to the practicability of successfully organising a system of correspondence by means of carrier-pigeons between steamers and sailing-ships and the land, some interesting facts relating to what these "messengers on the wing" have up to now accomplished may be appropriate at this moment, says the *Westminster Gazette*.

In England carrier-pigeons, as we all know, are utilised for purposes of communication between the lighthouses and the shore. They are also utilised by the masters in command of fishing-smacks who, having had a successful venture, despatch them with the news to their landing-post. No sooner is the information received than steamers are sent out for the purpose of collecting the fish, so that the masters may continue their fishing operations under favourable conditions.

On the steamers of the Transatlantic Company trading between Havre and New York, the system of communicating by means of carrier-pigeons is now organised. Travellers who wish to communicate with the land write their messages on post-cards, which are photographed on thin tissue-paper the size of a visiting-card, and, inserted in a light tube, secured under the wing of the carrier-pigeon. At daybreak the cage is opened and the pigeon starts for home, where these miniature messages are either retransferred to other post-cards for transmission, according to superscription, through the post, or wired to destination.

At the present time the distance accomplished by carrier-pigeons between the trans-Atlantic steamers and the land is somewhat less than a thousand miles, but it may be considerably increased if the companies unanimously agree to erect pigeon-houses at the extreme south-west point of Ireland on the one hand and Halifax on the other hand.

Several miles out at sea beyond Auckland, New Zealand, lies Great Barrier Island, which has no regular communication either by cable or steamer with the New Zealand Archipelago. But now the idea is being seriously entertained of organising a fortnightly service of carrier-pigeons between it and Auckland. The messages styled "pigeongrams" will have to be written on tissue-paper not larger than a visiting-card. The superscription, written in pencil, like the text of the message, must be at the top of the paper, to which will be affixed a postage-stamp representing a pigeon on the wing with "Great Barrier Island" written over it; "special post" beneath it, and "One Shilling" on both sides of it. A first issue of 1,800 of these stamps has lately been put into circulation.

A service of carrier-pigeons is organised between Sardinia and the Italian coast. By this means Cagliari can communicate with Naples on the one hand, and, on the other hand, the island of Maddalena can correspond with Rome. The distance between Cagliari and Naples is 450 kilomètres, and between Maddalena and Rome it is 270 kilomètres, and it is covered by the carrier-pigeons at the rate of 65 kilomètres per hour.

In America pigeon-houses have been erected on board warships, for the purpose of intercommunication and corresponding with the land. This system is also in vogue on board several French men-of-war. The pigeon-houses on the American ships are most ingeniously constructed. They have two stories, are painted in bright colours in order to attract the pigeons, and are fitted up with every convenience for the comfort of the birds. Not long ago nine of these "messengers on the wing" were brought to London from Boston and set free three months later. Three of them crossed the Atlantic: the one found its way to Boston direct; another was discovered near Boston, and the third was found in Allegany.

In 1877 the Société Colombophile of Saint-Nazaire tried experiments with carrier-pigeons taken out at sea on board the steamers. They were intrusted to the pilots, who were instructed to set them free at increased distances. Many of them returned home, having travelled back 300 kilomètres. But most remarkable of all feats performed by carrier-pigeons was that of the pigeon despatched by Sir John Ross from Assistant Bay on October 13, 1850. It safely reached its home in Ayrshire in direct line across the Atlantic.

IN the Tesla Interrupter, the interruptions are obtained by a stream of mercury impinging upon a rotating disc having projecting teeth. The interruptions take place in a gas under pressure, thus permitting a much higher frequency than would otherwise be possible.

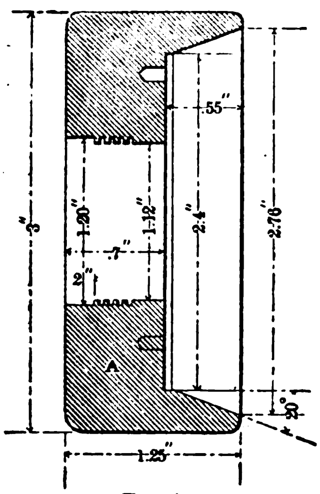


Fig. 1

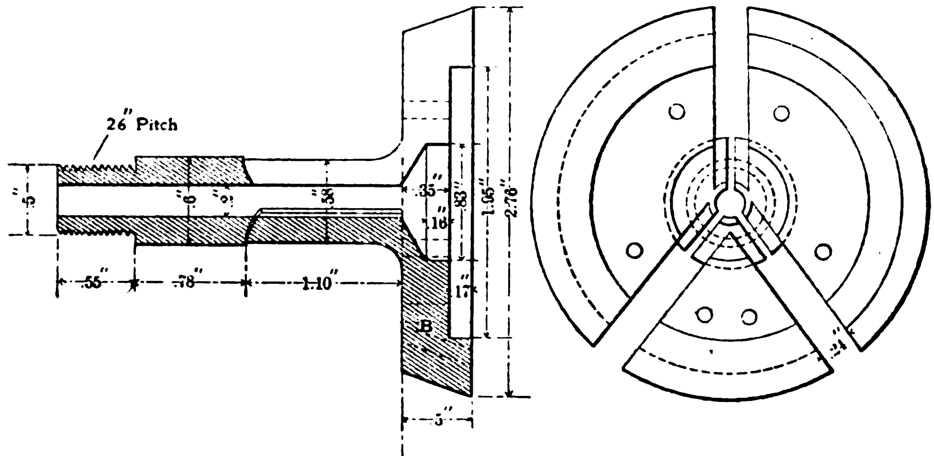


Fig. 2

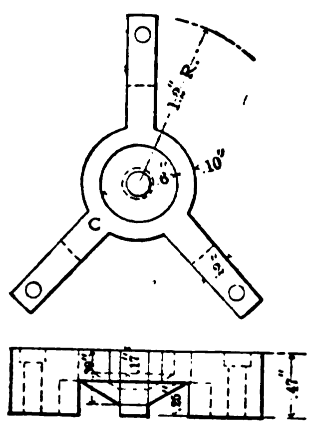


Fig. 3

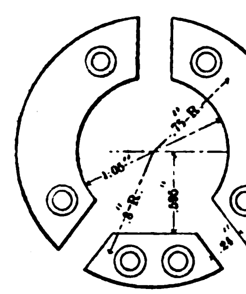


Fig. 4

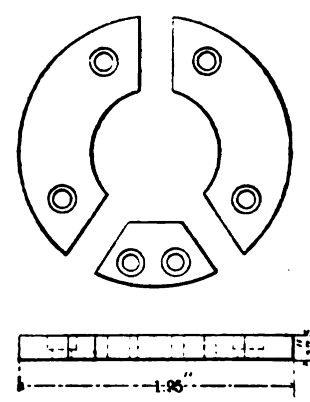


Fig. 5

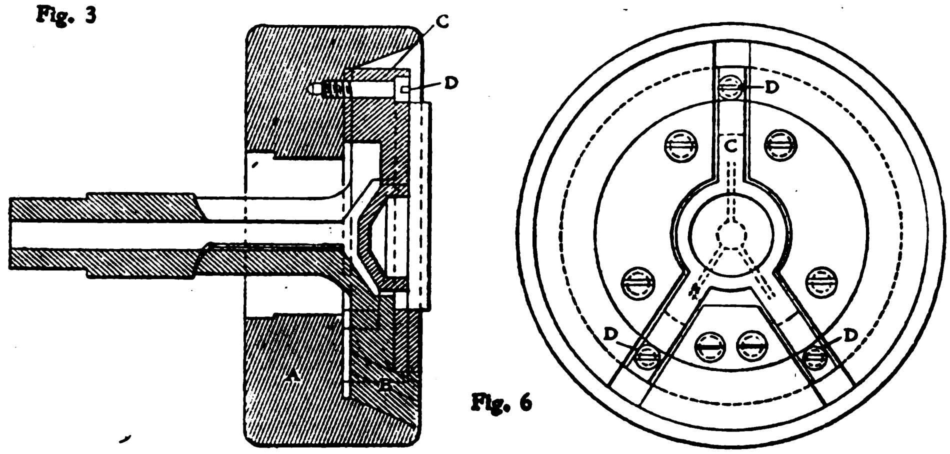


Fig. 6

CHUCK FOR FACING OFF WORK OF UNIFORM THICKNESS.*

SOME time ago I had occasion to make the following chuck, which I think is a very good one, and will prove so to anyone wishing to try it. The chuck was, in this case, fitted to a No. 5 bench lathe; but it can be made to suit any lathe of the draw-in collet type. The face-plate A, Fig. 1, is fitted to the spindle of the lathe, and is recessed to receive the split collet B, Fig. 2, deep enough to allow perfect freedom for the collet to grip the work in case of any variation in the size of the blanks to be faced. The collet is milled through its largest part, four or five one-hundredths wider than the bridge C, Fig. 3, to give clearance, the balance of B being sawed with a small saw, as shown, to allow the necessary spring. The bridge C is fastened to the plate A by the screws D, Fig. 6, and is hardened and then ground on its face when in position on the spindle. Figs. 4 and 5 are steel plates worked out to fit the work desired to be faced and screwed to the collet, which is cut after the plates are in place. In this case the parts to be chucked are armatures for relays, which are required to be of a uniform thickness. The collet is spring-tempered and ground to fit the angle of the face-plate, which is 20°. No matter what the variation in diameter of the work is, so long as it is within a reasonable amount, say one-hundredth of an inch, it never can be drawn back with the collet to change its thickness, as the work, when put into the chuck, rests on the bridge, and the collet is then drawn in until it grips it. The complete section—Fig. 6—will show the arrangement clearly, I think, and for many jobs where accuracy in thickness and speed are required it will be found to be a very good chuck.

* By M. LEECH, in *American Machinist*.

ACETYLENE.

CONTINUOUS study is being made of the new illuminant, and to such an extent that eventually it is bound to occupy a position of the greatest importance. Meanwhile, however, the fire insurance offices continue to throw in the way of would-be users difficulties of a harassing and obstructive character. It has unfortunately happened that explosions of the gas have occurred, and naturally the companies, having no practical acquaintance with the matter, set their face against the "new-fangled" process, and will have none of it if they can so arrange. However, coal gas had to face much opposition at its first introduction, and in the present instance the natural conservatism of human nature is intensified by a fear of interference with dividends.

In the early stages of experiments with acetylene it was seen that an important factor of safety lay in the production of as pure a gas as possible, and to this end it is that so many experimentalists have been directing their attention, their various plans being the subject of mutual discussion. The impurities whose presence is hurtful fall into two divisions—those arising from impurities in the raw material, and those produced during the electric fusion. In the former category occur phosphuretted and sulphuretted hydrogen, while ammonia and cyanogen compounds would fall into the latter. Their danger lies in their liability to produce explosive compounds with the metal of the fittings or of the storage tanks, and the tendency in some cases to initiate spontaneous combustion.

With regard to the methods of purifying the acetylene by removing these injurious bodies, those most discussed recently are Luder and Cederkrutz's method improved by Dr. Wolff—the oxidation of the impurities by chloride of lime—or Frank's, consisting of the use of acid saline solutions to absorb them, the ammonia being neutralised by the acid, the phosphuretted hydrogen absorbed, and the sulphuretted hydrogen precipitated as metallic sulphite. The use of acid saline solutions is said by Dr. Wolff to have great drawbacks; but its inventor states that it is by no means necessary to employ liquids, as the materials can be used to impregnate porous bodies such as kieselguhr, a method suitable for a plant of small size. The latter writer points out that acid saline solutions are not, as stated, liable to cause explosions through the formation of acetylide of copper, the copper being precipitated as sulphide long before the whole of the acid is neutralised by the ammonia, even if the latter is

present in large quantities (from 0·05 to 0·15 per cent. by volume being the proportion shown by a large number of experiments).

The purifying material is a very acid solution of cuprous chloride, or an acid solution of ferric chloride of known strength. One kilo of the latter suffices to purify seven to ten cubic mètres of acetylene, or eighteen to twenty-five if the copper solution is used. An advantage in using the latter method is found in the fact that the copper solution can be regenerated by simple boiling and the addition of a little extra solution to make up for the copper thrown down as phosphide. Herr Christian Göttig draws the conclusion that the absorption of phosphoretted hydrogen by easily reducible metallic salts is increased by the presence of an alkaline chloride, whilst the need of using acids to prevent the formation of explosive acetylene metallic compounds is avoided.

With regard to this acetylide, the danger of which is admitted on all hands, mention may be made of Herrn Freund and Mai's experiments. They found that, when dried at 50° to 60° C., and placed in a tube through which acetylene is passed, it explodes after a short time, but does not cause the explosion of the acetylene itself; while, before the explosiveness is developed, the acetylide must have been exposed to the action of oxygen or air while drying.

In the practical use of acetylene one grave source of danger is the after formation of gas in the generators when the carbide has been removed from contact with the water. Dr. Wolff has measured the quantity thus generated from one kilo of carbide when, firstly, pure water was employed, and, secondly, when the carbide reservoir was over petroleum. The results were in the latter case 0·25 litres at the end of half an hour, 6 litres at the end of 24 hours, and 16 litres after three days, no more being then given off. In the case of water the numbers were respectively 7·25, 25, and 30 litres, but the carbide still went on decomposing at the rate of 5 to 6 litres a day. It is thus seen that great risks of explosion occur with small generators, with table lamps in particular. In large apparatus it can be avoided by the use of a sufficiently large reservoir to hold the excess of gas without undue compression. One means suggested for avoiding this constant discharge is the use of a layer of petroleum on the water, but it is open to the objection that a thin layer does not prevent evaporation of water, while with a thicker layer the probability is that it would be absorbed by the carbide, which would then be rendered impervious by water.

It will be seen from this brief account of work that the problem of safety in the use of acetylene illumination is being attacked from all sides, and there is fair ground to hope that eventually we shall have methods available which shall render the use of this most valuable illuminant as safe as the familiar coal gas.—*British Journal of Photography.*

PETROLEUM MOTORS.

THE high economy which may be obtained by the complete combustion of liquid fuel in an internal-combustion motor is now generally conceded, and as a result there have been numerous attempts to design motors which shall prove acceptable for general use. The Dopp motor was discussed at a recent meeting of the Verein Deutscher Maschinen-Ingenieure. Dopp maintains that the high compression advocated and used by Diesel is not necessary to the attainment of superior thermal economy, and claims that equally good results can be secured by the use of vaporised petroleum, drawn into the cylinder with the proper proportion of air, and burned under practically the same conditions as obtain when gas is used in a well-designed gas-engine. It seems to be generally admitted that the main element in the economy of a petroleum motor lies in the combustion of the fuel. While this is secured by providing a compressed atmosphere, it does not appear that it is necessary to use a compression materially greater than is now employed in the gas-engine. The Dopp motor does not differ in general construction from an ordinary gas-engine, except that the petroleum fuel is gasified by the heat of a lamp before it is drawn into the cylinder, and the excellent economy which appears in the regular service is claimed to be due only to the completeness of the combustion, attained by a thorough mixture of the fuel with the proper quantity of air. Herr Dopp gives figures from a number of his motors in daily use, which show a consumption of 0·197 to 0·240 kilogrammes per H.P.-hour, the lower result being obtained with a 10H.P. motor after it had been in practical service for more than 11 months. This result is better than was attained by the Diesel motor of 20H.P. tested by Prof. Schroter, although under less favourable conditions. Herr Dopp maintains, as has been claimed by others, that the Diesel motor by no means realises in practice the theory enunciated by its designer, and shows that some of the fundamental points which, according to the theory are essential to the highest economy, are distinctly controverted in the working of the motor. From this he deduces that the high economy of the Diesel motor shows that the theory is not sustained.

An important feature of the motors constructed by Herr Dopp lies in the fact that they can be constructed and operated in a satisfactory manner for small powers, good results being obtained with motors of 2H.P. to 5H.P., while the construction of the Diesel motor is such that it does not appear advisable to make them for less than 20H.P. Regardless of the theoretical questions at issue, there seems to be little doubt that very simple, efficient, and convenient petroleum motors can be made upon the same general design as that already in public use for gas, and that care in design and in the correct proportion of air to fuel supply can, with a moderate degree of compression, insure such a complete combustion as to leave little or no trace of soot either in the cylinder or in the exhaust gases. Under such circumstances there can be little doubt that the petroleum motor has a most useful future before it, especially for small powers.—*From the Engineering Magazine.*

MANIPULATING HIGH CARBON STEEL.*

THIS subject has in the past been so ably and thoroughly discussed, that it seems to us there is little left to be said. We might go into a lengthy exposition of what we should consider the best method in the manipulation of steel, and yet when we consider the very many brands of this product, and that scarcely any two of them can be treated alike, we almost shrink from trying to lay down any fixed rule for the working of this article.

In looking over the subject, and in reading up the different articles written upon the same, we are impressed with the differences of opinion; one will insist that his method is the only one, and another that his is the true one, and they perhaps are so far apart in their opinions that they can scarcely be reconciled. We shall endeavour in this report to offer some suggestions that can be safely applied in any shop. You may perhaps think they are not new, and right here we might repeat the old maxim, "that there is nothing new under the sun," and yet, admitting there is nothing new under the sun, we can reach out and improve in the manipulation of steel, as well as in any other line of business.

In many instances the reason why steel does not give satisfaction is because the temper of the steel is not suited for the purpose for which it is being used, or that the method of treatment in the hands of the toolsmith is not what the steel requires. This results from the fact that when a smith gets a bar of steel, or a brand with which he is unacquainted, he very often injures the steel for any purpose.

All practical toolmakers know that there are many different qualities of cast steel; what we mean by that is that there are many degrees of carbon. A steel of low carbon cannot be made to do the work that a higher percentage of carbon properly manipulated can do.

One suggestion your committee would offer is, that should the smith get hold of a bar of steel of which he does not know the percentage of carbon, it would be safer to heat it for working too low, rather than run the risk of overheating. To avoid in a measure this trouble all shops should have a well-regulated steel rack, with the steel properly classified, and the key of the rack in the hands of the foreman, or someone competent to take charge of same, and in order that the very best results may be attained in this matter, no purchasing agent should buy any other brand of steel than that asked for by foreman smith.

We believe that it is not so much the brand of steel we use, but the many different brands, that causes no little amount of trouble, and, indeed, in our opinion, is very expensive to those who must foot the bills.

The most valuable property that steel possesses is its capability of being hardened and tempered. The changes in the properties of steel produced by these processes are most extraordinary.

A full knowledge of the degree of heat at which steel containing a greater or less percentage of carbon should be hardened is of very great importance, and can be very easily designated as "dark red," "blood red," and "bright red."

We should not forget that to produce a good tool one of the first things to be observed is the manner in which it is being treated when being forged. Should the steel be subjected to extreme methods in forging, so that the structure of the steel has been injured, it will be almost impossible to secure a good tool. There is no doubt but this is the cause many times when steel is hardened to have what we call fire or water cracks, as the defects caused by severe hammering, and when too cold are not discernible to the naked eye.

Steel should be heated very slowly, and evenly, for it is a well-known fact that to forge it when not heated through evenly, the particles are driven asunder, the colder ones being driven into the hotter ones, and causing a general dislocation of them.

There has been a theory advanced that to harden a tool, a large milling cutter, it should be heated very slowly, which is perfectly proper, and when at the right heat dip in water for a few seconds, and then finish the cooling process in oil. This may be all right; but is it a practical method for hardening a large tool? Where do all our arguments come in as regards having all the particles of steel in an even, easy condition, and without any undue strain.

It makes very little difference in what way you cool a large piece of steel, so as to have sufficient hardness for very hard work, whether you quench it in cold water, hot water, or oil. If the tool is to be made sufficiently hard, it must be dipped at such a heat that will produce the required hardness, and in so doing you have certainly contracted the outer surface, while the inner particles are in an expanded state; this will be the result to a greater or less degree, and the steel will be left in a strain. Now what we want to demonstrate is the fact that any tool to give satisfaction must be in its natural easy state as nearly as possible.

Now, in case of a large milling cutter, after it has been quenched, and, of course, is then in more or less strain, owing to its unequal contraction, is it not a fact that to draw the temper from the inside to the outer surface, that we have relieved the tool of very much of the strain put upon it in the quenching.

I hope the members will express themselves upon this subject, as I think it one of the most important ones connected with tool work.

All tools that have been heated in a common fire, especially large tools, that require considerable length of time for heating, will lose more or less of their hardening qualities upon the surface, and to overcome the effects of the fire there should be enough material turned off, so that none of the decarbonised material remains, and when the tool is again heated for hardening it should be done in a charcoal or wood fire.

We will conclude this article with a few suggestions that can be safely followed, and first will say that the only way a toolsmith can be successful is to study his business and be perfectly conversant with it.

It is very important that the steel should be suited to the work which it is to do.

All steel should be marked the degree of carbon which it contains.

The toolsmith should be very careful in heating, so that it will be thorough and at the proper degree.

Heat tools in charcoal or wood fire or lead for tempering.

In tempering dies, taps, reamers, or any small tool, have the water warm, so that the change will not be too sudden.

Draw temper on piece of red-hot iron, and when the desired colour has appeared, cool in oil.

To anneal steel, make it hot, put in hot ashes or charcoal dust, and cool slowly.

Mark every bar of steel on one end, so that you will know at a glance the percentage of carbon in it.

In forging steel, have the blows sufficiently heavy to affect it to the centre, and decrease blow as the steel gets cooler.

When tempering any tool, like a tap or reamer, do not plunge it into the water as some say, but let it enter the water vertically and slowly, as sudden quenching causes them to become distorted.

And last, but not least, we would recommend that the best method for the treatment of burnt steel is not to burn it. The idea of restoring burnt steel is like trying to subtract something from nothing.

* By M. R. Messimer and E. F. Carter. Report of Committee on "How to Obtain the Best Results in the Manipulation of High Carbon Steel," submitted to Annual Convention of National Railroad Master Blacksmiths' Association, Milwaukee, 1899.

HIGH PRESSURE AND DRY STEAM.

THE most favourable steam pressures for locomotives seem by many to be considered as settled at about present limits, and in recent discussions involving this subject it is made apparent that considerable comfort is being taken from this supposed fact. It is generally believed that simple locomotives should not carry pressure higher than 190lb., and that 200lb. is most favourable for compounds. It has never been clearly demonstrated that either of these limits is correct, and the problem of pressures is unquestionably important enough to warrant specially careful investigation, in view of the great advances in economy which have been made in this direction in marine practice.

It is generally understood that higher pressures permit of improvement in economy at the engines, and that this is the cause of the greatest improvement of modern steam-engineering. It is not so well understood, however, that a great advantage may be gained by increasing the boiler pressure without increasing the pressure in the engines, and yet this is probably one of the most effective of recent improvements in marine work which has accompanied the rise of pressures in the engines. By this is meant that there is a great deal

to be gained by carrying a very high boiler pressure, which is reduced to a proper working pressure at the engines. The worst enemy of fuel economy is wet steam, and this reduction of pressure, which is accomplished without doing work, is an effective and inexpensive method of drying the steam before it goes to the cylinders. If the steam is dry when it leaves the boiler, it will be superheated by this process, and everyone knows the desirability of superheating. The explanation for the superheating effect is simply that when steam passes through a throttled passage in a pipe and reduces its pressure, its pressure changes without a corresponding change in temperature, and it is therefore hotter after throttling than the steam calls for in the tables of the properties of saturated steam. This excess temperature may disappear by evaporating moisture in the steam, drying the steam, or it may remain and the steam pass on into the engines in a superheated condition. This is advantageous because the cylinder is a powerful refrigerator, and the entering steam needs all the heat it can carry, in order to remain dry as long as possible.

The British Admiralty believe that pressures in marine work will go higher yet. Pressures of 250lb. and more are successfully used in marine engines, and when steam is furnished by Belleville boilers it is at a pressure of 300lb., this reduction at the engines being for the purpose of securing dry steam, as explained. Dry steam will do more work than wet steam, and the locomotive is noted for using wet steam. The question raised here is whether there is not enough advantage to be had from dry steam at the cylinders to more than offset the additional weight that would be required in the boiler in order to carry the higher pressures. This is one way to attain an increase in boiler capacity which is generally desirable, and the effect on the economy of working may be very easily ascertained. All that is necessary is the building of one locomotive boiler for a working pressure of, say, 250lb. and a reducing value in the steam-pipe, to throttle the pressure to a proper working point at the cylinders. It would cost so little to investigate the merits of this question as to cause surprise that some enterprising motive-power officer does not take it under consideration. We would like to emphasise what has in effect been already said: That this idea may possibly prove to be a good method for increasing boiler capacities.—*American Engineer.*

SPIRIT PHOTOGRAPHY.

DECEPTION in spirit photography has become a fine art. Many so-called spirit pictures have been taken upon plates that have already been exposed. When these plates are developed, the several faces, of course, are brought out. These prepared plates are held in stock by dealers in photographers' supplies, says *The Banner of Light*, and sold to all who send special orders for them. It is now well known that a certain symbol in the order for plates indicates that "doctored" plates are desired. In some cases, men and women who are perfectly honest with themselves are obtaining what they claim to be spirit pictures. They order their plates themselves, and take pictures of themselves by means of a mechanical device, develop the plate alone, and find faces side by side with their own on the plates. This would seem to justify them in believing the pictures to be likenesses of disembodied spirits. If they would reflect a little, they would not be so certain.

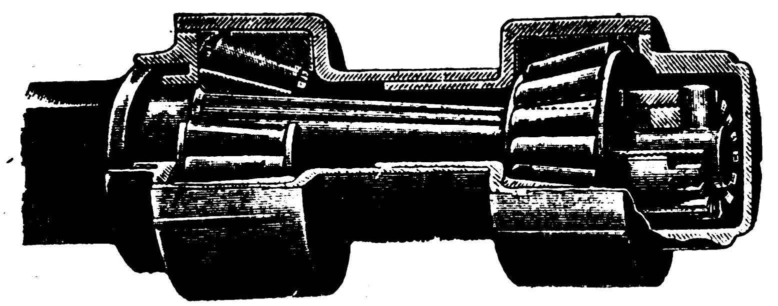
Pretended mediums for spirit photography know of the experiments of these parties to whom we refer. They notify the dealers in photographic stock of the fact, and these dealers send them the prepared plates. The pictures are taken, and the amateur photographer becomes convinced of the truth of spirit photography because they alone were implicated in the experiment. The fact is they have been deceived in their plates through the efforts of some faker who wished to add to his own income, and to maintain his influence over the parties whom he is instrumental in deceiving. It is often done, and many reputable people are thereby victimised.

Occasionally a few of the prepared plates are slipped into the boxes ordered by regular photographers. They are not spiritualists, nor are the majority of their patrons. Everyone is greatly surprised, therefore, to find half a dozen faces upon the proof of a certain plate. When the fact of these specially-prepared plates is made known, the source of the phenomenon is easily determined. The unsuspecting person, however, does not stop to think of possible collusion in the case, and accepts the result as evidence of supernormal power.

THE GRANT ROLLER-BEARING.

IN the accompanying illustration we present a novel roller-bearing made by the Grant Axle and Wheel Company of Springfield, Ohio, which has been used with noteworthy success upon waggons, carriages, auto-mobiles, and vehicles in general.

The tapered rollers of the bearing turn between a cone held upon the axle spindle and an exterior coned ring. The inner cones are not keyed to the spindle, but are loose, so that they turn independently of the rollers. Should the rollers bind, the wheels would not be locked; for the cones could still rotate on the spindle. The method of assembling the various parts of the bearing is so apparent from the illustration that no extended description is necessary. Perhaps the most striking feature of the construction is the simple method provided for taking up the wear.



The adjusting-nut is held on the outer end of the axle-spindle by a pin or cotter passing through the nut and through the reduced end of the axle. The nut is made in two concentric members having threaded connection, whereby the outer portion or shell of the nut may be adjusted inwardly, to take up the wear of the cones. Once set, the nut cannot be jarred or loosened from its position. It is evident that the spindle may be removed from the hub or wheel without in any way disturbing the adjustment of the parts.—*Scientific American.*

THE LATEST TELEGRAPHY.

TELEGRAPHIC marvels abound; or, at all events, accounts of them, which are not quite the same thing. We have wireless telegraphy, which is perhaps not exactly novel. From Vienna comes a glowing description of a new invention by which stencilled messages can be transmitted in very nearly less than no time, along wires, to great distances. The rapidity of despatch is so great that, to parody a well-known bull, the last word of the message is received before the first one has been sent off; and as if this was not enough, we learn from *Pearson's Magazine* that a Pole, named Jan Szczepanik, has invented an apparatus by which he telegraphs pictures in their natural colours. The landscape is at one end of the wires; a ground glass screen is at the other end; and on this screen the picture is produced. We need, perhaps, scarcely add that selenium plays an important part in the invention, for a full account of which we must refer our readers to the magazine which has so far a monopoly of the novelty. The Vienna folk are, we may add, doing nothing more than has been done here daily in the service of the newspaper press for about thirty years. But this, of course, is only a detail.

There never has been a time during the last half century or so when announcements of marvels connected with electricity have not been made. Many of these have been true, and the results of the discoveries or inventions to which they referred have been largely, if not always wholly, satisfactory. Others, however, have been anticipations of desirable things rather than fulfilment; and, reasoning from the past into the present, it is well that all statements concerning telegraphic or electrical wonders should be received with great caution. The daily Press of the country has, we are sorry to say, recently pursued to some extent the vicious practice of the United States newspapers. If news could not be found, let it be made. A dozen times within the last few months we have had to make inquiries concerning paragraphs in our contemporaries which dealt with matters likely to be of some interest to our readers, and in all cases we have found either that they were not true in any sense, or that they were misstatements of truth; or that very small germs of truth were contained in a multitude of words. The principal importance of all this appears when we consider how prone a small section of the world is to the formation of syndicates, and how eagerly a great section of the public will follow a syndicate into financial morasses without the least hesitation. There is always the possibility, of course, that some extremely valuable invention will be made, and those lucky enough to exploit it properly will no doubt secure large fortunes, and will deserve what they get; and it so happens that, because of the mystery which apparently surrounds it, electricity and all its uses constitute a happy hunting-ground for the inventor, and, we may add, the speculator. Our readers may rest assured that in many, we do not say all, but in nearly every case, when information is given to the public of the kind to which we have just called attention, it is promulgated by a speculator, and must be received with caution. We have not the least intention of imputing dishonesty of purpose; yet very frequently the information published is lacking in that scientific accuracy which can alone enable us to pronounce an opinion as to whether the thing is or is not true.

But even when it is certain that a very clever invention has been made, it remains to be seen whether it has any commercial value, and, if so, how much, and what. We may cite, for example, the microphone, an invention or discovery which attracted enormous attention when it first came before the public. It was held to be an extraordinary thing of boundless possibilities, that the footsteps of a fly walking on a carbon-plate in Brighton could be distinctly heard in London. No doubt this was, in a sense, a marvel, but it was a marvel of no utility; and although it is possible that the microphone taught some things of use to the telephone, it has long since passed away into the land of The Laid Bye. Dozens of inventions in electric lighting have travelled the same road, and the inventions and discoveries which have implied the revolution of telegraphy are simply legion. It is, therefore, a good thing when an invention is so far successful that it is talked and written about, to consider what part it is likely to play in the future; what are its possibilities of development, what its limitations. Of course, at this moment, the most prominent invention is wireless telegraphy. At the recent meeting of the British Association it scored a success, messages being sent with much accuracy and certainty through hills and over sea distances. At first sight it seems marvellous that sounds and signals can be produced at a distance of many miles without any visible means of transmission. But we must not let ourselves be dazed by the beauty of the invention, nor blinded by its success. We must ask ourselves first who wants to send messages slowly to somewhere? and next, what are the conditions under which alone they can be sent? Up to the present the field for wireless telegraphy, however important, is extremely limited. Curiously enough, the cost of transmitting messages over a wire in the ordinary way is very much less than that of sending them without wires, and as to speed of transmission, the wireless system is nowhere as compared with the normal work of the post-office. What may occur in the future we do not know; but at present the Marconi system appears to be unable to compete in the least degree with the wire system of telegraphy, to say nothing of the telephone. In a word, for commercial business so far it is quite unsuitable. Indeed, it is fair to say that no one of importance has, so far, suggested that it may supersede ordinary telegraphy. It is claimed for it, however, that it may have an incalculable value in war time and at sea. Thus generals may be able to transmit messages by day and night, and in all weathers, instead of being confined, as now, to the use of the heliograph, which out of the east seems to be of very little use. At sea, again, ships may communicate with each other, and convey information of much value. Thus, for example, a scouting torpedo-catcher might find an enemy and tell the admiral in command of our fleet as much, although the torpedo-destroyer and the fleet were quite out of sight of each other. Again, by wireless telegraphy we can put our lightships in direct communication with the shore. We can blow up mines, probably constructed for the purpose, and accomplish many other wonderful things. All this sounds very well in the lecture-room, and it reads very well in print; but there are limitations. The ether waves are rather delicate affairs, and require dainty handling. They emanate, in the first instance, from a single vertical wire about 120ft. long. At least, that seems to be the best transmitter and receiver. The vibrations are believed to pass in a vertical plane. The receiving apparatus is extremely delicate, and very sensitive to inductive effects. It has long been known that there is no privacy about wireless telegraphy. That which can pass through mountains it is very difficult to stop by a screen. It is true that certain metals check the passage of the vibration; but up to the present no efficient form of screen has been devised, and we are compelled to fall back, in the pursuit of privacy, on some

equivalent of two tuning-forks. That is to say, unless the receiver is in tune with the transmitter, no intelligible message can be sent or received; but it will be readily understood that for military purposes, whether by land or sea, the difficulties to be overcome in carrying this system into practice are very great. This is not all. The wireless telegraph requires isolation in order that it may work. In the early days of the telephone much trouble was caused by induction. But the sensitiveness of the telephone to induction is as nothing to that of the wireless apparatus. It is not too much, we believe, to say that a large induction coil properly used on board a ship would entirely prevent a distant fleet from transmitting signals. It is to the last degree unlikely that two friendly ships could transmit messages at the same time to a third ship without rendering each other unintelligible. We do not wish to say—or intend to say—that these and similar objections to the wireless system will not be got over. We cannot tell. We confine ourselves to facts as they are. Even in the matter of lightships, it is doubtful if the invention is likely to prove of real value. It may not be generally known that for several years various lightships have been placed in electrical communication by cable with the shore, at an annual outlay of about £10,000, and there is no known instance in which life has been saved as a result of this outlay. The lightships, as a matter of fact, have very few opportunities of knowing whether vessels are in danger or not; and in most cases the lifeboat stations are infinitely better situated for receiving information.

We would not have it said that we depreciated the labours of the eminent workers who have achieved such marvellous deeds as those about which we have written. Far from it. But in the present day marvels are fairly numerous, if not quite plentiful; and we are all easily enough carried away by admiration, and so lose our sense of proportion. It would have been a wonderful scientific feat if it had only been possible to transmit one word per hour from London to Edinburgh. The fact that instead of one word an hour, twenty or thirty words per minute can be sent, scarcely at all augments the scientific interest of the invention or discovery. In fact, that is all centred in the doing of the thing once. The value of the invention to the world is quite another matter. Up-to-date telegraphy is good because it is accurate, and cheap, and rapid. Any system which is to take its place must be more rapid, or accurate, or cheaper, or all three. When someone directed Michael Angelo's attention to a certain picture which he was supposed to admire because the artist had painted it with his feet instead of his fingers, the great man only said, "Why did not the fool use his hands?" Our readers can apply the story without aid from us. The bare fact that any system of telegraphy, or electric lighting, or power transmission, is wonderful, signifies nothing. The world's work is not done by wonderful things because they are wonderful, but because they satisfy certain conditions. Unless new inventions or discoveries will do this a little better, they must remain marvellous. They will never find their way into such common use as to cease to be wonderful.—*The Engineer.*

THE YEAR'S WORK OF A LOCOMOTIVE.

THERE are 19,914 locomotives at work on the railways of the United Kingdom, and each of these on an average runs 19,096 miles in a year, and earns for this £4,573, so that each mile the locomotive runs its gross receipts are about 4s. 9d. Out of this the working expenses of stations, the upkeep of permanent way, and the cost of signalling, &c., as well as the drivers' wages and the coal burned, amounting in all to nearly 3s., have to be paid. Like the human factor in all industries, the locomotive to-day is doing less than that of ten years ago, for the 15,924 locomotives then on the railways each ran 19,035 miles, but unlike the human factor, the engines are now earning less—or £4,629 per annum. If, therefore, we take the cost of an average locomotive at £2,700, it is found that it earns in gross receipts her total cost in seven months; but net receipts are quite another matter, for, not only the expenses of the locomotive, but of the railway and all the extensive organisation, have to be met, and are payable from the receipts got directly from the locomotive's work. The Scotch locomotive seems to do the most work; that is only consistent with the chief characteristic of the hardy Northern. There they have one locomotive for every 1 mile 6 furlongs of railway open, whereas in England and Wales there is an engine for every seven furlongs or so; and although in the latter case there is £5,136 worth of traffic to be dealt with, against £3,010 in Scotland per mile of railway open, the number of locomotives is relatively less for the volume of traffic. Thus, a Scotch locomotive in a year travels 23,361 miles, against 18,591 miles in the case of the English locomotive; while the Scotch engine takes in gross receipts £4,855 and the English engine £4,544. In Ireland there is only one locomotive for every four miles of railway, the amount of traffic being £1,112 per mile of railway open, and thus the engines work more leisurely than the Scotch, running 20,911 miles and earning £4,416.—*Engineering.*

DID MAN ONCE POSSESS A THIRD EYE?

THIS query heads the following statement in a recent number of the *Evening Telegram* (American). Deep researches as to the structure of the human body have recently furnished some startling facts regarding changes which man is at present undergoing physically. It is believed that man was formerly endowed with more teeth than he possesses now. Abundant evidence exists that, ages and ages ago, human teeth were used as weapons of defence. Unintentionally, traces of such use are often revealed by a sneer. The teeth are sometimes bared, doglike, ready, as it were, for action. The practice of eating our food cooked and the disuse of teeth as weapons are said to be responsible for the degeneration that is going on. The wisdom teeth, in fact, are disappearing. Human jaws, found in reputed palæolithic deposits, have wisdom teeth with crowns as large as, if not larger than, the remaining molars. In ancient times a short-sighted soldier or hunter was almost an impossibility; to-day a whole nation is afflicted with defective vision. It is almost certain that man once possessed a third eye, by means of which he was enabled to see above his head. The human eyes formerly regarded the world from the two sides of the head. They are even now gradually shifting to a more forward position.

In the dim past the ear flap was of great service in ascertaining the direction of sounds, and operated largely in the play of the features. But the muscles of the ear have fallen into disuse, for the fear of surprise by enemies no longer exists. Again, our sense of smell is markedly inferior to that of savages. That it is still decreasing is evidenced by observations of the olfactory organ. But the nose still indicates a tendency to become more prominent.

USEFUL AND SCIENTIFIC NOTES.

THE calorific value of blast-furnace gas is on the average 1,000 calories per cubic mètre. In utilising the waste heat to generate power by steam-engines and boilers, the best one may hope to obtain is about 450I.H.P. from a 100-ton furnace.

A NEW YORK electrician has invented a new form of condenser. In its construction two conducting wires are wound on a bobbin, preferably arranged in alternate layers, one of the wires covered with thread, having a comparatively low specific inductive capacity, the several convolutions of which are separated from one another so as to leave open spaces between them; the other wire is bare. The ends of the covered conductor are connected to one terminal, and those of the bare wire to a second.

Tea and Rheumatism.—Dr. Kellogg says the habitual use of tea as a means of relieving headache is, without doubt, an efficient cause of rheumatism in numerous ways. The writer has met many persons who could not forego the morning cup of tea or coffee without suffering severely from headache and depression during the day. The thein or caffein of tea has precisely the same effect as uric acid, and hence has come to be a favourite domestic remedy for headache. When used habitually, however, as will readily appear, the effect must be to cause a storing up in the body of uric acid and urates, thus laying the foundation for chronic rheumatism and the various allied conditions which have their foundation in the so-called uric acid diathesis or lithemia.—*Popular Science, N.Y.*

The Electrical Engineer Institute.—The Electrical Engineer Institute of Correspondence Instruction of New York has issued the third edition of the Institute's catalogue, which shows the interest all classes of workers are taking in this new educational departure. The courses taught include all branches of electrical engineering—e.g., electric lighting, electric railways, electric mining, telephony, telegraphy, mechanical engineering, mechanical drawing, &c. A strong feature of the Institute's work lies in the fact that all its instruction-papers have been prepared by the most eminent specialists and authorities in their respective fields. A valuable feature of the new catalogue is a complete synopsis in detail of every topic in every course which the Institute teaches. Mr. Joseph Wetzler, M.E., E.E., is the president of the institute, and Mr. T. C. Martin, Editor of *The Electrical World and Engineer*, is vice-president. The Institute's catalogue will be sent free to anyone on application by addressing the main office, 120-122, Liberty-street, New York.

SCIENTIFIC NEWS.

A NEW comet (*e*, 1899) is reported to have been discovered by M. Giacobini, on Sept. 29. It was situated in the north-western part of Ophiuchus, and was moving in a south-easterly direction. Its position, 8h. Nice mean time, on Sept. 29, was R.A. 16h. 26m. 32s., S. Dec. 51° 10′. From Konigsberg its position is given on Oct. 1, 8h. 0·5min., R.A. 16h. 31m. 0·7s., S. Dec. 4° 39′ 50″. The comet is described as faint, and is "new" only in the sense of rediscovery, as it was observed in 1896 and in 1898.

It is stated that the observatory on the Schnee Koppe, in the Silesia Mountains, is now finished, and is the loftiest in Germany, being at an altitude of 5,216ft. It will be managed under the Prussian State.

Two new "variables" are announced by Dr. T. D. Anderson, of Edinburgh. A star in Hercules, position is (1855) R.A. 17h. 53m. 27s., N. Dec. 19° 30′. It has a variation of nearly a mag. as observed in August, and is about 2′ or 3′ *n.p.* B.D. + 19·34, 89°, which is of 9·2mag. Another is in (1855) R.A. 20h. 9m. 44s., N. Dec. 30° 37′, but when observed in September was rapidly diminishing in brightness. It is in Cygnus, and the variation is 8·5 to 9·2.

The Melbourne Observatory is open to visitors at certain times, and according to the report the great telescope and the south equatorial have been used during the year by 189 persons on Wednesday afternoons and by 195 visitors who observed at night.

The *Bulletin* of the Société Astronomique de France for October contains, amongst other interesting articles, one by M. Berthelot entitled "Sur les Miroirs de Verre doublé de Métal," and another by Ch. V. Zenger on "Le Centre du Monde," and the law of the movements of the Celestial Bodies. The illustrations of lightning flashes accompanying an article by M. Em. Touchet on "Les Orages d'Aout et Septembre, 1899," are specially interesting.

Prof. Andrew Gray, F.R.S., Professor of Physics in the University of North Wales, has been elected to succeed Lord Kelvin in the chair of natural philosophy in Glasgow University.

Major R. Ross, of the Indian Medical Service, has returned with other members of the Liverpool Tropical medical expedition to this country, and is reported to have stated that the authorities at Sierra Leone had, on the advice of the expedition, decided to use every means to exterminate the malaria-spreading mosquito. Other conditions in West Africa were favourable to health, there being a good water supply. He thought, however, that the white population were not careful enough, and that the houses were badly constructed, and compared unfavourably with the residences of whites in India, which were constructed on plans that gave the inhabitants every chance of health, despite the tropical climate. Major Ross attached great importance to this question of the construction and situation of the houses. Dr. Fielding Ould, a member of the expedition, remained behind to consult with the medical officers on the coast respecting measures to be taken for the extermination of the malarial mosquito in the neighbourhood of the principal towns. The opinion of the party was that these measures would decrease the danger of the spread of the disease.

The building for the Paris Institute of Biological Chemistry, towards which the Baroness Hirsch contributed £80,000 for erection and endowment, has been completed, so far as the erection is concerned; but it has now to be equipped, which will probably be done in a few months.

A special committee appointed to make representations to the London University Commission have presented an interim report, in which they recommend that there should be one faculty of science connected with the University, with adequate representation on the Senate and the Academic Council; that engineering should be a distinct branch of the one faculty of science and not a separate faculty, but degrees should be given in engineering bearing a distinctive name. The art or profession of teaching, the committee felt, should be a branch of the faculty of arts. The committee was also of opinion that the restriction of the amount of property to be held by the University to an annual value

of £10,000 should, if possible, be removed. In moving the adoption of the report Prof. Dyer pointed out that when the value of the London University property was compared with that of other universities, it was comparatively small. A proposal was made to institute a degree showing the merits of teachers. "Master of Education," it was contended, might clash with "Master of Engineering." So "Doctor of Pedagogy" was suggested. Eventually it was moved that the committee should reconsider their recommendation with regard to the faculty of teaching; but the motion was defeated and the report received.

In his address to the students of the Royal College of Science, Prof. Rücker said that the changes which loomed largest in the immediate future were the erection of new buildings and the creation of what would, in effect, be a new university. A university was a place where education was combined with the advancement of knowledge, and the teaching of a university was based on the principle that knowledge was desirable for the influence which knowledge and the search for knowledge exerted upon ourselves, and not merely for the power which it conferred of improving our external surroundings. The first of these characteristics distinguished it from a school; the second from a workshop or a college with purely technical aims. The Royal College of Science had not been unmindful of the fact that the duty of a university was to advance knowledge.

It is announced that Mr. Richard B. Westbrook, of Philadelphia, has left to the Wagner Institute of Science the sum of 10,000dol., which, after the death of his widow, is to be used as an endowment fund for a special lectureship to secure the full and fearless discussion of disputed questions in science, especially those relating to the theories of evolution.

The death is announced of Mr. John Donaldson, the partner of Mr. J. I. Thornycroft in torpedo-boat construction. He was born at Elgin, and was in his 58th year. The deceased gentleman was apprenticed to engineering, and went to Glasgow University. Subsequently he went out to India, where he did much good work, but, having married Miss F. S. Thornycroft, he joined his brother-in-law, and they produced for the Norwegian Government the first fast torpedo-boat ever built. Mr. Donaldson induced other foreign Governments to introduce torpedo-boats into their navies, and by his lectures to the Royal United Service Institution in 1877 and 1881 he helped to bring about their introduction into the British Navy. When Mr. Thornycroft produced his water-tube boiler, Mr. Donaldson at once saw the far-reaching consequences of that invention, and a year or two later, by accepting absolute responsibility on behalf of his firm for the boilers of H.M.S. *Speedy*, he gave the then First Lord, Lord George Hamilton, the opportunity of initiating his policy of water-tube boilers for the Navy.

Dr. C. Russ, an enthusiastic ornithologist, died on Sept. 29, at Berlin.

The death is also announced of Prof. Kowalowsky, professor of hygiene in the University of Warsaw.

The Corporation of Glasgow have appointed Dr. R. M. Buchanan bacteriologist to the city, and a laboratory has been assigned to him in the Sanitary Chambers. He is expected to devote the whole of his time to the work.

The degree of Doctor of Pharmacy has, for the first time, been conferred on M. Lacourt by the University of Paris.

The Hackney Vestry have issued a warning in connection with milk to housekeepers. They state that out of a hundred samples of milk examined by an "experienced biologist" twenty-two were infected with tubercle bacillus. They wisely advise the public to boil the milk before using it.

The tenth International Congress of Hygiene and Demography is to be held in Paris, from Aug. 9 to 17, 1900.

It is stated that Prof. A. E. Dolbear, of Tuft's College, Mass., the inventor of a telephone and the author of a work on the art of projection intends to seek an injunction (according to the Central News) to restrain Signor Marconi using wireless telegraphy in the United States. It is further stated that Prof. Dolbear patented a wireless telegraphing apparatus in 1886. There may be some interesting disclosures if the case comes before the courts, for it is certain that wireless telegraphy is not a new "discovery," for it was suggested by Steinheil about sixty years ago, and there are some records of experiments. Sig. Marconi has, however, demonstrated the utility of his arrangement.

The Senate of the Welsh University have just appointed Mr. W. Jenkyn Jones, B.A., lecturer in Philosophy in succession to Dr. McIntyre. Mr. Jones graduated B.A. in the University of London from Aberystwith, and in 1893 proceeded to Cambridge, where he gained a scholarship at Caius College. In 1895 he obtained first class in the Moral Science Tripos Part I., and 1897 first class in Part II. of the Paine Tripos. For the last two years he has filled the post of professor in Psychology at the Cambridge University Day Training College.

The iron sand found on the coast of New Zealand, which has puzzled so many exploiters, is not as valuable as some people seem to think. According to Sir George Whitmore, who lately gave an interview to a representative of *Commerce*, there is a good deal of misapprehension concerning the extent and the possible value of this sand. There are great quantities of it, but if the industry assumed anything like large proportions the sand would not last very many years. And, besides, these deposits are not unique. On the coast of Norway and Sweden there are already under treatment great breadths of this kind of sand, containing quantities far beyond anything that exists in New Zealand.

The Continuous Brakes return presented to Parliament for the half-year ending Dec. 31, 1898, shows that the number of vehicles complying with some or all of the conditions laid down in the Board of Trade circular amounted to 95 per cent. of the number in use, and that only 4 per cent. were fitted with pipes and connections only.

In June, 1900, there is to be an International Exhibition of Tramways and Light Railways at the Agricultural Hall. It has been arranged with the object of acquainting municipal and other local authorities, as well as the general public, with the latest apparatus designed for the equipment of mechanical tramways and light railways. The idea is good. It may hasten the progress of electric traction, and may possibly help to get rid of the present expensive practice of sending deputations to the Continent and America to inspect for the thousandth time the system in Buda-Pesth, Hamburg, or New York. The exhibits will comprise examples of every imaginable method of traction, and the auxiliaries and accessories of the newer systems.

Fifteen thousand eight hundred and fifty-two miles of railways in Russia are operated by the Government, and 9,114 miles by public companies.

Seven hundred and fifty-five locomotives were built at the Baldwin Locomotive Works last year, of which number 348 were exported. Two hundred and forty-two were compound engines and the rest single-expansion; of the compound locomotives, 235 were of the four-cylinder type and seven were of the two-cylinder type.

A highly satisfactory test of the new 6in. quick-firing gun, constructed for the American Navy by Messrs. Vickers, Sons, and Maxim, has been made at the Indian Head Proving Ground. The first shots were fired with cordite, which in each instance gave velocities of 2,700 foot-seconds. After a sufficient number of rounds to demonstrate the fact that the velocities would exceed what was expected of the gun, Admiral O'Neill, chief of the United States Artillery Department, determined to obtain a comparative result by using Navy smokeless powder. Accordingly, he had employed a charge that would give a chamber pressure not exceeding 17 tons per square inch, and the result obtained under these conditions was a velocity of 2,913 foot-seconds; such a muzzle energy with the pressure employed has never before been obtained. In England, with the use of cordite, this gun gave a velocity of 2,873 foot-seconds with a pressure of 17 tons. The projectiles fired weighed 100lb. A gas check was used, and to a considerable extent accounts for the high energies obtained, and prevents any abnormal wear due to the use of modern gun-cotton or nitro-glycerine explosives. The striking energy of the gun was no less than 5,724 foot-tons, which would perforate a thickness of steel amour of 17in. The energy obtained per ton of gun is 768·3 foot-tons, and as a rate of fire of ten rounds per minute for long series of rounds has been easily obtained, the gun is capable of doing work to no less extent than 57,240 foot-tons per minute.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE ABSOLUTE ZERO OF TEMPERATURE AND METEORS.

[42911.]—In answer to "F. J. G.," according to the current theory, heat consists of motions of the particles of matter. The greater the velocity of these motions the larger is the quantity of heat and the higher the temperature. The two extremes are evidently that the velocity should become 0, and that it should become infinite. Both extremes are probably unattainable. But in measuring the relative quantities of heat contained in two bodies (or their respective temperature) it is convenient to start with an assumed position of molecular rest, and to estimate the quantity of heat by the excess of motion over this position. It is computed to be at −273° C. or thereabouts. As rest does not admit of degrees, when this position is attained no further cooling is possible. In fact, your correspondent seems to confound the popular ideas of heat and cold with the scientific. Popularly, a thing is said to be hot if it is above the ordinary temperature, and cold if below it. But scientifically, all known bodies are hot, and cold is the mere absence of heat. The heating of a body consists in increasing the heat, and the cooling of a body in diminishing it. There is probably a limit to the possible heating of bodies other than that of infinite molecular velocity. But we know nothing about this limit at present, and there seems reason to believe that every known substance is capable of being heated after it attains the gaseous state. Indeed, the gaseous condition itself may pass into another unknown condition when the temperature is sufficiently raised.

It is not of much consequence whether we can conceive an absolute zero or not. But if heat consists of molecular motion, so far is the absence of this motion from being inconceivable, that in reality it is only the scientific who conceive its presence. However, many of our supposed laws only hold good within certain limits, and fail when these are surpassed; and I confess that I do not in the least know what a body totally divested of heat might be like. I might form, not merely a conception, but a dozen conceptions, and they might all be egregiously wrong. As to Fahrenheit's zero, however, I believed he merely took the lowest temperature that had (to his knowledge) been actually observed.

May I add a remark as to meteors which are often supposed to reach us with "the cold of space," which, again, is supposed to be not very far from the absolute zero? Now, a meteor is exposed without an atmosphere to the heat of the sun until it gets into the shadow of the earth, and if we suppose it to be travelling at the rate of 1,000,000 miles per day (which is no doubt in excess of the truth), and to be moving almost directly towards the sun (the most unfavourable direction for the present purpose), the intensity of the sun's heat on the meteor ten days before impact will be four-fifths of its intensity at the earth, and this heat will gradually increase to equality as the meteor continues its approach. Now take a stone of about the supposed size of the meteor, and expose it for a few hours to a hot sun. What will the temperature be? A meteor will, I think, be highly heated when it enters the earth's shadow.

W. H. S. Monck.

METEOR.

[42912.]—A splendid meteor passed over here this evening (Sunday) exactly six o'clock, course S.W. to N.E., and exactly overhead, very slow, 8sec. to 9sec. passing over. Just after passing the zenith it emitted two sparks, apparently no noise, and in passing over it left a long train of light. I was fortunate enough to see the start and finish, and it started from one horizon to the other.

High-street, Epsom, Oct. 8. W. Nash.

[42913.]—A brilliant meteor was seen here this evening at 6.3 (Sunday). I happened to be looking at the part of the sky where it appeared, almost due S.W., at a height of about 30° above the horizon.

It passed almost directly overhead, and disappeared in the N.E. at about the same height of 30°. Colour, glistening primrose yellow, with a bright golden tail about 3° long. When overhead it threw off two small portions, which trailed behind and disappeared. Total length of time visible, about ten seconds. John H. Bateman.

1, York-road, West Norwood, Oct. 8.

EPSILON LYRÆ.

[42914.]—Adverting to Mr. Espin's remarks (letter 42873), and his reference to the correspondence which took place years ago in these columns and his doubt whether this group had ever been laid down in a diagram, I may be allowed to state that one was supplied at the time by the late Major T. A. Skelton, using a 15in. With mirror, which I think showed several more stars than Mr. Espin's sketch.

Southampton. A. H. S.

OBSERVATIONS OF THE PERSEIDS AND AQUARIDS, 1899.

[42915.]—The following is a synopsis of the watches kept for meteors:—

1899.	From.	To.	Number seen.	Number Regd.	Seeing.	Remarks.	Hours of Obs.
	h. m.	h. m.					h. m.
July 27	—	—	—	—	—	Unobservable	—
„ 28	10 15	13 0	15	13	3	Moon up during whole watch......	2 45
„ 29	10 30	12 30	9	8	3	Moon up during whole watch......	2 0
„ 30	10 20	12 45	20	17	2	Sky very clear, but moon up nearly the whole time	2 25
„ 31	10 30	12 0	18	15	1	Watch for Perseids	1 30
„ 31	12 0	12 45	8	7	1	Watch for Aquarids	0 45
Aug. 1	10 15	11 30	7	5	2	Watch for Perseids	1 15
	11 30	13 0	11	11	2	Watch for Aquarids	1 30
„ 2-7	—	—	—	—	—	Unobservable	—
„ 8	9 50	11 50	21	15	2	——	2 0
„ 9	9 50	13 5	55	47	2	——	3 15
„ 10	10 10	14 10	67	50	2	——	4 0
„ 11	10 25	14 0	84	50	2	——	3 35
„ 12	11 15	13 30	35	28	1	——	2 15
„ 13	10 30	12 30	25	20	1	——	2 0
„ 14	9 45	12 0	19	18	3	——	2 15

In the above table, under the heading "Seeing," 1 means excellent, 2 good, 3 fair.

Thus, during the period of observation—July 27 to August 14—observations were made on 12 nights. On three of these the seeing was 1, on six 2, and three 3. Seven nights were overcast.

The times spent in observing were distributed as follows:—

—	Number seen.	Number recorded.	Hours of obs.
Perseids	375	286	29h. 15m.
Aquarids	19	18	2h. 15m.
Totals......	394	384	31h. 30m.

RADIANTS OBTAINED.

No.	Radiant Point.	No. of Meteors	Nights of Observations, 1899.	Date of Max.	Remarks.	Name.
	α° δ°					
1	44½ + 57	7	Aug. 9	—	Swift; streaks	Perseids
2	45 + 57	29	Aug. 10	—	Very swift; streaks	Perseids
3	46 + 57	17	Aug. 11	—	Very swift; streaks	Perseids
4	48 + 58	7	Aug. 12	—	Very swift; streaks	Perseids
5	49 + 57	5	Aug. 13	—	Very swift; streaks	Perseids
6	49 + 58	8	Aug. 13, 14	Aug. 13	Very swift; streaks	Perseids
7	342 − 11	3	July 31, Aug. 1	Aug. 1	Bright; stellar; trained; slow	δ Aquarids
8	0 + 90 85 + 87	7	July 31, Aug. 9, 11, 13, 14	July 31	Rather swift; short	Polarids
9	2 + 48	13	July 28, 29, 31, Aug. 9, 13, 14	July 31, Aug. 9	—	α Cassiopeids
10	18 + 59	10	July 31, Aug. 1, 9, 11, 12, 13	Aug. 9, 11	Short; streaks	δ Cassiopeids
11	25 + 62½					
12	21 + 40	5	July 30, Aug. 11, 12, 14	—	Swift	γ Andromedids (1)
13	26 + 48½	12	Aug. 8, 10, 11, 14	Aug. 10	Swift; streaks (?)	γ Andromedids (2)
14	39 + 52	8	Aug. 8, 10, 11	Aug. 11	Very swift; streaks	θ Perseids
15	45 + 64½	4	Aug. 8, 9, 11	Aug. 11	Swift; streaks	Piazzi III. 94 Camelopardids
16	55 + 70	4	Aug. 9	—	Swift; streaks	γ Camelopardids
17	61 + 58	10	Aug. 9, 10, 11, 12, 13, 14	Aug. 12	Very swift; rather bright; streaks	P. III. 208 Camelopardids
18	325 + 9½	6	July 31, Aug. 1, 12	Aug. 1	Swift; white	ε Pegasids
19	340 + 32	4	July 29, 31, Aug. 1	Aug. 1	Swift	β Pegasids
20	341 + 46	4	Aug. 8, 10, 11, 14	—	Slowish; stellar; short	o Andromedids
21	354 + 50	5	Aug. 11, 13, &c.	—	Swift; streaks (?)	λ Andromedids
22	359 + 59	5	July 28, Aug. 9, 14	Aug. 14	Moderate	β Cassiopeids

In the above table the radiants are arranged in order of R.A. The column headed "Date of max." contains the date on which the largest number of meteors belonging to each shower was observed.

INFINITESIMAL ETHER—MICRATOMIC ETHER—CREATION OF MATTER—SOUND, LIGHT, AND HEAT—CHEMICAL AFFINITY—COHESION—GRAVITATION.

[42916.]—The object of this letter is to present to readers a line of thought which may perhaps help to simplify ideas as to the nature of the ether, of matter, and of the forces with which they have to do.

Reference is first made to "Lucretian's" letter (42770, page 68), headed "Micratomic Ether," in which the theory is advanced that atoms of matter are themselves composed of atoms of ether. Thus is the mystery connected with the genesis of matter turned into a mystery of the ether. But why stop at micratoms, "Lucretian"? If the human imagination, with its ever-widening scope, can conceive no bounds to the outer universe, why complicate matters by attempting to assign limits to its inward divisibility?

The following qualification of the micratomic theory is suggested:—Ether consists of a substance, infinitely divisible, allied with motion, occupying all space. There would, therefore, be no finite particles to deal with, for wherever there were space to be filled the ether would (by virtue of its separability) break up and (by virtue of its motion) extend itself to fill it. Nor could the objection raised to a "gaseous" form of ether be applicable here. In a gaseous ether, discrete particles transform the energy of translation into that of vibration, and vice versâ; whereas, in the case of an infinitesimal medium, the force acting will be of a simple kind throughout. And yet from this uniform substance "matter" has probably evolved. Exactly how it commenced to do so is a question which must be answered when those relating to the origin of ether, of motion, of life, and of intellect receive elucidation. A directive impulse, however, passing through a formless ocean of ether and inducing therein a state of momentary instability, would, the writer thinks, suffice to explain (so far as that be possible) the creation of matter. For, assume by some such means the motion to be abstracted from a portion of the ether, it would there close up or contract—forced together by the more energetic ether surrounding it, which latter would thus acquire the space the central mass had lost. What would happen during the process of contraction? According to Laplace's Nebular Hypothesis, the contraction of a gaseous body causes it to rotate. Similarly, in the case of the ether (if the analogy hold good), a resultant rotation would ensue, which would permanently isolate and differentiate the contracted portion from its surroundings, and an "atom" would be created.

If the stability of an ether constituted as aforesaid cannot be mathematically demonstrated, the writer would suggest as an alternative an *original* instability in the ether to result in the creation of atoms. Further, that these atoms, by ordering the etherial vibrations around definite centres, would produce the needful stability in a hitherto ungovernable medium. The writer is aware that in the modern vortex ring theory a construction is contemplated for the atom somewhat different to that above suggested. However, if our simpler rotating atom is able to satisfy all queries, the other need not be gone into. Otherwise, it should be observed that the two theories by no means appear to be antagonistic, for, to reconcile them, it is only necessary to show that a number of rotating atoms, if placed end to end around a circular core, would form a vortex ring.

In leaving this part of the subject, the attention of those who would speculate further as to the causes involved in the creation of matter is drawn to the enormous quantity dispersed throughout the universe—from the myriads of suns down to those smaller agglomerations rendered visible occasionally as meteors. From this it is evident that the amount of ether condensed and converted into matter formed at the outset no insignificant proportion of the whole, although it now occupies comparatively far less space.

Let us now proceed to investigate some of those properties and conditions of matter which it is sought by this theory to explain.

Etherial Resistance.—The first question likely to occur would be that of locomotion. Would not an atom, battered on all sides by a powerfully vibrating ether, be as much confined as is a prisoner in his cell? It is a part of the present theory that single atoms (at all events, in a normal state) would be so fixed. Contrive, however, to bring two or more atoms together—that is, inclose them in one and the same cell—and it will be evident that, while the wall of their prison has not increased in strength, their power to break it down has grown directly in proportion to their numbers. Thus, for bodies of atoms, and also for single atoms abnormally excited, the resistance of the ether becomes a negligible quantity.

Mechanical and Atomic Force.—Before proceeding further, it would be as well to state that the word "mechanical," as applied hereinafter to force or motion, is intended to define that condition of the atom, or bodies of atoms, in which etherial resistance to locomotion is overcome. To illustrate: the motion of a cricket ball sent flying through the air is mechanical. Water poured from a jug moves mechanically. The locomotion of the molecules of a gas is, by this definition, likewise mechanical.

On the other hand, "atomic" force or motion refers to that exerted by one atom or more, whereby the ether is strained only, and is not broken down nor rendered resistless. The straining of a dielectric, magnetic rotation, chemical affinity, vibrations originating heat and light, &c., are examples of atomic force.

Incompressibility of the Ether.—The distinction between mechanical and atomic force here made is of much importance in solving an apparent difficulty in the way of the present theory—viz., the supposed incompressibility of the ether. That you cannot charge a prescribed space with more ether than it already contains has been demonstrated by the ice-pail experiment of Faraday, the insulated sphere of Cavendish, and other tests.

Now, incompressibility may imply one of two things: (1) That there are no spaces between the particles to allow for any diminution in bulk, or (2)—and to this view the writer would beg the most careful attention—that the power of subdividing itself possessed by ether, coupled with its exceedingly rapid state of vibration, baffles all attempts to hold it—it slips, as it were, through the

fingers. To put the matter in other words, the force required to *appreciably* compress the ether is mechanical, being at least equal to the minimum amount needed to break the medium down; and the latter effect, therefore, occurs when that amount of force is used.

It may be urged as an objection to this view that, in the case of a dielectric charged with electricity—(i.e., with "ether," a process somewhat analogous to pumping water into an elastic bag) this breaking down does not occur, because, if it did, the dielectric could not be charged at all. The answer to this, of course, is that the process of charging a body with electricity is atomic, not mechanical. This is shown by the fact that where a charge is so powerful that the atoms composing the insulator are jogged into "mechanical" motion, the insulator itself at once breaks down, its cohesive power is lost, and equilibrium is restored.

Sound, Light, and Heat-Wave Propagation.—The word "appreciably" italicised above, is used because the writer does not deny—nay, he suggests, for reasons to be now stated, that the ether is capable of an "atomic" compression due to the atom's heat and light vibrations; and this slight change in bulk, being atomic, is obviously incapable of direct measurement.

We have now to account for the propagation of waves in the medium surmised, and, in doing so, to take into consideration the phenomenon of polarisation.

First, let it be said that the writer is not at present convinced that a medium, whose vibrations can fix an atom as before mentioned, would not be electrostatically rigid up to the limits of its power to resist being broken down, and, therefore, capable of a certain amount of shearing stress, such as is required in the creation of transverse waves. That water and gas (both molecularly constructed) assume this this state may, of course, be assigned to reasons more complicated—e.g., the attraction between their positive and negative elements. But, when the nature of these forces is made clearer, such a reason will have to give place to a simpler one, which will, perhaps, prove the analogy between a gas and the ether in this respect to be very close indeed.

Assuming, however, pure transverse motion to be inadmissible, the following argument in favour of the "sound" class of pulsation and criticism of its theory is put forward. Sound is propagated by reason of the medium becoming suddenly compressed in the direction in which the sound is about to travel, and then springing back to its original state, such compression and expansion being communicated onward at a certain speed depending upon the elasticity and density of the medium. Now, what the writer suggests is that in a compressible "sound" medium the impulse is not communicated directly forward. When the blow is given, the compression which follows tends to cause a lateral spreading out of the particles at right angles to the line of progression. This transverse expansion goes on until the limits of the medium's compressibility is reached, when reaction sets in and produces the amount of resistance necessary to send the impulse forward.

To make the matter more clear, let us take a mechanical illustration. When a gun is fired the gas evolved within expands all ways; but it is chiefly to the *lateral reaction* of its metal walls upon the gas that the necessary force of propulsion is due. Without this, the projectile would stand a poor chance of reaching its destination. In the same way, a sound impulse, without the lateral resistance of the surrounding molecules, would be deprived of the best part of its propelling force. If this be the correct view to take, then, as each longitudinal pulsation proceeds the lateral pulsation will proceed also, and the sound-wave works itself out as a sort of combined transverse-forward impulse, able, by proper means, to be polarised.

Chemical Affinity and Cohesion.—Having grasped the foregoing facts, the nature of chemical affinity will not be difficult to comprehend. Briefly, the process may be typified as follows: Two atoms are, by mechanical means, brought into contact—i.e., become inclosed in one etherial "cell." If equal as regards temperature and constitution (size and rotation velocity may possibly affect the latter) nothing particular happens; they are simply held together by the walls of their prison house. This is cohesion. But assume one to be a more energetic atom than the other. The former at once begins to equalise matters by jogging its weaker neighbour, and in this way transfers some of its own heat to the other. This causes the latter to expand abnormally and to become strong enough to break down the ether. It flies off into a state of momentary freedom, is relieved of its superfluous heat by radiation, and, finally, its initial motion carries it again into contact with another atom similar to the last, when the process is repeated. Thus it will be observed that chemical union is not an "attraction" properly so called. The atoms, having been brought into contact by some means, such as the mechanical intermingling of two fluids, are held together cohesively (as in a vice) until the action above described separates them with great force, and this force carries them into union with new partners.

Gravitation.—What, then, is gravitation? This question has been left until last, because its answer depends to a great extent on what has been already said. The force we have here to deal with is an exceedingly minute one compared to that of chemical affinity. The latter is (according to Dr. Oliver Lodge) ten thousand million billion billion times greater than that of gravitation acting at the same distance. It is not hard, therefore, to accept the statement that gravitation is only a residual pressure by the ether towards the atom. We have all noticed the effect of surface tension upon bubbles in a teacup. Etherial pressure can be shown to have a similar effect. It may be explained in this way: —Were the ether free of gross matter, the pressure exerted by the continual collisions among its parts would be no greater in one direction than another. Evolve an atom, however, and the case is different. As has been suggested previously, the atom, by virtue of its definite shape, tends to order the vibrations of the ether relatively to itself, just as, for instance, reflected sound-waves tend to assume the form of the object which reflects them. The vibrations, for this reason, practically resolve themselves into two sets—viz., those to and from the atom (that is, radially) and those at right angles thereto, which it will readily be seen extend round the atom in layers, or concentric spheres. The former may be disregarded because they act in straight lines, and their pressure is no greater inwards than outwards.

It is to the latter, therefore, that we must turn our attention. These "spheres" of vibrations are infinite in number, and enlarge, of course, directly as the square of their distances from the atom.

Now, it can be shown that forces acting round a curved surface and parallel thereto will have a resultant effect, not *round* the curve, but *inwards*, and the greater the curvature the stronger this effect. Consequently, by the same reasoning, collisions between the parts of a sphere will have a resultant pressure towards the centre, its strength depending upon the curvature or distance of the sphere. Hence, in the present case, the atom being in the centre of the vibrations, the phenomenon of gravitation is accounted for.

In conclusion, the writer is conscious of having attempted to condense into a small compass materials that would occupy a book, but trusts that the general idea will be grasped. If the inferences herein set forth find acceptation, he will be pleased; if refuted, then the knowledge gained thereby will amply compensate him for the trouble taken.

R. A. Kennedy.

THE LATE FLYING MACHINE ACCIDENT.

[42917.]—It is to be hoped that the late flying-machine accident in which the valuable life of Mr. Pilcher was lost, or, more properly speaking, thrown away, will be a warning to all such thoughtless persons that we hear of now and again who contemplate trying some wild plan such as that advocated by Mr. F. L. Davidson, and many others, among them Prof. Langley of America. Nothing but disaster can come of any of these wild plans, because they are not devised on the true principles of aërial flight, as shown us by nature in the mechanism and manner of the bird; Mr. Maxim has been able to foresee this, or why did he give up after getting the power to fly, as he actually did attain? The truth is, Mr. Maxim, fortunately for himself, could see clearly that though he had actually overcome one half of the difficulty—namely, the power to rise into and go forward through the air, there was not the slightest chance of his ever attaining the other and far more important half—the power to keep his machine safely balanced in the air—so like a man wise in time, he gave up while he had whole bones. I have said so many times, and I say it again, in no machine designed to travel fast can safety be attained, because you introduce the element of danger even before you get in the air. It would be with you every moment of time you were in the air; but the moment you tried to land it would be intensified a thousand times. The same will happen in the case of Prof. Langley, unless he uses balloons in conjunction with his flying-machine; in that case it will not be a flying-machine, but a mechanically-propelled balloon. The true flying will require no gas-bags to aid it; it would be a sorry machine if it did, and, as I say, would not deserve the name of flying-machine. But I suppose these lamentable accidents will take place now and again until men get to use a little common sense on this subject; even had Mr. Pilcher succeeded ever so, he could have taken us no further than Mr. Maxim had already taken us. Mr. Maxim actually proved it is possible to ply the air mechanically; but we knew all that before—the bird had shown us all that—and Mr. Maxim has not shown us how to do the work for the simple reason that he does not know himself. I do not here intend to go into the subject of the construction of a practical flying machine; my object is to point out the utter madness of trusting precious human life to such flimsy contrivances as those of Herr Lilienthall and Mr. Pilcher, neither of which deserved the name of flying machine one mite more than would a large paper kite. The machine intended to have the care of human life up in the air should be built upon a decided and well-defined mechanical principle; this same principle should be worked out into a perfect system; there should be no loop-hole for danger. We must not be left to suppose this or to suppose that. We must suppose nothing, but be sure of everything beforehand. Nothing must be left to chance. These, then, should be the rules in regard to any machine intended to take human life into mid-air. First, should be perfectly uncapsizable—that is, it should be safe under any condition of the atmosphere; second, there should be no possibility of the machine descending rapidly, no matter what happened. Now these two simple conditions are all that is required to make it as safe to go up into the air in a flying machine as it would be to go out on to the ocean in a steamboat, and can they not be gotten? Most decidedly they both can, and in a simple manner, but not in the manner that so many seem to think, not in a machine designed to rush through the air at something like a hundred miles per hour. All we want in a practical flying-machine is plenty of power applied in the proper manner. This has never yet been done; hence there is not yet such a thing as a flying-machine.

Thomas George Challis.

A FORMING-TOOL HOLDER.

[42918.]—The following description of a forming-tool holder which I found in a back number of the *American Machinist* may be of interest to some of your readers, so I send it over. The writer, who

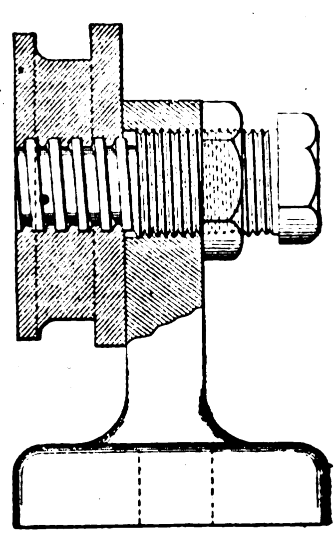
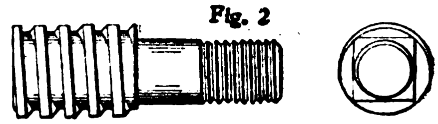


Fig. 1

Fig. 2



merely signs "S. B.," says:—"Anyone who has tried to hold heavy circular forming tools in place by the usual means employed—viz., a flat-headed bolt through the former and holder, with a nut on the opposite end, will, I am sure, appreciate the simple device here shown, which will hold any circular former precisely in the position in which it is set.

In the old way the holding power depends upon the friction of the head of the bolt; and no matter how hard the nut is tightened, even if a piece of gas-pipe is used on the wrench, the former will slip at times, much to the annoyance of the operator, besides decreasing the output of the machine by the delays necessary for the readjustment.

Various means have been employed to overcome this difficulty, most of them too complicated and expensive to be practical. In endeavouring to find something to do away with this annoyance, I hit upon the idea here shown. So far it has proved a great success. The lock is positive, the adjustment simple and quickly made. Very little force is necessary to tighten the nut to hold the former against the heaviest cut.

"Fig. 1 shows the method of holding the former if a new holder is made. A square thread is cut in the former as it leaves an arbor for turning, milling, &c., without injuring the thread. A five or six-pitch thread is used, right or left hand, depend-

ing upon which side of the machine the former is set; the direction of the thread being such that the former will tighten by the force of the cut.

"To get any adjustment, the thread inside the holder must be of a finer pitch than that in the former, and run in the same direction. If desired to use the old holder, the bolt is made as in Fig. 2; the result is just as good. When once the square-threaded taps are made, the work upon the forming cutter is but little more than when making them the old way, while the result is a hundred times more satisfactory."

Criticism from your readers would be welcomed.

Minneapolis. **M. P.**

THUNDERSTORMS.

[42919.]—During a thunderstorm about three weeks ago I noticed the phenomenon mentioned by Mr. Monck in letter 42902, p. 185. I was watching a wind-vane when I noticed the dark thunder-clouds were approaching in a direction opposite to that indicated by the vane. The position of the vane was S.E., directly opposite to the clouds, which rapidly approached from the N.W. The vane veered round to N.W. in this case, however, long before the storm was over. From the speed at which these clouds moved, they must evidently be at a low altitude, and the cross-currents which must be flowing to produce the observed effects are not easy to account for. I was told by a friend who was standing near that he had noticed "that thunderstorms *always* came up against the wind." It was, however, the first occasion on which I remember noticing the phenomenon.

C. M. Dowse.

[42920.]—I watched closely the progress of the storm to which Mr. Monck refers (letter 42902), and saw exactly what he saw—that is, at first the smoke was blown in a direction opposite to the clouds, afterwards the smoke was blown in the same direction as the clouds, and then the storm ceased. I have noticed the same thing on many other occasions, and the explanation is easy. The wind all day had been blowing from the west, roughly speaking, and this was the direction in which the smoke was blown. The storm came from the east, also roughly speaking. While the lightning was still in the distance, the front of the storm-wave blew overhead, carrying clouds from the east; but did not disturb the ground current, which was from the west, as shown by the smoke. As the storm approached there was for a moment a calm, and then as it came closer it overpowered the westerly breeze, and smoke and clouds were blown in the same direction. The change of the wind thus denoted the moment when the storm passed overhead, and as it was moving rapidly it was soon gone inland out of hearing.

One night last year, while in the Queen's County, I observed a fierce display of lightning. On making inquiries I found that there was not any storm in Ireland in the direction of the lightning, but the "Mechanic" the week after gave an account of a heavy storm in Cheshire, I think, at the same hour. Is it possible to see the reflection of lightning at such a distance—about 200 miles? **Zeta.**

THE GREAT GLOBE AT SWANAGE.

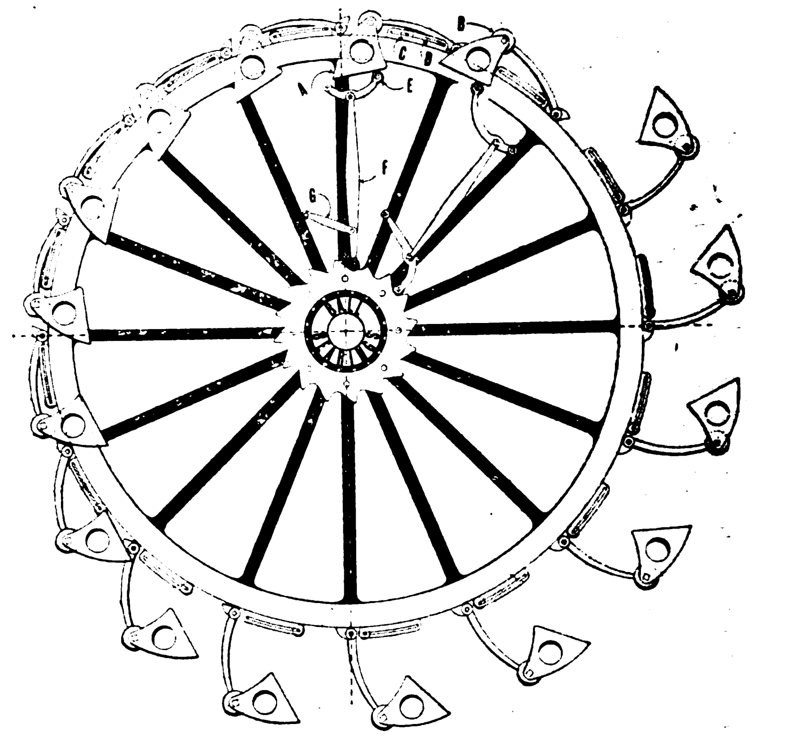
[42921.]—Having seen the great globe at Swanage several times while I was at Bournemouth, I can give "F.R.A.S." the information he wants about it. As far as I can make out it was placed there by a Mr. Burt, of the "Granite House," Swanage, who has in a great measure made Swanage what it is, I believe. I think the globe has been there about nine years. It is near the Tilly Whim caves, about a mile from Swanage. I do not know whether it is solid or not, but should fancy it was. The diameter is about 8ft., and I think it is constructed out of the Purbeck marble, but am not quite sure. I do not think it was made for any special purpose, beyond illustrating the earth as a globe, showing its rotundity, &c. The various Continents, &c., are marked out very distinctly, being in relief, while the chief mountain ranges are also marked out, slightly raised up. There are a good many names on it.

The data "F.R.A.S." alludes to as being cut on the wall in front of it refer to various facts relating to the earth, moon, sun, and stars, such as their size, mass, weight, distance, &c. This is doubtless for general information and edification. I believe a photograph and short explanation appeared in the *Strand Magazine* some time during 1896 or 1897 (or possibly 1895). **Ivo F. H. Carr Gregg.**

GILBERT'S NEW POWER MACHINE.

[42922.]—I beg to send you herewith outline drawings, blocks, and particulars of my machine, to enable you to ventilate through "Ours" this long-forsaken problem of perpetual motion. There is some friction in these two machines which I do not like; but still the principle is there, and in my drawings Nos. 3 and 4, with which I am now busy,

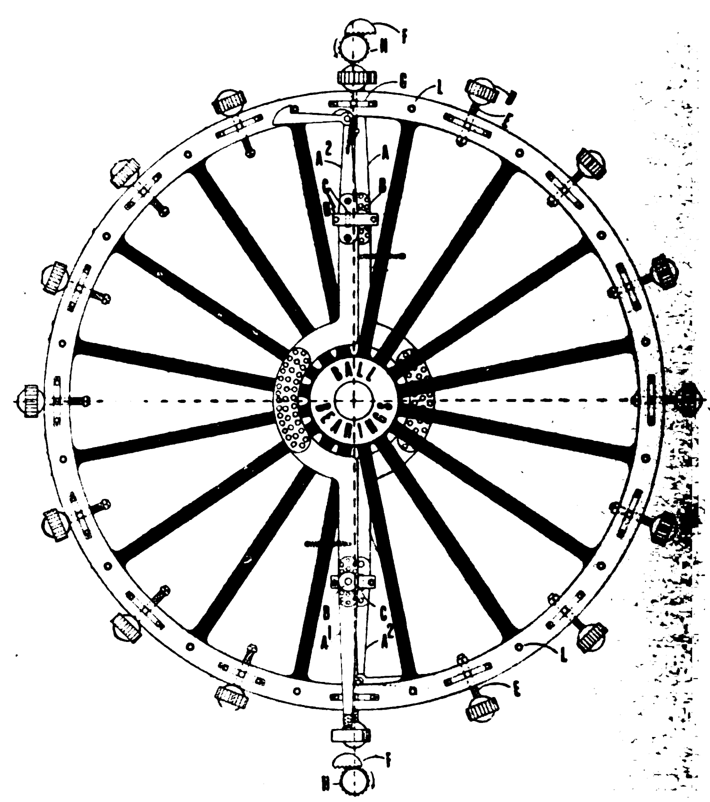
Fig. 1.



[Scale about $\frac{1}{8}$in. = 1ft.]

A, lug fixed to B; B, solid weight 2ft. diameter; C, check roller to hold up B as it is lifted; D, check roller slot; E, roller of lifting arm; F, main lifting bar; G, hinged guide. Wheel 50ft. diameter. E, F, and G, and those at right-hand are supported independently of wheel, and may be fitted at off-side in same manner. N.B.—Although the lugs and weights A B are all shown to be lifted at near-side, half may be lifted at off-side, and thus reduce the number of teeth to eight each side.

Fig. 2.



[Scale about $\frac{1}{8}$in. = 1ft.]

A, lever for increasing weight; A^1, lever for decreasing weight; A^2, impulse end of lever; B, pivot of lever; B^1, guide plates; C, roller; D, solid weight 2ft. diameter; E, thread; F, lifting comb; G, blade check spring to prevent weight D moving out or in by gravity; H, revolving cogwheel, part and parcel of D; L, pin roller. Wheel 50ft. diameter. N.B.—The two levers are supported, independently of wheel, at B; the combs F are a fixture on end of A, A^1.

I have, I think, entirely overcome friction, and fail to see why Nos. 3 and 4 (they will follow later on) should not revolve continuously or, if you exclude dust, say perpetually.

Although my drawings represent a 50ft. wheel, a 100ft. or larger would cause a steadier and more reliable action, and you would thus be able to increase the number of the propelling weights to double or treble that shown. I may mention that it is 20 years since I first took up perpetual motion

(I have had many tries in that time), but I could never get over certain points to my liking until now.

Arthur E. Gilbert, A.I.E.E.

23, King John-terrace, Heaton, Newcastle-on-Tyne.

THE STEREOSCOPE.

[42923.]—L. Paxton, in his letter (42893) with diagram, demonstrates clearly, that unaided eyes 2¼in. apart can unite, by gentle convergence of the optic axis, any stereoscopic pictures that are less than 2¼in. apart. But he does not show us how an average pair of eyes, say 2⅝in. apart, can perform the feat with average stereoscopic pictures set 2⅝in. and more apart. Will your correspondent explain, with another diagram, how that can be done without either looking cross-eyed as at Q in his diagram, or else stretching the eyes wider apart, which is what I meant in my last by outward squinting?

Leading opticians give me 2⅝in. as a rough average width between eyes, and any one who has a collection may see for himself that stereoscopic pictures are mostly set between 2⅝in. and 2¾in. apart. Here and there one may be found mounted at 2½in., but one of my best measures full 3in., and I saw to-day an American view on sale, that measured fully 3¼in. between corresponding points.

R. S. D.

THE MISTAKES OF AUTHORITIES A HINDRANCE TO PROGRESS — THE AURORA.

[42924.]—It is desirable to correct a misprint in letter 42895 (p. 163), headed as above, which alters the intended meaning. I wrote that the errors in the *Monthly Notices* relating to a class of ambiguous phenomena mentioned were *passively* sanctioned, meaning thereby that they were never challenged by the members, and the absence of any debate or criticism in reference to their value or accuracy was liable to misconstruction by the outside public. The explanation of responsibility given by one of the respected members of the R.A.S. (letter 42896, p. 184) is quite in accordance with my expectation; but I think their discussion by the members would be a decided advantage, instead of relegating them to obscurity unnoticed.

The example referred to is a calculation of the height and locality of a supposed auroral ray observed March 4, 1896, by Mr. T. W. Backhouse, Sunderland, founded on observations from three given places. An examination of the data supplied by them shows differences inconsistent with identity. If it be admitted that the results can be justified, then there can be produced observations of an opposite character, which will contradict those previously selected.

In answer to the concluding query, I was obviously dealing with auroral phenomena, and with certain advised methods of observing them by the same author as above.

Birmingham, Oct. 8. W. H. Wood.

IMPROVEMENTS IN ROTARY ENGINES.

[42925.]—In your issue of Sept. 29, p. 162, your correspondent "J. W." (letter 42891) makes reference to some practical experiments with rotary engines for steamship propulsion, which very much interest me. I assume from the names "Breynton" (not Brenton) and Wimshurst, these experiments took place about the late "Forties" or early "Fifties," as these gentlemen are credited in the Patent Office with patents No. 10786[45], 11541[47], and 13340[50] respectively. Would he kindly, if he can do so conveniently, amplify his remarks by any data concerning these trials, the chief drawbacks found in practice, and also say where any printed reference to these trials can be found, either in societies' *Transactions* or in published papers at that time, which, unhappily, were not very scientific?

I have the patents referred to, which confirm by the drawings attached "J. W.'s" general description. I quite agree with "J. W.'s" remarks as to modern men repeating the former failures; but surely it is worse to be permitted by the authorities to pay for a patent already three or four times, if not a dozen times, taken out for the same thing by others, which is notably the case with patents for rotary engines.

I am interested in a development of the form of rotary engine under discussion, which I think quite eliminates the causes of previous failure, and brings rotary engines up to what they should be—viz., an advance on reciprocating engines. Of the details of this engine, I shall be glad to forward details and photos., with notes of performance at an early date, for the benefit of "ours."

W. D. G.

MAGNETO IGNITION.

[42926.]—I should be glad if Mr. Bottone would give us his views as to whether it is better or not to use an induction coil with magneto dynamo for ignition for motors. In the Sims machine the bobbin oscillates between the poles of a permanent magnet, and sparking is advanced in ordinary manner by varying moment of drop in cam. This oscillating movement appears to me inferior to a rotary motion at high speed. A view of Sims' method is given in *Auto-Motor Journal* for August.

In another I have seen no coil is used at all, and armature is advanced or retarded by moving a sleeve which carries armature round at angle of 45°. To get best results for starting and running this works very well; but armature is about 6in. diam., and appears altogether too large for tricycle work. Only advantage appears, it will spark easily at a very low rate of speed, which is important where you have to start by pedalling, as on a tricycle.

What I want to know is whether it is possible, by using larger armature, to do away with coil, or if same is of advantage in starting at slow speeds? The coil itself weighs 5½lb., so if half this weight was saved and put into armature it would spark easily when running slowly. The weight of "Dion" dry battery and case is 17lb.—a considerable item. Perhaps in reply to a query this week you may give some information that will be of interest just now. I am convinced some form of magnet will eventually remain as a survival of fittest. Can you oblige us with sketch of one suitable? Monty.

WHEN WERE YOU BORN?

[42927.]—Many of these tricks have been published by the "E. M.," but I do not remember to have seen this: Tell a young lady, or any other person, that you are able to find out the very day of her birth, if only—

1. She writes down on a piece of paper (that she shall not let you see) the date of the month in which she was born.
2. Multiplies that number by 2.
3. Adds 4 to the product.
4. Multiplies again by 50.
5. Adds to this second product the number of the month (January = 1, February = 2, &c.)
6. Multiplies the sum by 100.
7. And finally subtracts from the product the exact number of years she was old last year, and gives you the result.

For instance, let us say that the young lady is born on the 3rd of September, 1880. She, therefore, writes 3; multiplies it by 2, and has 6; adds 4, which gives 10; multiplies again by 50, which makes 500; adds 9, and finds 509: multiplies a last time by 100, and has 50,900; subtracts 18, the accomplished years last year, and produces 50,882, a number which apparently is not to give you any information whatever upon the date of her birth. Well, take the paper anyhow, and feign to examine it with the greatest attention; meanwhile, add mentally 100 to the number produced, it gives 50,982; subtract from it 20,002, an operation easy to do, also without a pencil or a pen. What have you then? 30980; and you can tell the young lady that she was born on the 3rd day of the 9th month of the 80th year of the century.

As I am always happy to find and note tricks of this kind, I should be grateful if any of "ours" should, with the Editor's leave, let me know of others I may not be acquainted with.

Milano, Oct. 7th. Hunot.

An American statistician calculates that in Pittsburg, under normal conditions, pig-iron can be made at a cost of 9·53½dol.; England can only produce it at the minimum of 15·70½dol.; and Germany at 15·34½dol. The United States can therefore produce pig-iron 5·81dol. cheaper than Germany per ton, and 6·17dol. per ton cheaper than Great Britain.

Blue Prints and Photo-zincography.—C. Fleck, writing in the *Photographische Chronik* on the use of grained zinc plates for three-colour printing, gives the following formula for preparing a ferro-prussiate sensitising solution. The prints produced upon the zinc plates are only used as a guide by the artist, who makes three-colour drawings as in chromolithography. For the sensitising solution take: Distilled water, 100c.c.; alcohol, 15c.c.; ammonio-citrate of iron, 15grm.; ferricyanide of potassium, 10grm.; gum-arabic, 5grm.; honey or caramel, 2grm. The gum-arabic may be replaced by three times the quantity of albumen, or five times the quantity of fish-glue. The plates should be immersed before coating in dilute filtered gum-water, and to obtain an even film the plate should be twice coated with the sensitiser, starting each time from opposite corners. Equalise the film upon the whirler, and dry over a spirit-lamp. Print till the shadows are slightly bronzed. The printing must be done in sun or electric light. If over-printed, reduce with yellow prussiate of potash. The correctly exposed prints should be washed for ten minutes in water, and the image thus obtained is in Prussian blue. After drying, the drawing may be made over the print with Lemercier's chalk, No. 2.

REPLIES TO QUERIES.

⁂ In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.

[96555.]—**Equation.**—To "M.I.C.E."—The assumption referred to is surely sufficiently obvious from the symmetry and rotation of the coefficients, although, like most algebraical devices, it is merely a means to an end. As "M.I.C.E." so strongly objects to it, I am the more surprised he should have recourse himself to a similar non-algebraical supposition. When, for instance, a quadratic is presented for solution—say $x^2 + 3x = 5$—there is no implied condition that x shall be an exact integer or fraction, and unless the equation represent a set of conditions in which positive integers and fractions are the only admissible quantities, we have no right to import any such restrictions into the problem. Hence, one cannot accept the solution given by "M.I.C.E." on pp. 163 and 164 as orthodox, although we may admire its ingenuity. If we accept the premises that 34445·25 must be exactly divisible by x^2, and that the latter must also be an exact quantity, then the statement that ·25 and 2·25 are the only values which fulfil these conditions is certainly not accurate, for—

$$34445\tfrac{1}{4} \div x^2 = 137781 \div 4x^2 = (7 \times 3^9) \div 4x^2$$

where x may be $\frac{1}{2}$, $\frac{3}{2}$, $\frac{9}{2}$, $\frac{27}{2}$, $\frac{81}{2}$, or each of these multiplied by $\sqrt{3}$, $\sqrt{7}$, $\sqrt{21}$—i.e., twenty values in all. The particular values which satisfy the equations are therefore dependent, even on the false premises alluded to, upon twenty trials, and do not otherwise express certainties—i.e., the assumed x may not be the true x. The correct process of solution leads to the biquadratic.

$$m^4 - \tfrac{2240}{447} m^3 + \tfrac{1300}{149} m^2 - \tfrac{24125}{4023} m + \tfrac{5000}{4023} = 0$$

where $m = \frac{5}{3}$, $n = \frac{7}{3}$, $x = \pm \frac{3}{2}$, and the only values which satisfy the problem are $\pm (\frac{3}{2}, \frac{5}{2}, \frac{7}{2})$. The expression $\sqrt{9m^2 - 45}$ employed by "Ontario," or its simpler form $3\sqrt{m^2 - 5}$, may denote 2, 6, 22, &c., where $m = \frac{7}{3}$, 3, $7\frac{2}{3}$, and possibly some other values. So, likewise, $\sqrt{16m^2 - 351}$ may denote 7, 15, 57, &c., by putting $m = 5$, 6, 15, &c. Therefore the values $m = 3$, $x = 6$, as obtained by "Ontario," do not *necessarily* satisfy the equation. The only legitimate solution of "Ontario's" equation, like that of Mr. Harding's, is one involving a biquadratic, and if we attempt any alternative method it must involve assumptions and trials, or the "guesswork" complained of.

West Norwood. Henry T. Burgess.

[96588.]—**Wool Grease.**—If a "patent was taken out," as stated in the query, the particulars can, of course, be found in the specification. The query is rather funny, because readers are asked to give "common names in trade terms of the above." The "above" seems to be missing; but if the subject is a patent, full particulars can be obtained from the specification, or that is worthless and quashes the patent. R. S.

[96589.]—**The Keyword Interest.**—The "keyword" is simply some word known to those interested, and when known anything can be read by it, although to others it might appear to be mere "rubbish." To a 'cute man that would suggest something beneath. M. T.

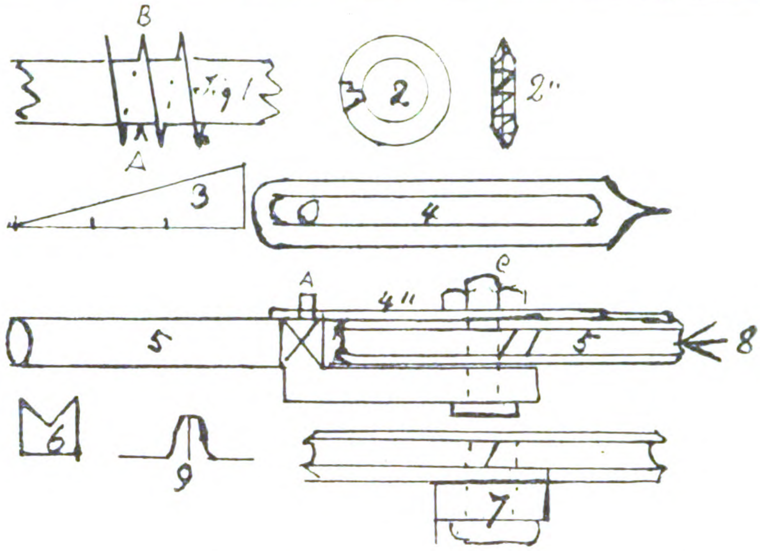
[96633.]—**Green Water.**—I have to thank "M. T." for kindly noticing my query. The water turns green without any bather entering it. I should be grateful if "M. T." would tell me where to send samples of the water for analysis, and for a sound opinion as to whether the greenness can be cured? Will he also kindly inform me what the cost of the analysis will be? Quex.

[96675.]—**Railway Lines.**—I have seen electric tram lines put down, but there was no welding of any kind. The connection between the rails was made in this way: A hole was bored in each rail near the end; one end of a copper rod was fixed into the hole in one rail, and the other end of the rod into the hole in the next rail. This rod was not straight, but somewhat bent—corrugated, as it were, and it got more or less bent according as the temperature tended to make it shorter or longer.

Trams.

[96680.]—**Temperature.**—Solution of the following will enable you to get 5° to 22° Fahr. of the heat of chamber. Inexpensive comparatively. Placed in a convenient vessel in room:—Calcium chloride, 20, magnesium chloride 20, sodium chloride 6, potassium chloride 13, water 41. If mixed with equal volumes of snow of 32° Fahr., freezing mixture of 5° to 4° Fahr. obtained. Ammonium nitrate 1, water 1, gives 5° Fahr. Ammonium nitrate 4, water 3, gives 13° Fahr., &c. Regent's Park.

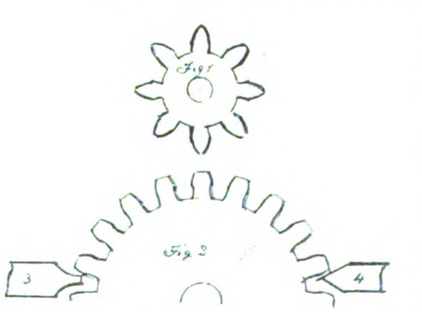
[96602.]—**Cutting a Worm-Wheel.**—You are not going to make a satisfactory job of it unless you go the proper way about it. Say Fig. 1 is the screw of the pitch you want to cut. Take the diameter from bottom to top of thread, as shown at B, and



plot out three times, as shown at Fig. 3, the base being, of course, the pitch. Now you have the angle for lining out face of wheel. Your hob section, shown at 2, step-toothed half the depth of thread and cutting clearance, only every other one into the bottom of hob—i.e., just below the others just to the bottom—and you will find it cut all right; 2 is the single disc-cutter to divide your wheel out, and cut out very near down to the depth (it cuts best if the teeth are zigzag from the centre); 4 is an index made out of a piece of saw-plate or sheet steel—the former best with the temper in it; 5 is the bar for placing the wheel on for cutting—may be made out of wrought iron or cast, of a pattern. A stud is placed upon it at A that just fits the slot in 4, and two flat sides are filed upon the bolt C that holds the wheel 5, to fit the same. The wheel should only embrace one-fifth of the circumference of the screw and the edges chamfered off, as shown, to depth of thread, and the face hollowed out very near same radius as the bottom of hob. The stalk of bar is round, and you will want a saddle-piece or vee-block to put it in, so that you can cast your job to the proper angle (see 6 and 7). The best section of thread for the teeth is wheel teeth or pitch, as shown at 9. Set your work central with centre of lathe (see 8). Divide your wheel out on the edge of chamfer, cut very near down to it with the single cutter, then finish with the hob, letting the wheel run loose upon the pin, not forgetting to set the top cheek of wheel level before performing the latter operation, and you will find it a beautiful job.

JACK OF ALL TRADES.

[96667.]—**Wheel-Cutting.**—You can do a lot of work with two cutters, only you must know how to use them, and they will work well enough for any ordinary purpose, and I have made one cutter do various jobs in that line; but it is in the one instance a cutter proper for every job that is done at once; then with the two cutters going over twice, then again with a single cutter going over the work three times. Just look up the sketch, and it will show you how it is done—rather stout for



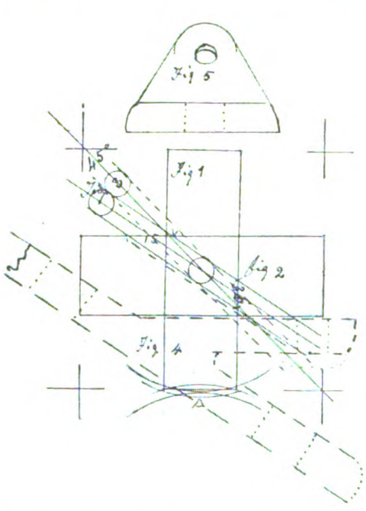
clock wheels. You should have given more particulars—i.e., diam. and pitch. Fig. 1 shows you pinion, and Fig. 2 a wheel. Now this is to illustrate the difference in shape of teeth. I have cut wheels from $\frac{5}{8}$ bevel or mitre top to close upon 3ft., and many I have done by the following dodges with fly-cutters. Where rose-cutters were not in stock, and time could not be spared to make them, or the job would not pay to do so, make either a cutter as 3, with a radius the same as the tooth, or a vee the same as 4, and raising your cutter above or below the centre of work, or applying it central and down to the pitch-line for your gauge, made them as near an approximate as no matter for practical working, and have had no fault found with them. Go thou and do likewise.

JACK OF ALL TRADES.

[96692.]—**Liquid Nitrogen.**—The question as put by "Pressure" cannot be answered without making various assumptions, and even then an exact solution would be a matter of some difficulty; and I cannot at present see how to solve it in a simple manner. However, "Justus's" remarks (p. 166) are certainly wide of the truth. Whether or not the liquid state persists above the critical temperature is still somewhat a moot point, owing chiefly to the fact that there appears to be no sharp line of demarcation between the liquid and gaseous states. This much is, however, certain—that it is impossible to convert by pressure a gas whose temperature is even slightly above the critical value into what is usually considered a liquid. "Pressure's" assumption is therefore correct.

Trin. Coll. Oxon. J. M. W.

[96711.]—**Spiral Gear-Wheels.**—The accompanying sketch will show you how to go about it. This shows you how to lay them out and how to go about cutting them. You will want two angle-plates made as shown in the bottom Fig. 4, which is the side view, and show you the lines to get them. Fig. 1 and Fig. 2 are the two wheels at right angles. They are $\frac{3}{8}$in. thick to $\frac{5}{8}$in. diameter, the one wheel marked off to 30 and the other 15, about $\frac{1}{4}$ pitch. The bottom shows you depth, and pitch line is $2\frac{1}{2}$. There is only one cutter wanted, a single point Vee with the point taken off, so as to make the bottom



$\frac{1}{16}$ wide, and the tops the same; top of between teeth $\frac{3}{16}$. I believe that they will run at that for what power is wanted for manipulating cams for gas-engines. If you are anything of a lathe man you can do the lot upon your lathe.

JACK OF ALL TRADES.

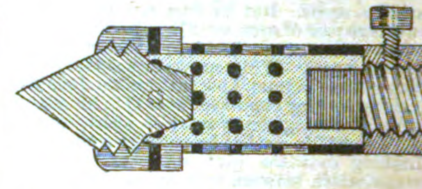
[96719.]—**Gauging Tanks.**—I am much obliged to "Regent's Park" for answer he has furnished; but the tanks may contain anything, from empty to full, and I wish to construct tables for various tanks, giving the contents for each inch of fluid in tank.

CHEMICAL.

[96729.]—**Grindstone.**—Possibly data might aid. Resistance to deflection from a direct line of motion offered by a body making one revolution in a minute in a circle of 1ft. radius is ·000341 of its own weight. This resistance varies directly as the radius of the circle, and as the square of the number of revolutions per minute. Thus, let A = radius of wheel in feet; R = revolutions per minute; C = constant ·000341. Then, $A \times R^2 \times C$ = centrifugal force of wheel in terms of its weight.

REGENT'S PARK.

[96738.]—**Gas-Heating Soldering-Iron.**—The blowpipe, Fig. 1, illustrated on p. 120 in



"Ours" of September 15 last, only needs a copper bit (as here shown) attached to meet "Bunson's" requirements.

161, Albion-road, N. A. CLARKE.

[96749.]—**Electro-Magnets in Series.**—The electro-magnet which will not work has probably got all or most of its turns short-circuited. This may be tested, if suitable apparatus is available, by measuring the resistance of the two coils, when the partially short-circuited one will be found to have the lower resistance; or a rough test may be made by connecting the two magnet coils in series across the battery, and then placing the wires from an electric bell across each coil separately, as if the coils were batteries. If one coil is badly short-circuited, the bell will ring only very feebly, or not at all, when placed across it, but will ring vigorously when placed across the good coil, if this has not too low a resistance. It is also possible that the coil of the magnet which will not work has been wound so that some of the turns are in opposition to the remainder; but this is not likely. In either case the only remedy (if no fault with the insulation can be seen on inspection) is to rewind the coil.

G. A. R.

[96756.]—**Ornamental Blocks.**—If you ever come across "Silk," by G. H. Hurst, of G. Bell and Co., London, you will see lustring is given to yarns by exposure to action of steam in oven, whilst stretched between two highly-polished revolving rollers of steel. Hanks are hung on rollers, oven closed, steam 5lb. to 10lb. pressure admitted, rollers revolve, at same time gently drawn apart, thus stretching and opening out silk yarn. The hanks obtain high lustre. Sometimes ovens are dispensed with; hollow rollers used heated with steam, but said not to be so good. Sometimes rollers are horizontal, sometimes vertically. However, this may not suit you, as you may want something in the nature of a size or starch. Possibly following may be worth a trial on small scale, and then if found adaptable done on the larger:—Lustrine Alsacienne (starch gloss): Borax, $2\frac{1}{2}$oz.; gum arabic, $2\frac{1}{2}$oz.; spermaceti, $2\frac{1}{2}$oz.; glycerine, $6\frac{3}{8}$oz.; distilled water, $2\frac{1}{4}$ pints; a few drops of some sweet-scented essence; add six spoonfuls lustrine to $6\frac{3}{8}$oz. of boiling starch.

REGENT'S PARK.

[96759.]—**Bikes and Prams.**—I am much obliged to your correspondents who have kindly noticed my query, but I want to know whether any court of law has decided the point. Let me put the case. A bicyclist out with his wife wheeled his bicycle and his wife's on to the pavement—say, in Bond-street—while she went into a shop. He was summoned and fined for having bicycles on the pavement (meaning the footpath or sidewalk); but perambulators are permitted. I happen to live in a place where perambulators are tolerated—in fact, we call it Perambulator Parade—and don't wish to say a word against the practice, because it is better that mothers should bring their children out than leave them at home to play with matches, &c.; but if perambulators are all right (legally) on the sidewalks, why should "bikes" be considered as offenders against the law? I have read of cases where a cyclist has been fined because he wheeled his machine on the sidewalk, when he could not wheel it on the road, as that was "up." Is there any "law"?

ROTA.

[96761.] — **Ginger-Beer Plant.**—I am much obliged to the gentlemen who have replied to my query, but I think Mrs. Harris does come into the question. The query originated in, or was based on, a statement that the ginger-beer plant was a "root" from Asia Minor, and that all that was necessary was to put it into water with sugar, and you obtained ginger-beer: hence the question—"Does it make ginger-beer without putting ginger into the sugar?"—"water" should have been appended. I think it may be stated definitely now that there is no such thing as a "ginger-beer" plant, but that there is a fungus which will produce carbonic acid; and if there is sugar and ginger (the ginger is the

point), in the water, it will produce ginger-beer. Hope the replies will be useful to some people.
ZINGIB.

[96763.]—**Salicin.**—Chemically it is $C_{13}H_{18}O_7$, a glucoside, obtained from most of the willow or salix order, used as a febrifuge and adulterant of quinine, soluble in about 28 times its weight of water or spirit at common temperatures, a white, shining, bitter crystal. See Attfield's "Chemistry" and Greenish's "Materia Medica," and others.
REGENT'S PARK.

[96776.] — **Wickless Paraffin Lamp.**—Most likely if you boiled the corroded part for a very short time in soda and water, or stronger alkali, you would cleanse. REGENT'S PARK.

[96777.]—**Balloon.**—A small model can either be made of gold-beaters' skin, cambric, or calico; the last two varnished with linseed oil, boiled. If querist could refer to back numbers, he will find all the information he seeks *re* lifting power of balloons, &c., together with practical information on the utter fallaciousness of aërial navigation by balloon or aërial vessels containing gaseous contents.
E. WILSON.

[96781.]—**Electric Lighting.**—To MR. BOTTONE.—There would be practically no use in employing a lamp in your case. The purpose that a pilot lamp serves, in a large installation, is to show at a glance, by a comparison between its brilliancy and that of the other lamps in the system, the potential at the terminals of the dynamo, as compared to that at the distant points. (2) If the shunt dynamo is correctly wound, with a fair proportion of wire on its F.M. coils, little or no difference would result. The lamps left on would probably "blink" momentarily; but the increased resistance caused by throwing two lamps out of circuit would quickly send up the voltage to the requisite point. (3) No. 18 platinoid wire, about five yards to the ohm. S. BOTTONE.

[96781.] — **Electric Lighting.** — A voltmeter would be better than a pilot lamp, since it would consume so much less current. Either piece of apparatus is simply for the purpose of ascertaining whether the dynamo is given the correct voltage. The result of suddenly switching in half the number of lamps would be a diminution of the voltage, partly on account of the increase in armature reaction, and possibly also owing to the slowing down of the engine under greater load. A variable resistance in series with the shunt-coils is a useful addition, as, by these means, the voltage can be varied at will within certain limits. For a 50v. 4a. dynamo a suitable resistance would be a number of 1-ohm coils (about 10), each consisting of 2ft. of No. 21 Reostene wire.
A. H. AVERY, A.Inst.E.E.
Falmen Works, Tunbridge Wells.

[96785.]—**Lamp for Firing Tube.**—As several ask questions on same, one answer will serve the lot. (1) Lamp will not do for paraffin, only benzoline or petrol, which will vaporise without heat; it makes a little noise, but only half the noise of Æ na. It, of course, must be used vertically, the loose pan first filled with methylated spirit to heat it. When spirit is just burnt out, turn on petrol, when it should burn with an intense blue flame. An air-pump is necessary on tank, same as Æ na lamp; but as tank should always be higher than lamp, not more than half a dozen strokes are ever necessary. The correct height of lamp is ⅞in. from under side of tube to top of lamp; it is held by a clip round the lower part of steel union. This is same pattern as used on Daimler cars. An outside lamp-case, made of sheet-iron, about 2in. square by about 8in. long is necessary, to prevent draught cooling tube. This latter is 1⅝in. long by 3/32in. diameter. The chief drawback to use of lamp is, it frequently blows out in wind, when it is a great trouble to relight, and it is impossible with it to vary the firing moment as with electric. They can be bought a great deal cheaper than it is possible to make one only—cost about 7s. The nipple, locks, central tube, and burner-chimney altogether is shown clearly in sketch given on p. 141. MONTY.

[96787.]—**Gas Battery.**—In 1843 Mr. Grove succeeded in constructing a novel battery in which the active elements were gases. It consisted of a series of 50 pairs of platinised plates, each about ¼in. wide, inclosed in tubes partially filled alternately with oxygen and hydrogen gases. The liquid in tubes was dilute sulphuric acid (sp.gr. 1·2), and the following effects were produced: (1) A shock was given which could be felt by five persons joining hands. (2) A brilliant spark visible in broad daylight was obtained between charcoal terminals.
A. HORSFIELD.

[96787.]—**Gas Battery.**—Consists essentially in two tubes of glass, closed at the top, but open at the bottom, plunged into a vessel containing dilute sulphuric acid. In these tubes are strips of platinum, the upper extremities of which pass through the top of the glass tubes, when they are sealed or otherwise closed. These tubes, before being placed in the containing vessel, are also filled with dilute sulphuric acid. If when the tubes are placed in the containing vessel, mouth downwards, oxygen gas is introduced in the one tube, and hydrogen in the other, the free ends of the platinums projecting from the tops of the tubes being connected together, a current flows from the platinum in the hydrogen tube to the one immersed in the oxygen through the acidulated water, thence back again through the connecting wire to the hydrogen platinum. If the gases are liberated in these two tubes by electrolysis, the effects are more powerful.
S. BOTTONE.

[96790.] — **Hot-Air Engine.** — According to Bryan Donkin, an expert engineer, they appear to be used only as stationary engines. You had much the best inquire about oil or naphtha. The Daimler Co. have an oil motor for boats. I saw something of the sort at Hurst and Lloyds, engineers, High Holborn, the other day. They were 6H.P., but no doubt 1 or 2H.P. (big enough for your purpose) is made by them. REGENT'S PARK.

[96791.]—**Dynamo.**—For an output of 15v. 5a. at 2,800 revs., wind your armature with 3oz. No. 20 S.W.G. If the armature were wound with wire of double the section (in conjunction with the same field winding), you would probably not get the machine to work at all, since you would only get about half the original volts generated in the armature, and these would be insufficient to force the requisite magnetising current round the field coils.
A. H. AVERY, A.Inst.E.E.
Falmen Works, Tunbridge Wells.

[96791.]—**Dynamo.**—There is some mistake in your query. It is impossible to wind a cogged drum armature as a Gramme ring. Please state exactly what your armature is, and I will advise.
S. BOTTONE.

[96792.]—**Dynamo and Engine.**—Knowing the proper revolution speed per minute required by the dynamo to enable it to give its normal output, take the speed per minute of the driving-wheel or shafting. Divide the former number by the latter, when the quotient will be the relative size (in diameter) which the driving-wheel or shafting should be to the pulley on dynamo. For instance, suppose the proper speed of dynamo to be 1,200 revolutions per minute, while that of the flywheel or shafting were 160revs. per minute. Then 160)1,200(7½, therefore the diameter of driving-wheel must be 7½ times that of the diameter of pulley on dynamo, or what amounts to the same thing, the pulley on the dynamo must be 7½ times smaller than the driver in diameter. 2nd. According to where it is purchased; our firm supplies this at about £35.
S. BOTTONE.

[96792.]—**Dynamo and Engine.**—Obtain from the makers the speed at which the dynamo is intended to run; then, knowing the speed of your engine and diam. of the flywheel, it is a very simple matter to calculate what size of pulley to put on the dynamo, for the speed is proportional to the diameters of driving and driven pulleys. For instance, if both engine and dynamo pulleys were of equal diameter, they naturally would both run at the some speed (quite irrespective of the length of the belting). If the dynamo pulley were now reduced to half its original diameter, it would run at twice the speed of engine flywheel; if reduced to a quarter its diam., at four times the speed, and so on. The rule is, when wishing to find the diam. of any pulley, to run at a given speed, multiply the diam. of flywheel or driver by the speed at which it runs, and divide by the required speed of the driven pulley. The result will give the diameter of the latter. For instance, if the engine flywheel is 36in. in diameter, running at 160 revs. per minute, and it is required to drive the dynamo at 1,600 revs. per minute by the above rule—

$$\frac{\text{Diam. of flywheel and revs. of flywheel}}{\text{Revs. of driven pulley}}$$

$= \text{diam. of driven pulley, or in figures } \frac{36 \times 160}{1,600}$

$= 3{\cdot}6$in. A 60-light (16c.p.) dynamo will cost £40.
A. H. AVERY, A.Inst.E.E.
Falmen Works, Tunbridge Wells.

[96792.] — **Dynamo and Engine.** — Your dynamo now apparently runs off your 4N.H.P. engine at 910 revs. per minute. Before we can give you the different sizes of pulleys to run your small dynamo off your larger engine you must give us the speed of it; but you can calculate for yourself thus: Multiply the diameter in inches of your flywheel by the revolutions per minute and divide by the revolutions your dynamo should run, and the product will be the diameter of your dynamo pulley. A thoroughly good, efficient, and reliable dynamo for fifty or sixty 16c.p. lamps will cost you from £35 to £40. If for 8c.p. lamps (you do not say whether 8c.p. or 16c.p.), £18 to £20.
WEBSTER MICHELSON AND CO.
Dudley. Electrical Engineers.

[96793.]—**Speed.**—It appears to me that any guess of speed of an engine is a rough one. If it is a gas-engine you want speed of, allow one of the valves to keep touching your hand. Count these for a minute and double the number. This will give the exact revolutions. If steam-engine, allow the crosshead pin or some other reciprocating part of the engine to touch the hand and count for a minute. WEBSTER MICHELSON.

[96793.]—**Speed.**—Hold a watch having seconds hand in your left hand, while you hold your right hand in such a position over the head of the piston rod, so that it just touches it as it rises at each revolution of the flywheel. Keeping your eye on the watch for, say, 15sec., count how may blows you receive, multiply by four, and this will give you, roughly, revolutions per minute. S. BOTTONE.

[96793.]—**Speed.**—You will get useful general hints in W. S. Hutton's "Works Manager's Handbook." Piston-speed governs mainly, and may be found by multiplying twice the length of stroke in feet by number of revolutions per minute of crank-shaft. Piston - speeds vary as you know in different types from 250 to 1,200ft. per minute. Stationary and non-condensing range from 250 to 300ft. per minute. Average of modern stationary non - condensing simple engines is 260ft. per minute. Piston-speed of engines with high rates of expansion should be not less than 420ft. per minute, but rather 500ft. per minute. The length of stroke in engines of strong construction is usually = diameter of cylinder multiplied by 2. Engines of light construction have generally a length of stroke = diameter of cylinder multiplied by 1·5, &c. REGENT'S PARK.

[96793.]—**Speed.**—Fix a sheet of white paper to the flywheel, not too far from the centre, and, watch in hand, count how often the paper passes a certain fixed point in any given time, say 60sec. With a little practice, it is quite easy to follow the paper accurately up to about 300revs. per minute. With more practice 1,000revs. per minute can be counted with a fair amount of accuracy.
A. H. AVERY, A.Inst.E.E.
Falmen Works, Tunbridge Wells.

[96794.]—**Bluing.**—Perhaps this requires a little time; black takes about a half-hour's immersion; steel-grey less; uniform light blue less; to light brown least of all. Hot solution: Lead acetate 50 grains, sodium thiosulphate 50 grains, water 5 fluid oz. See "Hiorns." REGENT'S PARK.

[96798.]—**Gelatine.**—F. H. Storer gives thus of it:—Gelatin, $C_{13}H_{20}N_4O_5$, permanent. It swells up in cold water, but does not dissolve therein. Soluble in warm water, insoluble in alcohol, soluble in acetic acid, decomposed by boiling in alkaline solutions. Soluble with decomposition in cold concentrated sulphuric acid, also soluble with partial decomposition in nitric acid. Soluble in cold concentrated chlorhydric acid. Slowly and partially dissolved by solutions of the caustic alkalies. Have a look at Watts's Dictionary of Chemistry under "Proteids," to see whether you get extra hints, page 339. REGENT'S PARK.

[96799.]—**Acetylene Gas.**—A five-gallon tank would hold ⅘c.ft. of gas, and one pound of the best carbide would give off probably 4½ft. of acetylene at most in the hands of the amateur. In any case, carbide varies from 3c.ft. to 5c.ft. per lb. according to quality. "Cape Colonist" had better be persuaded not to experiment with any acetylene apparatus till he knows a little more about gases.
W. D.

[96800.]—**Acetylene Carriage Lamps.**—It is so easy to make a lamp that will be dangerous that until R. Colin H. knows enough about acetylene not to require any help on this subject, he had better be content to buy one. A thoroughly successful carriage lamp would certainly be the subject of a patent. W. D.

[96801.]—**Pump.**—You would find an ordinary deep-well lift-pump the best fixed within a few feet of the water. We should be glad to send you one on knowing how you propose to work it—whether by manual labour or power.
Dudley. WEBSTER MICHELSON AND CO.

[96804.]—**Hertzian Waves.**—Premising that unless you have a fair knowledge of electricity and magnetism, and also of the cognate phenomena of light and sound, you will find even the simplest book on this subject by no means easy, I should recommend you to read "Electric Waves," by Dr. Heinrich Hertz, translated by D. E. Jones, 10s. 6d. net. S. BOTTONE.

[96806.]—**Rain Supply.**—I expect J. Blake, of Accrington, whose advertisement you may see in the BUILDING NEWS, is second to none for these goods. He would send illustrated list free, if asked. REGENT'S PARK.

[96808.]—**Dynamo Switchboard.**—You will find full description of the mode of using the switchboard, connecting-up to dynamo, accumulators, and to lamps in the book you mention, "How to Manage the Dynamo," at p. 36 *et seq* Sect. 19. S. BOTTONE.

[96809.]—**Bacilli.**—The symbol μ, which is sometimes termed micron when used to express the measurements of bacteria, denotes the one-

thousandth part of a millimètre. The other expressions referred to in the query relate to the specific rotatory power of solutions under two different conditions. Solutions of various substances in water are capable of rotating a ray of polarised light, to which the terms dextro- or lævo-rotatory are applied, according as the rotation is towards the right hand or the left. The terms dextro- and lævo-rotatory are very often expressed by the signs + and −. Now, the specific rotatory power (S.R.P.) of a substance is defined as that rotation which is given to a ray of polarised light when passed through a length of one mètre of a solution of the substance containing 10 grains of substance in 100c.c. of solution. Some polariscopes use yellow sodium light, obtained by placing a small quantity of salt in a Bunsen flame. The S.R.P. of a substance under these conditions is denoted by the symbol $[a]_D$. Other polariscopes use light of a pale rose-violet tint, which is secured by an optical arrangement of plates of quartz, to which the term "transition" is applied. The S.R.P. with light of this refrangibility is expressed by $[a]_j$. The connection between the two is $[a]_j = [a]_D \times 1{\cdot}108$, which is easily seen to hold between the two figures quoted in the query. A. Price, B.Sc.

[96812.]—**Winding ¼H.P. Motor.**—To Mr Bottone.—Wind the armature with 2lb. No. 26 silk-covered wire, as carefully as you would a coil, shellacing each layer as you put it on. Wind the field-magnets with 4lb. No. 24 cotton-covered wire, and connect up in series. The motor will take about 4amp., and will develop, if well made, about ¼H.P. With regard to your dynamo, it is rather small to get 10amp. or 12amp. out of, at 15volts. I should certainly wind two coils of wire in each slot, one on each side of the spindle. If you can get a little over two yards of No. 18 d.c.c. in each complete coil, or say about 6oz. in all, and wind the fields with 2lb. of No. 20, connected in series, you will probably get the desired results. S. Bottone.

[96813]. — **Oxidised Steel and Iron.**—Grey colour on iron. A good and uniform dark-grey colour can be imparted to iron and steel by first depositing a coat of copper on article and then immersing in the following solution:—Ammonium sulphide solution 1 fluid oz., water 6 fluid oz. Well to repeat immersion once or twice to get good colour. Potassium or sodium sulphide may be used in place of ammonium sulphide. A light grey colour may be imparted to iron and steel by means of a solution of antimony chloride. The article is first coppered as before, then immersed in solution of antimony chloride 30 grains, water 1½ fluid oz , hydrochloric acid to make solution clear. A deposit of antimony may be obtained on plain steel without previous coppering, but appearance not so good. A good grey colour can be obtained by immersion in hot solution of arsenious oxide 50 grains, hydrochloric acid 90 grains; to dissolve above, water 1 fluid oz. No effect is produced upon either plain or coppered steel in a cold solution. Puscher works by lead acetate and sodium thiosulphate: Lead acetate 50 grains, sodium thiosulphate 50 grains, water 5 fluid oz.; solution used hot: 1 light brown colour, 2 darker, 3 purple and blue mixed, 4 purple and blue (paler), 5 light blue, 6 steel grey, 7 black after half-an-hour; time of immersion various for tints. Black colour:—Sodium thiosulphate 50 grains, water 5 fluid oz. Blue-black produced has warm coppery tints, &c. Regent's Park.

[96814.]—**Acetylene.**—A burner passing one-third of a cubic foot per hour will give about 8c.p. actual, and require 1½oz. to 2oz. of carbide per hour. I have never experimented with a solution of acetylene in alcohol; but would advise caution both in making and using. It would be very awkward to use in a lamp, and certainly dangerous. W. D.

[96815.]—**Malleable Castings.**—Pig-iron preferably used is a white charcoal pig, melted in cupolas, or in a reverberatory furnace. Mostly green sand used, from metallic patterns to insure constancy of shape and smoothness of surface. Castings as brittle as glass; then put into tumblers, or revolving cylinders of cast iron with ribs inside, in which article is deprived of adhering sand, and becomes polished by mutual friction. The clean castings, intended for conversion into malleable iron, next packed close, with alternate layers of powdered iron-scale from rolling mills into rectangular cast-iron boxes, which become of an elliptic shape after length of use, and which can be placed one on another, if need be, and closed at top by mixture of sand and clay, which prevents contact with air, and follows settling of the mass. Then into the annealing furnace, which resembles those used for making bone black of sugar refineries; leaving aside time necessary for raising temperature and cooling off, articles are subjected for about a week to a white heat—not sufficient, however, to melt what may still remain of cast-iron. After proper annealing, castings are covered with a film of oxide of iridescent colours. Any adherent oxide is removed by another passage through tumblers, and the process of malleable-iron making is finished, &c., &c. See "Moulder's and Founder's Guide," by J. Overman, M.A., Sampson Low and Co., London. Regent's Park.

[96819.]—**Coil, Transmitter, &c.**—To Mr. Bottone.—Either your tapping key does not make contact, or your jars are defective. To test the former, detach the jars, put a wire at a fair sparking distance across the terminals of your coil, and give a spark tap with the key, the battery and key being, of course, in circuit with the primary of coil. If you get no spark between the coil terminals, the key is at fault; but if you get a spark there, then there is something wrong with the jars. One may be cracked, or they are not of insulating glass, and will not retain a charge; or else the knobs of the transmitter are too far apart to allow the discharge to pass. Provided the vertical wire make good electrical contact with one side of transmitter, it does not matter about its being close to it. S. Bottone.

[96823.]—**Wimshurst.**—Rub the surface of your plates lightly over with a thick cream made of water and carbonate of magnesia. When quite dry, rub it all off again with a warm dry piece of flannel. Polish the balls, dry the glass-work with a hot flannel, and see that the brushes stand at 5min. to 5 on each plate, and that they really touch the plates. Your machine will then work. S. Bottone.

[96825.]—**Meteorites.**—Records of meteoric falls in the British Isles are few. In 1695 a "shower of unknown matter" fell in Ireland. This is apparently the earliest. I believe nearly all the remaining instances are given in the catalogues in "An Introduction to the Study of Meteorites," issued from the British Museum (Natural History), to which I presume the querist refers. A search for others might, however, be made in Arago's "Astronomie Populaire," tome IV. pp. 184-204 (French edition), where a list of 273 aërolitic falls will be found. The Reports of the British Association from 1860 to 1880 also contain notices of such fall (see reports of the Luminous Meteor Committee in those volumes, especially for the years 1860, 1867, and 1870 where general catalogues are given). Walter E. Besley.

[96826.]—**Polishing Oak Floor.**—You may have to scrape it level and sandpaper it. A good scouring mixture I suppose you know of, if not, clean sand 12 parts, soft soap 8 parts, lime 4 parts. Use scrubbing-brush, and rinse. Allow to dry thoroughly, and then polish with Ronuk, sold by oilmen in many places, or wax polish with pure beeswax and oil in proportions of 1¼lb. wax, ½lb. linseed-oil. Melt together, remove from fire, and when mixture is cooled a little add 1 quart turpentine and mix well. Use felt rubbers 4in. by 2in. square, or 6in. by 3½in. Avoid signs of tackiness. Avoid doing where you have to walk immediately, and therefore do not begin at door. If your door is S.E., begin on N.W., so as to get most light. Avoid dust entering. For large surfaces felt rubbers 8in. or 9in. long 6in. wide, glued on a piece of hard flat wood with centre arm fixed on upper side, two weights of ¼cwt. or less each placed on each side of upright arm, and another long arm be hinged to short arm on block. After applying the wax, draw and push weighted rubber backwards and forwards until the desired effect is produced. Wainscot work: Take beeswax as required, place in glazed pan, add q s. of 90 per cent. alcohol to cover, and let dissolve without heat. Make consistency of butter. Well rub mixture into grain of wood, clean off with clean linen, &c. Regent's Park.

[96827.]—**Trepanning Bar.**—The term is new to me. Fettlers knock out cores by means of a common round bar about 1in. in diameter, driven by hand, and operating like a tamping bar. J. H.

[96828.]—**Rontgen Rays.**—Better experiment for yourself. Get a one-pound coffee-tin. Throw away the lid. Cut a hole in the bottom of tin of sufficient diameter to allow it to slide over the top of the chimney of your paraffin lamp when the tin is inverted over it. The mouth of tin should reach to reservoir of lamp. Now put the lighted lamp covered by its tinned iron cap in a tall wood box having air-holes beneath, and an exit for hot air above. Put a "journal" or a newspaper in the box, close up, and see what you can read. Please report results for benefit of other readers. S. Bottone.

Four hundred and nine locomotives have been shipped abroad from the Baldwin Locomotive Works during the year ending August 1st last.

The Japanese are making progress in the ship-building industry. At Nagasaki there is now being constructed a vessel of 6,000 tons, similar to that built for the National Mail Steamship Company last year. Greater rapidity has characterised the building of the second than that of the first vessel, the latter having occupied fully eighteen months, while, from the laying of the keel to the launching of the second, not more than thirteen months will elapse.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96387. Exhaust Silencer for Gasoline Carriage, p. 561.
96395. Motor Cycles, 561.
96396. Steam Turbines, 561.
96397. Portable Engine, 561.
95404. Mottled Colour on Bright Steel, 561.
96410. Scale on Eyelids, 562.
96411. Dyspepsia, 562.
96413. Motor Cycles, 562.
96417. Photographing Spectra, 562.
96419. Slip Reversing Gear, 562.
96420. Iodine, 562.
96421. Paper and Paper Bags, 562.

96560. Electrical work in Australia, p. 74.
96570. Wheat Roots, 74.
96574. Jets.
96577. Seltzogene, 74.
96580. Speculum polishing, 74.
96583. Tips, 74.
96586. Liquid Air and Magnetism, 74.
96591. Black Enamelling Small Metal Articles, 74.
96593. New Storage Battery, 74.
96597. Paint for Hot-Water Cistern, 74.

QUERIES.

[96829.]—**Women as Inventors.**—Is it true that women have never invented anything? Can any readers give instances of inventions accomplished by women? An arrogant dinner-party of the superior sex sat on me last night by unanimously declaring that the total lack of invention in women proved the inferiority of the sex, and I had little to say; but I do not believe it, and I appeal to "Ours" for instances. — A Woman Reader of "Ours."

[96830.] — **To Practical Electricians.** — Our people intend building a factory, and propose lighting it with electricity. We require about 30H.P. for driving other machinery, and propose getting boiler and engine big enough to drive dynamo for 500 lights 16c.p. at 110v. Can we work dynamo at full speed, having only half the quantity of lamps on, sending surplus electricity into accumulators for use when engine is stopped. If we charge accumulators at 110v., what can be drawn out of it? How many cells would be required, and what sort would answer best in use? Can you give name of any work likely to be useful to novice, or outline a system likely to be successful? What is leakage in using accumulators, and what is the probable cost of battery? Would it be best to have smaller dynamo at a higher voltage for charging battery, say 130v., to insure getting 110v. back? H. Richards.

[96831.]—**To Mr. Bottone.**—I am constructing an intensity coil, and would like to know if cotton-covered wire would do for the secondary coil, as I have a quantity of No. 36 cotton-covered wire.—New Reader.

[96832.]—**Electro-Plating.**—Is there any simple process by which small articles, cast in alloy of lead and antimony, can be plated with thin coat just for appearance, and without a battery?—J. B. C.

[96833.]—**Wimshurst.**—Will Mr. Bottone please favour me with the following particulars for making a 12-plate Wimshurst for X-ray work, with plates 3ft. in diameter, cut from 21oz. glass? (1) The size of the base so as to case the machine in glass. (2) Size and number of sectors for each plate. (3) Size of hubs. (4) Diameter of steel spindle on which the plates revolve. (5) Size of discharging balls. (6) Size of long dumb-bell-shaped conductors to which the combs are fixed. (7) Fastest rate at which plates may be safely revolved. What lengths of spark may I expect to get?—Amateur.

[96834.]—**Transit Instrument.**—Can anyone tell me how to light up the interior of a transit instrument for night work? The diameter of the hole in the axis being only ⅜in., I find great difficulty in getting sufficient light down it.—R. A.

[96835.]—**Motor for Phonograph.**—Will some reader please describe how to make a clockwork motor suitable to drive an Edison style of phonograph?—R. W. A.

[96836.]—**Microphone.**—Will some of "ours" kindly explain the construction of a Hunnings microphone? Will ordinary gas carbon do for the granules, or must it be prepared in any way? Is there any reason why an amateur should not succeed in making one. What will probably be his difficulties?—Sarum.

[96837.]—**Phonograph.**—Would "F. F." kindly give some explanation of a "Bettine reproducer to show the difference between it and the ordinary glass diaphragm reproducer? Is there any superiority of the phonograph over the graphophone or vice versa? As far as I have found, the graphophone records seem louder than those made for the phonograph. Any hints as to the above would be extremely gratefully received.—C. E. O., Thaso.

[96838.]—**Chords of a Circle.** — What formula multiplied by the diameter gives the chord 1/18 of the circle? How is this formula obtained? What is a good book on the subject?—F. G. M.

[96839.]—**Spark Coil.**—Would Mr. Bottone please say if there is any difference in using thick tinfoil, the silvering kind. for condenser? I have made mine with very thin bright foil, bought as tin; but on testing get quite a flaming spark from the primary, much more than without c. in circuit b tween the brake, and only 1/32in. spark from secondary; ½lb. as yet of 32 d.s.c., have not made contact-braker yet, and same result with secondary

away, and also with another condenser instead, six sheets 24 by 12 between sheet glasses. My core is slightly altered, being 7¾in. by $1^1/_{16}$in. dia., and four layers 18 d.s.c., 1lb. full; ebonite tube, ¼ thick, equals 2¼ outside; battery 4v. accumulator, 8 amps. normal.—SPARK COIL.

[96840.]—**Microscope.**—I have seven lenses taken from an old telescope, with the following diameters:—Two of ⅞in., two of $^{11}/_{16}$in., one of ¾in., one of ⅝in., one of 1in. Can I use any of these to make a microscope? Kindly say length and diameter of eye and power tubes. Also distance between eye and field lens.—MICRO. AMATEUR.

[96841.]—**Decomposition of Mercury.**—Will any readers answer the following? (1) If a current of electricity is passed through a body of mercury, will it decompose it? (2) If the mercury is in a limited space, will the gases of the decomposed mercury gather, and in time explode?—F. E. N.

[96842.]—**Motor Tricycle.**—Can any reader tell me if I can obtain the complete component parts of motor tricycle, finished, but not enamelled or plated? I wish to make motor tricycles as cheaply as possible. Any particulars as to cost will be gratefully received. Is 1½H.P. sufficient, or 2¼ advisable? Should be glad of explanation of magneto ignition.—DAMON.

[96843.]—**Motor-Car.**—Could any of your contributors give me a little help in making a small motor-car? I intend buying a motor similar to those fitted to the Beeston tricycle, 1¾H.P. I propose making it after the style of a dogcart. My intention is to connect the motor by a strap to a fast and loose pulley running on a shaft 18in. from the motor, and at the end of the shaft, which will project through the side of car to have a eight-tooth bicycle cog, and connect this cog by a bicycle chain to a similar cog on one of the rear wheels of car. The motor runs at about 700 revolutions per minute. To stop car I should shift belt on to loose pulley. Will this work satisfactorily? What size pulleys should I use on motor and shaft to make car travel about 8 to 10 miles per hour? The car will have 28in. bicycle wheels.—IVANHOE.

[96844.]—**Arc Lamps not Burning.**—Can any of your correspondents say how to get over the following difficulty with the Crompton-Pochin arc lamp? The lamps are used outside, and in wet weather moisture gets on the rubber tubing, causing it to grip on the brake wheel, and thus stopping the feed of the carbons. The covers are whole, also a rubber washer around the joint at top of lamp, and the tubes on top of lamp, where leads come through, have been made secure against any rain getting through.—A. M. O. K.

[96845.]—**Water Motor.**—Will someone kindly tell me how I can make a ¼H.P. water motor from a ⅝in. main? The pressure is about 40lb. or 50lb. to the inch. I should like to have the dimensions for one this size. I do not want it to be too complicated, as I have not a very large selection of tools.—J. RIVER.

[96846.]—**Voltaic Cell.**—I should be extremely obliged for information, as I thought of making a voltaic cell. Which would be the best chemicals to use in the porous cell? If so, how should they be mixed? Would zinc in outside cell and carbon in porous cell act?—R. P. L.

[96847.]—**Motor Cycle.**—(1) Would "The Writer of the Articles" kindly state the length of the "life" of the De Dion dry battery which is mentioned in the articles as being sold at £1 15s.? (2) At what rate per hour would cycle travel on a fairly level road with motor working at normal speed (1,000 revs.) and carrying two persons? (3) Would travelling speed be doubled at 2,000 revs.? (4) Would motor be powerful enough to carry three persons if cycle was so arranged?—ANXIOUS.

[96848.]—**Failure of Dynamo.**—I have in our factory a dynamo 60 volt. 15 amp., which is supposed to run 15c.p. lamps, which I have in different parts of the premises; the machine is a compound, and well built. The difficulty is this: every light that is switched on appears to lower the voltage of the remainder, so that if I have an 8 or 9 lamp, I get practically no light at all. I have plenty of power, so that is not the reason. I am running the dynamo at 2,000 revs. per minute. Will someone kindly help me, as I naturally imagine I ought to get 15 good lights from machine? I may say I have been obliged to use 10-volt. lamps in order to keep six lights going. Any information relating to failure will be esteemed.—BREWED GINGER.

[96849.]—**Board of Trade Exam.**—I wish to sit for the Board of Trade exam. for marine engineer. I have served five years in the drawing office, and eighteen months in the fitting-shop at a large steel works. Will any kind reader inform me as to the best course to take?—NO NAME.

[96850.]—**Leaven.**—What is leaven? Does it differ from yeast? How is it made when there is none to begin with? Does it cause bread to taste sour?—S. A. M.

[96851.]—**Colouring Photographs.**—Can any reader inform me how the photographs to be seen in railway carriages are coloured? The colours appear to be laid on the face of the print. What paints are used, and is any preparation of the surface of the ordinary gelatino chloride paper required?—CURIOUS.

[96852.]—**Bicycle Rim.**—Is it possible to make a bicycle rim of any of the white metals (Kronand, Peerless, Hecnum, or other) strong enough to bear the unrestricted use of a Bowden or other rim-brake? Or can a steel rim be coated with one of these metals?—BENVENUTO.

[96853.]—**Heat-Absorbing Power of Alum in Solution.**—I think it has lately been shown that the supposed power of a solution of alum to absorb heat rays to a considerably greater extent than pure water is a mistaken idea, the difference being immaterial. Is this so? Where are the experiments described? How can they be easily repeated, and what was the exact result?—GLATTON.

[96854.]—**Rolled Paper Pipes.**—Would some kind reader inform me how machines are constructed for making rolled paper pipes about 3ft. long, 1½in. to 3in. diam.? How are the rolling mandrels made to be easily withdrawn from the pipes? If pitch be used for adhesion, how can it be sawn or cut without the pitch or tar adhering to the saw?—J. E.

[96855.]—**Aluminium for Electric-Lighting Cables.**—I read in a paper, the other day, that the lighting of the town of Northallerton, in Yorkshire, by electricity, is done by twelve arc lamps, each 2,000c.p., up to the present. The most novel feature of the installation is that an aluminium cable is used instead of copper, and is said to be the first in this country. The charge for the light is at the rate of 6d. per unit. Can anyone tell me what advantage is obtained by the use of aluminium for leads?—E. G.

[96856.]—**Emery-Wheels.**—In a comment on the report of the committee on Dangerous Trades (I think), it is stated that: "This is another very hard rock (from Smyrna or the Isle of Naxos), ground into the finest powder, and then made into wheels by the addition of some substance like shellac or indiarubber, and then made into wheels under hydraulic pressure. Corundum (an oxide of aluminium, which comes from Canada) is used as a substitute for emery. In the use of these wheels, owing to the great speed at which they are driven—a 3in. wheel will be driven at 7,400 revolutions a minute, and a 3ft. wheel at 600—there is great danger of centrifugal breakage, besides the injuries caused by the dust given off in their use. The committee recommend that all such wheels should be provided with protecting guards and with suction-pipes, and a fan to carry away the dust from the workman's face." I thought that emery-wheels were made with something similar to Portland cement, and were moulded under great pressure. It seems to me that both shellac and indiarubber would be rather dangerous substances to use as the cementing agents, on account of the heat engendered by friction. What is the truth?—J. M. T.

[96857.]—**Test for a Diamond.**—In a London evening paper it is given as a test for the genuineness of a diamond that you are to make a small dot on a piece of paper with a lead-pencil, and look at it through the diamond. If the "dot" shows only a single spot, the diamond is genuine. Please explain the reason.—DUBITANS.

[96858.]—**Doublets.**—In the trade imitation stones (imitations of precious stones) are known as "doublets." Can any reader tell me how these are to be detected?—X

[96859.]—**The Peculiarities of Precious Stones.**—Can any reader tell me what amount of truth there may be in this paragraph? "Diamonds are said to be as much alive as a starfish, or any other semi-vital inhabitant of the sea (remarks a writer in *Success*). A stone may appear flawless when brought fresh from the mine, but not unlikely before many hours are passed it will have burst. It may swell and develop flaws, and in a short time crumble to pieces and be useless. The turquoise is another stone which suffers bad health. The blue has infrequently been known to change to a pure white, and, of course, lose its value. In most instances, however, it can be made to regain its normal condition. The influence of cold upon jewels of various kinds is great, and capable of turning the colour in a short time." What is a "semi-vital" inhabitant of the sea or anything else?—Q. X.

[96860.]—**Companion to Aldebaran.**—Would "F.R.A.S." be kind enough to state the latest and most reliable measurement of the magnitude of the companion to Aldebaran? Also the minimum aperture that would fairly and doubtlessly show it on a dark, clear night? And, if possible, the present distance from Aldebaran? "F.R.A.S.'s" own measurements would be deemed a great favour.—C. H. STIBLOW.

[96861.]—**Shortness of Breath.**—I have for years suffered from shortness of breath; at the least damp I find it difficult to walk a few hundred yards even. If I stoop it takes some time to get over it. I am quite well otherwise. The doctors I have had do not seem to understand it. Can any reader help, or know of a remedy that will ease the choking?—BREATH.

[96862.]—**Fret-Saw Machine.**—Would a kind reader please give me a design for top work of above? I have good stand, treadle, and flywheel. I have used hand-saw frame with success, and, being a little ambitious, should like to make my own machine in preference to buying. I am only a young subscriber, so cannot refer to back vols.—TERF-WAS.

[96863.]—**Sticking Solution.**—Can any of "ours" help me with the following job? I have to split some ordinary sole leather $^1/_{16}$in. from the top surface for ⅝in. from the edge, and that has to be turned back when it is wet, and when dry it has to be stitched and then turned down again. I want something that I could put on when it is back which will stick the two substances together again when it is turned down. Is there anything that will stick without water taking effect on it, as I have to wet the leather again to turn it down?—SNOB.

[96864.]—**Knocking in Gas-Engine.**—I have a gas-engine that knocks through the hole in piston end of connecting-rod being worn, and there is no adjustment, the diameter of hole is ¾in., and diameter of boss is 1¼in.; leaving ⅜in. thickness of metal. Is there enough thickness to allow the hole to be bushed? If so, how large can I make it (with safety), and which is the best way to enlarge it? The rod is too long to swing in the gap of lathe. Connecting-rod is of mild steel.—CRACKPOT.

[96865.]—**To Mr. Bottone.**—I have a laminated drum armature 3in. diam., 4in. long. Would it be possible to wind it to give 50v. 20a., using cast-iron F.M.'s of Manchester pattern? Also, gauge and quantity of wire to wind A. and F.M. to be a shunt-wound machine for lighting purposes.—J. ELLIS.

[96866.]—**Wireless Telegraphy.**—(1) I should like to know if, in using a vertical wire 40ft. long, it should be perfectly vertical? (2) What is the box arrangement near the top of the long wire that Marconi uses? Does it make the apparatus more sensitive to the rays? (3) Is there any need, when using long vertical wires, to tune the transmitter and the receiver to each other, and if so, how is it done? (4) How to make Marconi's latest coherer? What is the size of silver discs, and the proportion of silver and nickel filings, and how fine should they be?—CARLIOL.

[96867.]—**Silencer for Oil-Engine.**—Please give the size of an exhaust silencer for a ¾H.P. oil-engine. The engine is to drive a lathe, and the exhaust annoys the neighbours.—W. TEAGO.

[96868.]—**To Mr. Bottone.**—Having purchased a ¾B.H.P. oil-engine, a 50v. 4a. dynamo, also a quantity of 7/22 cable and $^1/_{20}$ wire, (1) could I have engine and dynamo fixed in a shed about 50yds. away from where the lights are required, using 7/22 cable in casing running through outbuilding for about 46yds., the remainder across an open space in a tube of some kind? (2) Would the dynamo have to be running at a higher speed than 1,800 revs. per minute to allow for loss in mains to properly light the 50-volt 16c.p. and 18c.p. lamps that are required? (3) What difference in the voltage and ampères would there be if the dynamo was running at 2,000 revs. or more, dynamo being shunt-wound, with drum armature, undertype pattern?—W. P.

[96869.]—**Cycle Lamp Wicks.**—What can I put in sperm or colza oil to prevent it carbonising the wick in cycle lamp? The lamp goes out after burning two hours. How can I filter it?—C. W. STEPHENSON.

[96870.]—**To Perambulator-Makers and Dealers.**—I have an appliance that I wish to reach from the oil-valve of one wheel across to that on the other side (the larger pair of wheels I refer to). Will someone be kind enough to give me the different widths that I should have to make my appliance? Also, if possible, which width is most general in use?—LUBRICATOR.

[96871.]—**Image in Mirror.**—Where is the image, as seen in a mirror, formed? I have read several books on optics, and am rather puzzled to know how my image, which I see in a mirror five or six yards away from me, can be formed the same distance behind the mirror, remembering that there is a brick wall behind it.—THES. TOMPSON.

[96872.]—**Telephone Wire.**—Will galvanised iron wire do for a short telephone line—about 300 yards? Is the iron wire as durable as the bronze wire used by the telephone companies? What is the advantage of the latter wire?—TELEPHONE.

[96873.]—**Whole-Meal Bread.**—My wife has many times essayed the making of this, but has only once succeeded. We find it impossible in our suburb to get a good quality, and I should feel grateful to any reader who would give exact instructions as to proportions of yeast and meal, method of mixing, temperature of water used, temperature for rising, temperature of oven, kind of yeast, &c. In Devonshire, some years ago, I obtained some delicious whole-meal bread, and happening to meet the miller, was told by him that he had found by experiment that it was necessary to mix the Canadian red wheat with the home-grown product to obtain his present excellent quality of bread.—D. W. A.

[96874.]—**Prussic Acid for Fumigating Trees.**—The following paragraph is going the rounds, but can anyone tell me whether there is not some risk in using prussic (hydrocyanic) acid for the purpose:—"The fumigation of trees for the destruction of insect pests is soon to come into use in New South Wales. Successful experiments have already been carried out. The tree to be treated is completely covered with a tent, and is subjected for nearly an hour to the fumes of hydrocyanic acid, produced by the combination of sulphuric acid and potassium cyanide. The number of men generally employed in a fumigating gang is four or five, according to the size of the trees. One man introduces the chemicals, another looks after the generator and measures the acid, and two or three handle the tents. Such a gang can handle from thirty to forty medium-sized tents, and cover from four to six acres of orchard in a night."—HORTUS.

[96875.]—**Armour Plating.**—Can any reader tell me what is the maximum thickness of armour-plating on modern warships? I read in a technical paper that "the Krupp armour plates 1½ mètres in thickness, destined for the Russian ironclad now being built in Cramp's shipbuilding yard, have just been tested at Indian Head, in the presence of the American Admiral O'Neill and several Russian officers. It is reported that the tests proved that the Krupp plates are 50 per cent. stronger than the Harvey plates, and their success is expected to lead to their adoption in constructing new warships for the American navy." I suppose that by "1½ mètres" is meant a mètre and a half; but surely no ship floating can carry that weight of armour—plates a mètre and a half thick! There must be some mistake. If not, where are such plates rolled?—S. W.

THE State of Michigan contains large deposits of marl, which are about to be utilised for the manufacture of cement.

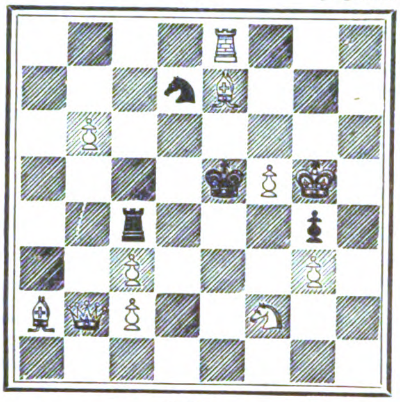
Railway Accidents in 1898.—The report on the railway accidents of last year contains some information which may be of use. The number of passengers killed in train accidents was 25, which is an increase on the previous year, in which the number was 18. These deaths were caused by eight collisions and two derailments of passenger trains. The total numbers of deaths and injuries to passengers from causes other than accidents to trains reported in 1898 were 128 killed and 1,238 injured, as against 115 killed and 1,315 injured in 1897. When all classes of accidents on railways are taken into account, however, only one passenger is killed in 6,947,131 passenger journeys, and only one in 568,402 is injured. Season ticket-holders' journeys are not included in these figures, because their number cannot be estimated. 1,283,045 season tickets were issued in 1898, and it is obvious that if an accurate estimate of the passenger journeys taken by the holders of such tickets could be made, a large increase in the number of passenger journeys would be shown, with a corresponding benefit to the passenger when calculating his risk of accident. During the year 504 servants were killed and 4,149 injured. These figures are irrespective of 38 killed and 8,830 injured in accidents in which the movement of vehicles was not concerned.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1696.—By F. G. Tucker.

Black. [4 pieces.



White. [11 pieces.

White to play and mate in two moves.

(Solutions should reach us not later than Oct. 23.)

Solution of Problem No. 1694.—By F. M. Teed.

Key-move, R-K 4.

NOTICES TO CORRESPONDENTS.

Problem No. 1694.—Correct solution has been received from E. C. Weatherley, P. Laubach ("Neat, but easy"), Rev. Dr. Quilter, J. E. Gore ("Neat and pretty"), G. W. U., Richard Inwards, A. Tupman, and Whin Hurst, Geo. Christie, F. B. (Oldham), T. Clark, Quizco.

Chalk, A. B. T., C. F., A. E. Stokes.—Only solution as above.

Of the 245,238 miles of railways in use in the United States in 1898, 220,803 miles had steel rails and 24,435 miles of iron rails.

Fuel made from compressed peat is being successfully manufactured at Stratford, Ontario. The peat is obtained from a swamp 40,000 acres in area, which varies from 1ft. to 20ft. in thickness. It is cut and air-dried, then pulverised, passed through a picker and to a hopper, which automatically feeds into a 2in. steel tube 15in. long. The pulverised peat is forced through this tube by pressure and formed by dies into cylinders 3in. long, and almost as dense as anthracite coal. It weighs 83lb. per cubic foot, as compared with 73lb. for bituminous coal and 93lb. for anthracite. It has been tested in locomotives, showing a thermal value of 100lb. of peat, equal to 95·15lb. of coal.

Big Skulls and Weighty Brains.—Prof. Arthur Thomson, M.A., M.B., continues his instructive discourse "On the Treatment and Utilisation of Anthropological Data" in the current number of *Knowledge*. Dealing with the form of skulls and brain capacity, he says: "The average weight of man's brain is about 50oz., that of woman about 45oz. This difference between the sexes is less marked in savage than in civilised races, and is apparently explained by the fact that in the higher races more attention is paid to the education of the male than the female, and consequently the brain is stimulated to increased growth. . . . It is hardly necessary to point out that quantity is no criterion of quality, and though the brains of many distinguished men have weighed much above the average (that of Cuvier weighed 64oz.), there are abundant examples of equally weighty brains, the possessors of which were not characterised by wits above the common herd. . . . But apart from the mere size of the cranium we have to consider its shape. If a number of skulls be taken and placed on the floor so that we can look down upon them, we will at once realise that they display a great diversity of form, provided always that we are dealing with mixed groups; some are long and narrow, whilst others are broad and rounded. . . . For scientific purposes these differences in shape are recorded by the use of what is termed the cephalic index . . . In practice, the cephalic index is obtained by the following formula: $\frac{\text{Breadth} \times 100}{\text{Length}}$ = cephalic index. The results are grouped as follows:—Skulls with a proportionate width of 80 or over are termed *Brachycephalic*. This group includes, among others, some Mongolians, Burmese, American Indians, and Andamanese. Skulls of which the index lies between 75 and 80 are *Mesaticephalic*, comprise Europeans, Ancient Egyptians, Chinese, Japanese, Polynesians, Bushmen, &c. Whilst skulls with a proportionate width below 75 are *Dolichocephalic*, and are more or less typical of Veddahs, Eskimo, Australians, African Negroes, Kaffirs, Zulus, &c."

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 11, and unacknowledged elsewhere:—

Nerps.—E. H. Micklewood.—F. A. M.—Chuck.—J. L.—W. B.—H. F. Y.—W. Ewart Gibson.—S. Elliman.—L. B. Tappenden.—A Fellow of the Royal Astronomical Society.—Dr. R. J. Ryle.

Joseph Jennens, Nelson, N.Z.—The makers inform us that your goods left England a few days ago, and that the delay has been owing to press of business. They say they have written you explaining this.

H. M. Campbell.—Thanks, but hardly sufficiently successful to warrant publication.

Doubtful.—(1) The question has been frequently answered. See the index of Vol. LXVIII. as to rights of patentee. Anyone can make a patented article for the purpose of experiment, but not for beneficial user. (2) An article must not be stamped "patented" unless it is really the subject of a patent.

B. L. S.—Probably we have illustrated every promising rotary engine, but, as you say, "none come to stay." The theory is faulty; the construction is not to blame. Reuleaux, as has been pointed out several times, said: "The irresistible tendency towards the invention of 'rotary' steam-engines has contributed greatly to increase the number of these arrangements. This tendency has given us many useless, or apparently useless, machines, and has been the means of wasting much thought and capital. Would-be inventors have again and again been warned of it, but the warnings do not seem to have had any effect." The "rotary" motion is, on paper, much superior to the reciprocatory; but it is at present only with dynamos that it can be obtained satisfactorily.

F. W. Baker.—All we can do is to offer to illustrate and describe your device. We cannot act as go-between for the benefit of perpetual motion inventors and capitalists. There is another Richmond in the field this week. Has he anticipated you?

G. Paget.—Cannot say who supplies them here, or if they are made for sale. Any ordinary electrician ought to be able to devise a pair for you, however, from the description we gave on p. 155.

D. G. Taylor.—Thanks; we have sent your letter and catalogues on to the writer of the articles.

H. R. Bone.—For the electric engraving machine, see pp. 120, 140, 163, 258, Vol. LXVI. Illustrations in No. 1701, Oct. 29, 1897. See also the indices of other volumes.

Learner, S.G.—Any bookseller can supply you with the works required; but if you are not within reach of a library, you could procure Lukin's "Lathe and its Uses" (Trübner), 16s. As to oil-engines, see recent volumes. Donkin's work, published by Griffin and Co., contains much information. See the articles on "Motor Cycles" in last volume.

L. Panton.—We have sent the photos on to "F.R.A.S." We fear we are unable to reproduce them satisfactorily.

Amongst the timbers of Tasmania, beech, or "myrtle," grows in immense forests, the largest trees having a trunk of 40ft. to the first limb, and a diameter of from 2ft. to 6ft. It is somewhat like the European beech in working, but tougher and rather heavier. It is a capital wood for all inside work, cask-making, tools, floors, and furniture; it wears to a smooth surface, and stands well if cut in the winter. There are two varieties of this timber—viz., the red and the white.

A town in Pennsylvania has an electric supply station, which, until recently, had been driven by a steam plant, the boilers being fired by natural gas. The boilers are now given up, and the gas is used directly in gas-engines, three of 125H P., and one 200H.P. The Westinghouse Company, which has supplied the engines, guarantees the consumption of gas not to exceed 13c.ft. per brake horse-power per hour, as compared with about 52c.ft. on the former system. An air compressor, driven by a small gas-engine, charges air reservoirs placed below the engine-room, which furnish the compressed air for starting the larger gas-engines.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the English Mechanic Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

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332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

The English Mechanic

AND WORLD OF SCIENCE AND ART.

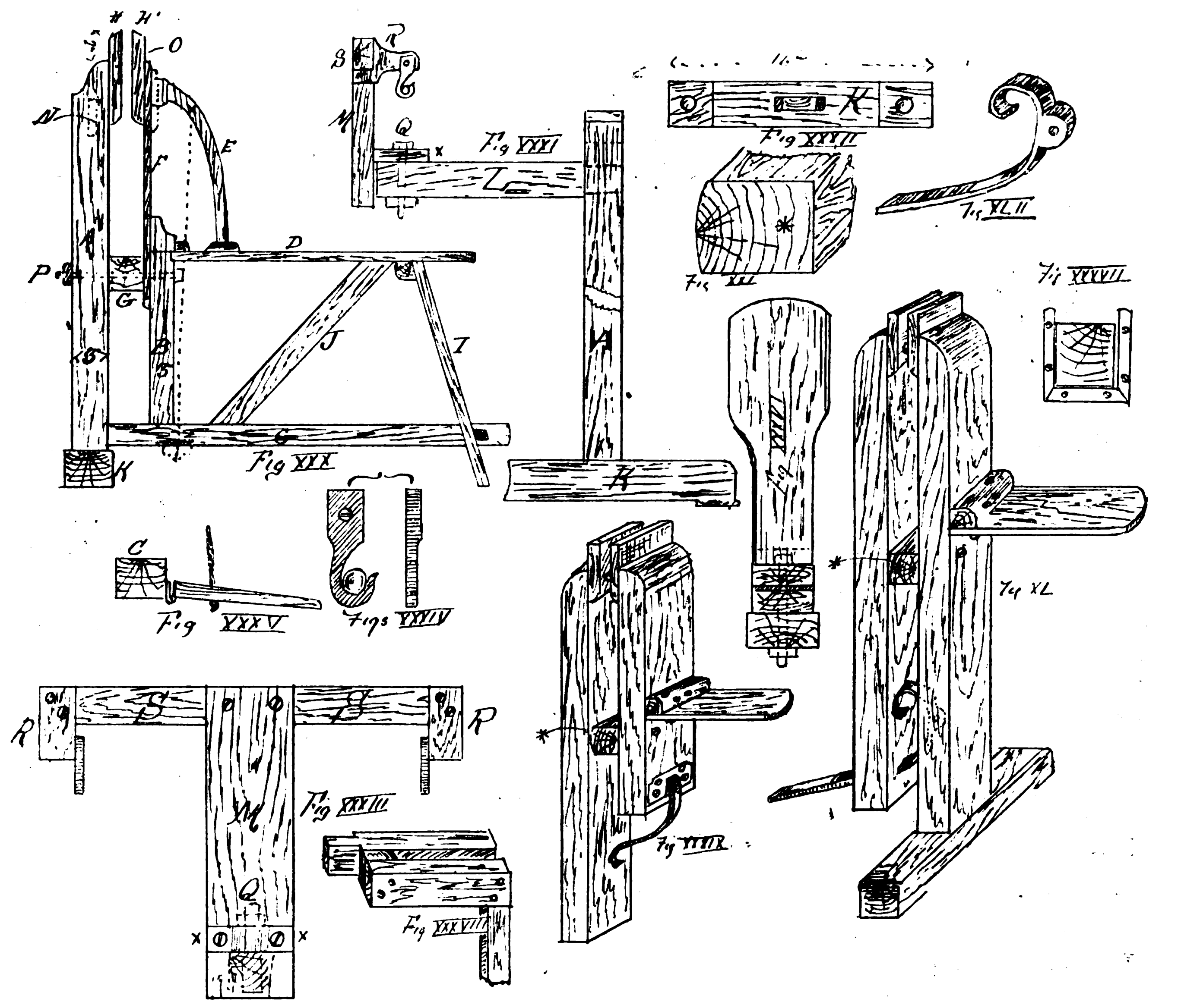
FRIDAY, OCTOBER 20, 1899.

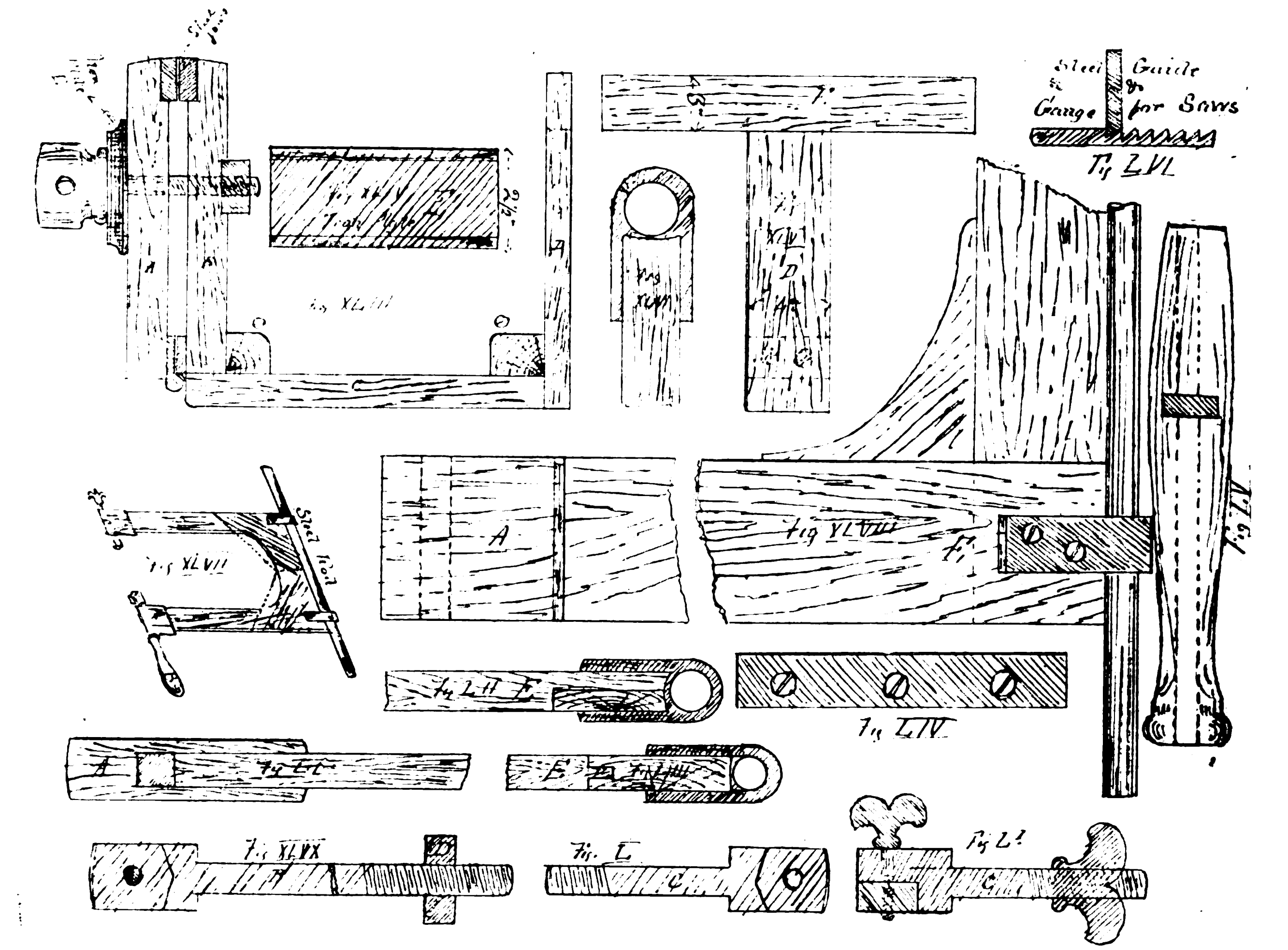
INLAYING.—II.

WE shall require a special appliance, first of all though of simple form. It can be made of deal, pine, or of more expensive material if desired. A slight knowledge of carpentry should produce a serviceable article of deal. It is termed a "donkey." The method of putting together is fully demonstrated in Fig. 30. The drawing shows the parallel frame as behind Fig. 30, the actual position being as at Fig. 31 viewing the standard A from the outside; consequently the guide frame is to the right of the sitter while at work. The standard or back-jaw should be stiff and about 4in. by 3in. in substance. From 30in. to 33in. will be about the average height to top of H H¹. For a shorter seated person much lower will do, even as low as 27in. As a better guide we may assume the position of saw-frame handle to be 3in. or 4in. below the chin. The exact height cannot be given, because we have to work at the medium, not too low for the eyes, causing a strain to them, or too high to tire the arms. An easy method to get at the working height is to seat oneself on an 18in. chair, and then measure off on a rod in front the height best suited to the individual use. The front standard B should be 3in. by 3in., and in height to extend above the seat board D about 3in. or 4in. To the inner face is glued and screwed the spring-jaw E, allowing clearance for the bolt P, central. The space between back-jaw and spring ditto is governed by the thickness of the hardwood clamps H and H¹. If they are of ½in. stuff, and the opening between ¾in., the block G must be 1¾in. thick, the length to be the width of standard A, and the height anything between 3in. and 5in. When bolted together, as shown in sketch, this should be very solid and firm. If the space is 1¾in., then our mortise hole should commence at 1¾in. in the stretcher rail C. The standard is tenoned at the bottom to fit the mortise in the foot. (See Fig. 32.)

Viewing the foot from underneath, the stretcher is tenoned into the standard just above the foot (about 1in.), and the shorter standard is tenoned into the stretcher at the dimensions given, 1¾in. The seat-board and leg are of 1in. stuff. The former is fitted into a shallow groove in short standard and blocked (glued and screwed); the latter splays out, and can be sunk into the seat-board if thought desirable, or only blocked, as per sketch, and glued and screwed firmly. On the leg end of stretcher is cut a long tenon with canted shoulders to follow the splay of the leg. A short mortise hole is cut in the tenon of stretcher, and is for the purpose of receiving a short wedge. The stay-piece J needs only fitting fairly between seat-board and stretcher to be glued and screwed. The lever E can be cut out of a piece of 1in. beech or birch, or a piece of bent shaft can be brought into use. Its use is to tighten or close together the jaws H and H¹ by means of the cords, which being attached to the pedals, the cords are drawn downwards when pressure is put upon the pedal by means of our heels, the toes meanwhile resting on the foot.

A better view is given of pedal and stretcher at Fig. 35. The upper jaws H and H¹ should be of very hard wood, preferably rosewood or Spanish mahogany, and about ½in. thick, and should project as at O, 2in. or thereabouts. Upon the other side, as seen in present view of standard, should be cut the mortise to receive the tenon of base L—about 3in. by 3in. is heavy enough. A bolt-hole is bored in the other end to receive the bolt Q, which passes through bracket X into and through the base L, and is fastened with a nut beneath. Its use is obvious: by slackening the bolt the frame can be twisted into position until the cut made with the saw is truly at right angles to our work. The upright M carries the cross-rail S S, to the ends of which are glued and screwed the wood brackets R R. The gunmetal sockets (see Fig. 34) are bolted to the brackets R R, as per sketch, and are for the purpose of receiving the steel rod of saw-frame (to be explained further on). The arm L should be bolted to the standard, and *not* glued, if to be portable. It remains now to glue and screw the bead pieces on seat-board to retain the lever E in position, no further





fixing being necessary on the seat, but at the top (as dotted) are glued and screwed two slips on to the spring, to prevent any sideslip of lever E, the bottom of which is rounded a trifle. The two circular holes of foot, Fig. 37, are to receive 1in. corks, so that when the donkey is in use it will not have any tendency to slip. Reducing the seat to give knee-room concludes the making of our donkey (see small sketch, Fig. 36 plan). At Fig. 37 is sketched the position or, rather, method of beading the lever F; Fig. 38 shows the double bed, where considerable length is required, as for cutting panels and table tops, and to be so made that the back tenon should fit the mortise hole of standard.

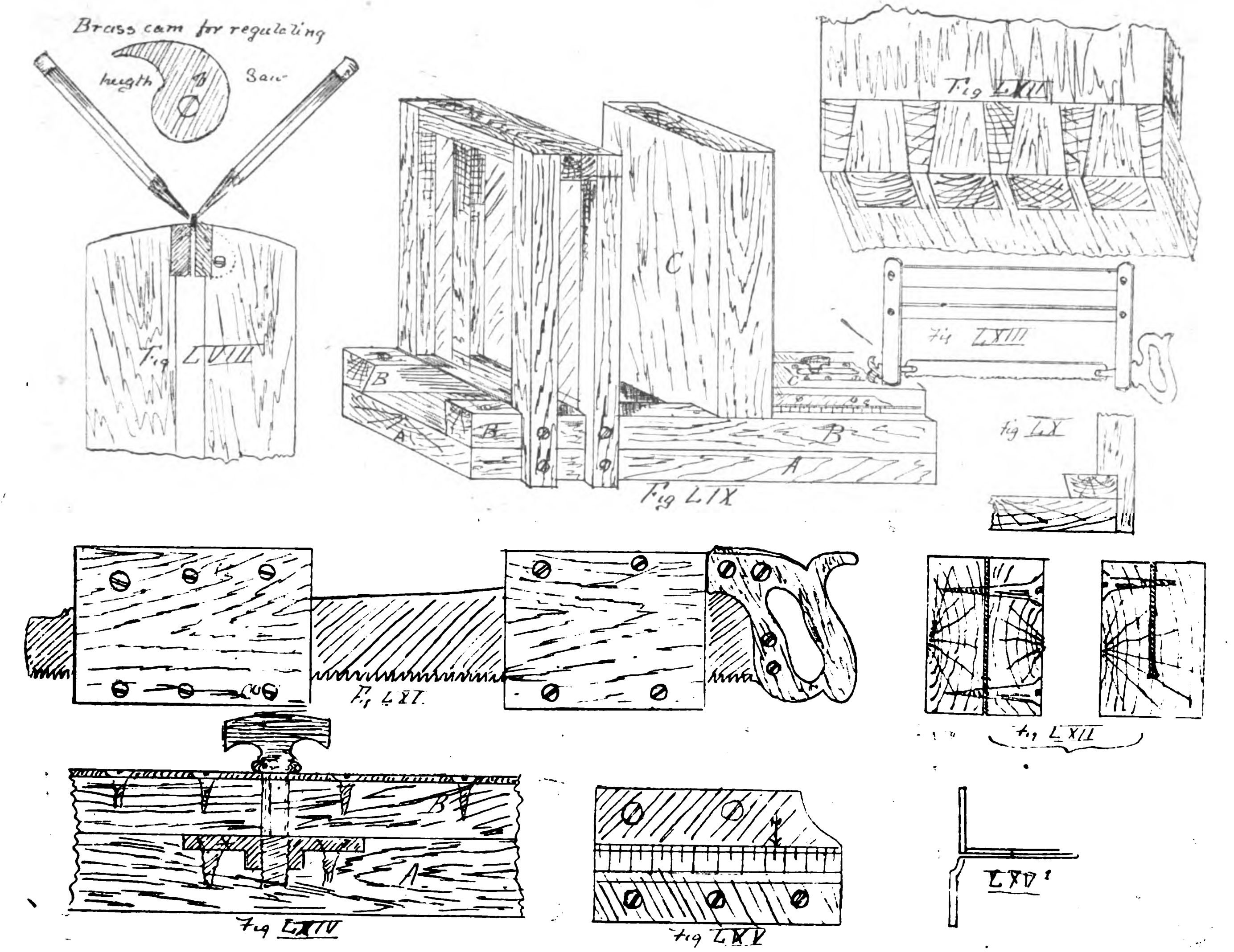
Figs. 39 and 40 show two simple contrivances that are easily fixed or removed at will. A parallel guide frame can be fitted to either, and little skill is required to bring ttem into use as duplicate machines. Fig. 42 shows the scroll iron entire, and in position in Fig. 40. The back standard will require a space cut out of such sufficiency as to permit of the scroll iron turning freely upon its centre. Fig. 41 shows the rounded block used at * in lieu of iron hinge. A good light is requisite. If the donkey is placed so that a ray of light is secured on the work over the left shoulder, no better position will be needed.

The next article required is the saw-frame (see perspective sketch Fig. 47). At Fig. 48 is shown the frame (one angle only with bracket in position). The angle joint can be either lapped (as at Fig 52) or tongued together (as at Fig. 53). The latter method will require a thin slab of wood 1/16in. thick glued both sides, when angle bracket is in position, and is to resist the strain put upon the frame when drawn together to gain the tension of saw necessary for cutting. Each side of the frame has two pieces of thin wood glued, the joint coming about the centre of cross-rail, as dotted in at Fig. 47 (small sketch). The two shoes, as at A, Fig. 51, are made to slip on to the sides of saw-frame, leaving a square hole just the size of the square part of steel clamps, Figs. 49 and 50 (B and C), which, by the way, show how to make them if not procurable at tool-shops. If a saw-frame is preferably purchased, a very good set of fret-cutting appliances are sold at cheap rates; but the frame, being invariably of metal, would require a slight modification to take the steel rod used in conjunction with the parallel guide frame. Upon reference to Figs. 49 and 50, it will be seen that the pinching jaws are so fashioned that the upper jaw, as at C, is solid with the shaft. The V-shaped joint is to prevent the loose jaw from turning round while in the act of tightening the saw-blade. The shorter clamp has a flying nut, and the longer a square nut, as at D, Fig. 49, which should fit tightly in the solid or rounded portion of handle. It follows that the handle is bored the entire length to receive the shaft of clamp. The inner portion of frame at the top can be rounded or hollowed out when the brackets and veneers are dry. The frame should be ¼in. wider at the mouth than at the top end, so that when pressed together they come about equal in width. Fig. 52 shows the lapped joint, with metal straps which secure the steel rod to the frame. As regards the measurements, these are not absolutely fixed sizes; the frame can be 18in. in length by 7in. or 8in. in width, the sliding shoes are about 2in. or 3in. long, glued and screwed as at A, Fig. 51. Fig. 46 gives a method of hollowing out the top of saw-frame to take the steel rod, which, of course, entails a little more labour, but looks well when done.

The vice for making and sharpening our saws can be made next. Two pieces of dry beech or birch, 5in. to 6in. wide, and the back B about 6in. high, the front one 5in. or 5½in., and of 1¼in. substance. The upper part of front and back jaws are rebated to receive two pieces of hardened steel accurately fitted, so that when the jaws are pinched together by means of the saw, the saw-blade is held perfectly rigid the *entire length*. It must be so, otherwise it will be a difficult task to put the necessary set on the saw that is requisite. The base-piece C is of such length as will permit the saw-frame resting on the upright D; about 14in. to 18in. will be ample (from front of jaw A to outside of rest D). The base-piece should be dovetailed at either or both ends to obtain a strong job. Reference to Fig. 62 will help you over the dovetailing. To make a secure and firm job, the blocks as at ⊖ should be glued and screwed; the upright D can be either mortised into or screwed bodily on to the cross-rail E in Fig. 45; the iron plate is to help in getting an even pressure over the front jaw E E. The steel jaw is shown at Fig. 64, and means of fixing by the countersunk holes. Fig. 65 is an enlarged sketch of handle with nut in position.

The means employed to set our saws is shown at Fig. 58. By striking the punch gently we shall be able to throw over slightly each alternate tooth. The aim should be to retain the punch in as near the one angle as possible, so that one tooth does not predominate over another.

The last contrivance is for the purpose of cutting small pieces of rich woods that otherwise would be cast aside. The capacity of our little machine will take in blocks of 2in. or more (according to the length of base) in thickness and of 4in. square measurements; a very useful size when we take into consideration that much of our ornaments will rarely exceed 2in. to 3in. in length. It is shown at Fig. 59. The base A, of 1in. stuff, has screwed and glued to its upper face two runners, dovetailed, as shown at B, glued and screwed. The frames are made of equal size, either by means of lapping or mortising, so that when half the substance is cut, as at Fig. 60, and fixed to both base and runner, a clear space of ⅞in. should be left. The opening space forms a guide for the saw with its long blocks, as at Fig. 61. The blocks are again shown at Fig. 62,



either as a pair screwed together, or one block with the kerf sufficiently deep to admit of fixing tightly by means of the screw shown. A simple saw-frame could be knocked up as shown at Fig. 63, only care must be bestowed to make all of the exact same thickness—viz., ⅞in. The index plates, as at 65, 65¹, should be of brass, when screwed in position, and with the upper plate marked with an index-point or line. The bottom plate is scored in this way: Assuming a block has been glued with a piece of paper intervening, so as not to injure the face of the sliding-carrier C, with the saw in position for cutting, a test cut is taken off the entire face. The saw is raised to clear the block, and the carrier is moved forward that amount, so that when the second cut is taken the substance of a veneer only projects beyond the saw. A mark is then made on the bottom plate, and a plate then has a series of marks of equal space marked on it the whole length.

If the saw is kept in good condition, the result should be a number of thin slices of exact equal thickness. The measurements can be varied to suit the maker. Solidity must be studied, and will prove of sterling value if due care is bestowed on the making. The manner of fixing is on the enlarged drawing Fig. 64. Into the base is sunk a socket-plate *, the T screw passing through a long slot, which is protected with a corresponding brass slot-plate and fixed on top of carrier base, engages in the socket-plate, and thus holds secure, whether the thickness be of one, two, or more veneers in substance. It will be seen then that we are not confined to a given substance, but can cut off, say, 1/16in., ⅛in., 3/16in., or ¼in., and that with precision.

A 28in. blade, with blocks of 8in. in length, will give us a clear run of 10in. to 12in., and plenty of bearing surface on the blocks.

How to make and sharpen the saws for marqueterie cutting will conclude this chapter. Very thin strips of steel ribbon can be purchased at most clockmakers' material warehouses, also the three-square piercing saw-file used to cut the teeth. A length of steel is broken off, long enough to be pinched in the steel jaws when the frame is pressed together. Although the saw-blade is shown having a hole in the end, that only applies to the larger or fret-cutting saws, that are generally purchased ready made. Having the blade ready in the frame, it is lowered down into the vice about half its width. The brass cam, which is fixed at each side of the vice, is to rest the blade on, and should be raised until they permit of only half of the blade projecting, as before stated. If the steel jaws are a good close fit, all along the blade will be securely held; but if, by chance, any portion does not grip, the higher parts must be planed or filed down until a perfect joint is obtained. A steel guide is required, especially by those who have not had any experience in saw-making.

About ¾in. from the end, measuring from clamp at the left hand, make a nick with the saw-file, then cut down, using the guide as a gauge as to width. By placing the guide as shown in Fig. 56, a second cut can be given without encroaching on the first. The same system must be pursued the entire length of saw. The main object should be to have all the teeth of as near equal space as possible, and all of one height. The setting can be done as before explained, by setting over every alternate tooth, working from back and front. If only one tooth should happen to be higher than the rest it will either cause the work to break away or the breaking of the saw.

Assuming all has been plain sailing up till now, it remains to prepare our cutting designs. If one only is wanted, or even two, a tracing can be made; but if several duplicate copies are wanted, then we must resort to a quick and ready method of preparing them. Pounced impressions are generally in vogue, and are prepared by placing the design proper on six or eight thicknesses of good substantial white paper—not necessarily thick, but should be tough and of close texture; the best white lining paper is in general use. Attach them by the four corners with either glue or gum. With a fine needle the whole of the design is pierced, forming a long line of minute holes, with the certainty of the whole six or eight being exactly coincident. Where a sewing-machine can be brought into operation, the task is rendered much easier, and a great deal quicker done. By raising the needle in the needle-bar, so that the needle, when at its lowest, just enters the piece of cork that is inserted in the little hole in the plate. It may be necessary to remove the pressure foot, but that will best be seen if found that the cork remains staple. Anyway, the use of the sewing-machine is of undoubted advantage, and better work can be done than by hand. The cutting up of the pattern and a few other matters will be treated later on, with designs that require separating, as for different-coloured woods, &c.

The object of piercing our patterns is to be able to drive some medium through them that can be fixed permanently upon another plain surface beneath. That most common is a dry, dark-powdered colour (a deep brown) and some resin powdered very fine. By mixing the two—say one-third resin to two-thirds colour will be about the proportion, because the resin, if in excess, will crack and fly off the paper beneath, and will not

require too much heat to cause the resin to melt, which it does when the pounced pattern or, rather, the printed result, is gently warmed, until the melting of the resin tends to combine with the colour, giving us an impression in minute coloured dots closely packed together. If the result has a tendency to wipe off, then a little more resin must be added. If they come off bodily, re-strain the resin until the happy medium is gained. Another plan is to pencil in the design with a lead of softer consistency; by rubbing a clean sheet of paper with an ivory or bone handle an impression will be got, only the reverse way; holding up to the light and tracing on a sheet of glass is also very handy, if, as we said before, only one or two impressions are wanted. There are a few more methods, but scarce worth while touching upon. A little ingenuity displayed by the student will soon overcome many obstacles that are sometimes in the way.

It is just possible at some time or other, a piece of work of great delicacy, requiring a lot of cutting, will demand a better impression; in that case, the dots will have to be connected up either with the pen and ink, or a lead pencil of hard texture. The retouching pencils, used in photographic purposes, will be found of great service.

Another method is to have a water-colour medium at hand to use in conjunction with what has already been cut. The method is thus:—Suppose we have a shield, crest-plate, or other ornament, which is singly, and not convenient to make a special drawing, we lay our piece of cutting on a slab with the colour spread upon the face, and transfer it to the paper on the ground work; the result will be a block impression of exactly the same particulars as piece of cutting. It remains when dry to cut the coloured portion out bodily. If the cutting has been fairly good an exact fit should result. There are one or two points that will require noting, not necessarily here (in case forgotten), but in that part that applies directly to whatever method will be employed other than what has been touched upon above. In cutting all pounced designs, endeavour to turn the work in such a manner as to keep the impression (dots) as intact as possible, otherwise great difficulty will be experienced in following the dotted design.

MILLWRIGHT'S WORK.—XIII.

THERE are several ways of erecting shafting. One is, to set out the position of the intended shafting on the underside of the beams. A chalk line is snapped, making a mark over the intended position of the shaft. Many have been

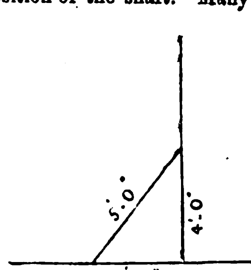


FIG. 78.

set in this manner, but it has the disadvantage that it becomes troublesome when several shafts have to be set up at right angles. Having the lines marked, the positions of the bearings in the vertical plane are obtained by a plumb-line. The device of a long parallel straightedge and level is adopted to secure alignment in the vertical direction, while for testing that in a lateral direction a straining cord will be used. The latter can be pulled taut along the edges of the open brasses, or at a little distance away therefrom, measurement being taken thence to the bearings, or to the shaft if the latter is in place.

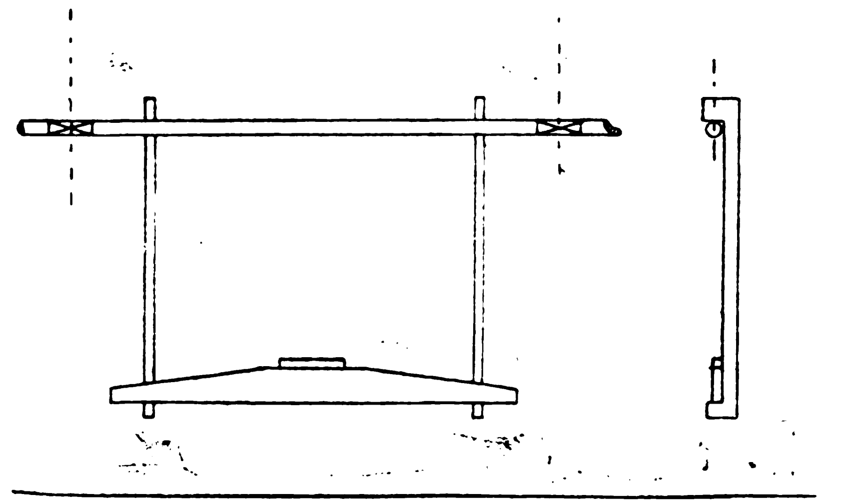


FIG. 80.

When machines already occupy the floor area, the bearings must be put up thus from above. But the best plan when the floor-space is available, as in putting in a plant in a new shop, is to lay down the positions of the shafts on the floor. Their centre lines are marked on the floor with a straining cord. Then this line is crossed at intervals with blocks of wood, which have to be all levelled exactly by means of a level and parallel straightedge. The straightedge being on the floor, set out also the positions of the bearings, and drive a nail in at the positions which correspond with the centre of each bearing. Plumb from these to the beams, and mark a centre on the latter exactly over the centre of each bearing. Make a templet to suit the bearings to be used, having a centre hole in it, and the bolt-holes drilled in the same positions as those in the bearing feet. Lay the templet under the beams with its centre hole over the

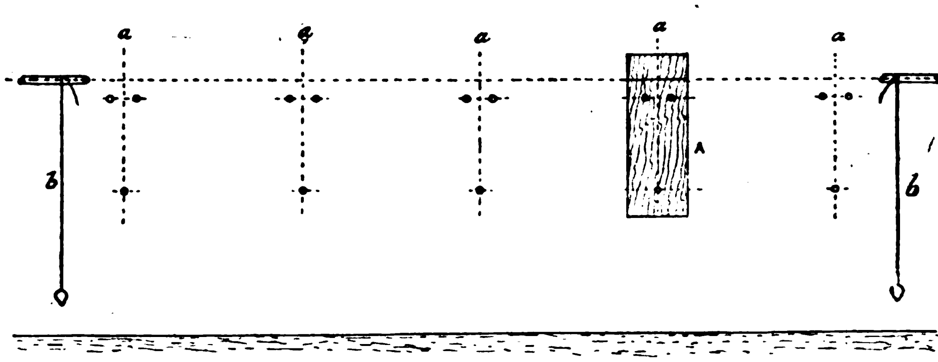


FIG. 81.

traversed from adjacent pairs of blocks, and shavings removed where necessary, until all are level: the result is a basis independent of the inequalities of the floor, from which basis the shaft can be levelled truly. Measurement is taken with a staff directly from the block in the first place to the bottom of the bearings, and afterwards to the under side of the shafting. Lateral adjustment, as before, is obtained with a straining line.

When bearings are fixed by lines laid down on the floor with a strained chalk line snapped carefully, then, as the chalk-marks will become obliterated, the end locations are fixed by driving in small nails. The positions of all shafts should be lined, and marked thus.

To strike lines at right angles with each other, a square is inadmissible because too short to give correct results. The rule "3, 4, 5," for obtaining a triangle is better; strips of wood, a long rule, or a trammel can be used for the purpose. Lay out 3ft. on the base-line, Fig. 78, from the point where one shaft is to intersect the other. Mark off a radius of 4ft. from the starting-point on the base, and 5ft. radius from the 3ft. point, to cut the 4ft. radius. The point of intersection will, when connected to the point of intersection of the shafts, be at right angles with the base-line.

Either of the geometrical methods of obtaining lines at right angles will also be suitable for adoption, provided radii of ample length are taken to eliminate error.

Lines at right angles on a floor to large dimensions may be drawn by a strip of wood having two nails in it. Fig. 79 shows the method. To bisect the line A B in C, set the rod alternately in A and B, and scribe arcs of circles on opposite sides of the line A B, as shown. A line drawn through the intersections will be square with A B.

Having the centre lines of shafting laid down centre plumbed on the beams, and mark off, and bore the bolt-holes. By these the bearings can be bolted in place.

The shafting will now be laid in the bearings, in readiness for final adjustments. The first setting will be that sideways; this will be set with a plumb-line over the floor. The line may either be looped over the shaft—in which case

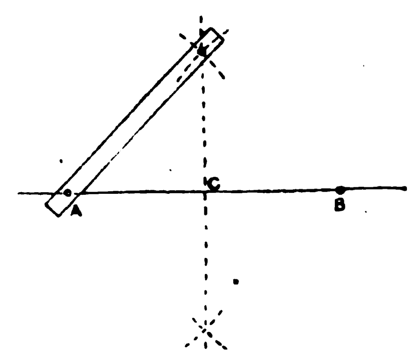


FIG. 79.

the centre of the shaft on the floor will be plumbed—or it may be set by one edge of the shaft, and then a line will have to be snapped on the floor for guidance at a distance of half a shaft diameter away from the centre line.

The vertical adjustment then follows. A couple of rods will be taken and notched to fit over the shafting, and to support a parallel straightedge below, Fig. 80. A start will be made from an end bearing, and each length corrected in succession by means of a level placed on the straightedge.

The risk of working with a spirit-level is that few shop levels are true. Sometimes a surveyor's level is used, and sights taken—a most accurate method, but one the use of which is as yet rather exceptional in millwright's work.

When a spirit-level is used, it should first of all be corrected by planing or filing the bottom if it has become worn by use. Then when employed in service it should be reversed, end for end, for every sight. Some millwrights set the level directly on the shaft; but this is not to be relied on unless the shafts are exceptionally true. If used in this way, the level should be laid upon a long parallel straightedge laid upon the shaft, by which device local inequalities will be merged in an average result. Levels, too, are often attached permanently to a long parallel strip, carefully corrected, which amounts to the same thing as interposing a temporary strip between the level and the work.

To lay down parallel shafts in adjacent shops, in which a dividing wall interferes with ordinary methods of measurement, a doorway may be utilised for the laying down of a line at right angles with the shaft in one room, and this line can then be made a base for obtaining another at right angles with that, and parallel with the one in the other shop. Even though geometrical methods are used, and the measurement made as large as possible, much care is necessary to insure complete parallelism by this method.

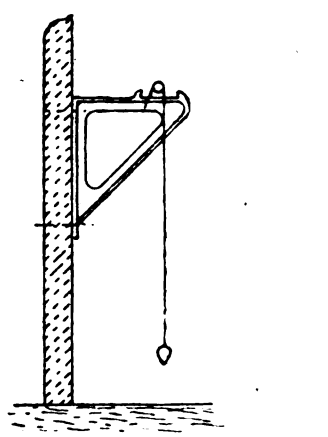


Fig. 82.

One way of erecting shafting is to locate the bearings from one end, working mainly in reference to a strained line, or to a wall or beams, but adjusting each separate bearing from that adjacent. Thus, the general positions of the bearings being indicated, an end one is bolted down, with the cap and top brass removed. The next one is set by a parallel straightedge laid in the hollow of its bottom brass, and extending to the same position in the first one. Lateral adjustment is effected by a straining line pulled taut along one edge of the brasses.

To fit wall-brackets, proceed as follows:—Mark the vertical lines Fig. 81, *a*, on the wall, which correspond with the centres of the brackets. These will be obtained with a plumb-line. The line will be chalked, and, when it is at rest, plumb,—the top and bottom will be held firmly, and the line snapped, transferring the chalk to the wall;—then chalk or scribe a line corresponding with the exact centre of the shaft, using a long straightedge and spirit-level for the purpose. Prepare a templet of wood or sheet-metal A, having holes bored in it to correspond with the holes in the foot of the bracket, and either with the top-edge or a centre line, coincident with the centre of the shafting. A vertical centre-line will be scribed and carried over the ends. The templet is laid against the wall, is set by the centre-lines, and the bolt-holes scribed off on the wall, and bored through. The next stage is bolting up the brackets. These may be all fastened before the shaft bearings are put in place, levelling and checking by the planed faces which receive the feet of the bearings. The latter are presumably bored and faced truly in the feet, and all of the same height. The first bracket is fixed by its holes and bolts, then the one adjacent is adjusted and fixed in reference to the first, using a parallel strip and spirit-level; thence adjustment is made to the third, and so on along the line.

The bearings can be now bolted in place, and the shaft inserted. Before finally inserting the wedge pieces at the ends of the bearing feet within the joggles, the truth of the shaft will be checked The horizontal accuracy will hardly be departed from at all; but a spirit-level can be tried upon it. The principal test, however, is that in the lateral direction. This is checked by dropping plumb lines over the shaft at the extreme ends, *b*, and Fig. 28, and at places intermediate, and sighting along them. Adjustment of the bearings by means of the end joggle-packings can be effected when all the bearings are in line.

J. H.

TRAFALGAR DAY.

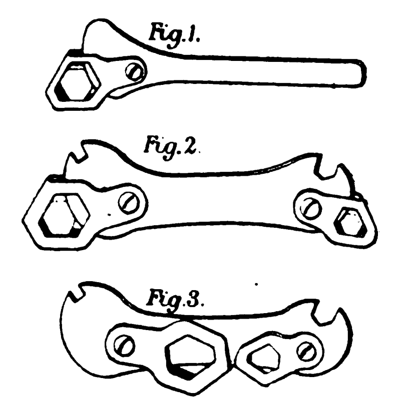
THE design selected by the Navy League for the decoration of the Nelson Column on Trafalgar Day, Oct. 21, is by Mr. George W. Bellgrove, F.R.H.S., outdoor manager of the Junior Army and Navy Stores Floral Department. The decoration combines floral and electrical effects, and bids fair to exceed anything ever attempted in this way before. The steeplejacks, Messrs. J. W. Gray and Co., commenced climbing the column on Friday, Oct. 13, and reached the capital on the following day—a record for this work. The laurel wreathing used is 3ft. wide, and encircles the column four times. The electric lamps, some 300 in number, are arranged to encircle the column between the wreathing. The four tablets—representing the Battles of the Nile, Copenhagen, Trafalgar, and St. Vincent—will be framed with laurel, and electric lamps and festoons of laurel garlanding will be hung from the top of the entablature to the lions' mouths, festooned over the four tablets, and then carried from lion to lion, entirely surrounding the column. Palms and foliage and flowering plants to the value of £1,000 will be grouped on the red baize covering the base.

ARCHITECTURAL PHOTOGRAPHY.

IN a paper read before the Photographic Club Mr. Henry W. Bennett said he would exclude from his lecture all those common or garden advices generally given to the same class of amateur, and confine himself principally to those matters on which differences of opinion might exist amongst experts. He first dwelt on the special difficulties encountered by the architectural photographers. The Scylla of limited space on the one hand, and the Charybdis of a too wide-angle lens on the other, were the two principal dangers encountered, which very frequently led to disaster. The judging of the length of exposure, too, is generally very difficult, and actinometers are of no value, whilst the so-called "intuitive" method of judging the exposure by the appearance of the picture on the ground glass must be altogether discarded. In fact, it is only by experience that one can hope to overcome this difficulty. The best atmospherical conditions will generally be those when light clouds are in the sky, especially when they are low down, as this illumination is best suited to reduce the harsh contrast frequently encountered in this kind of work. As already mentioned, the angle of the lens used is a most important feature, whilst it is generally impossible to work with long-focus lenses; wide-angle lenses frequently give monstrous results. Mr. Bennett found that a 7½in. lens on a whole-plate gave as a rule the best results. It is, however, necessary that the lens cover more than the plate, so as to allow the use of the rising front to its fullest extent. A flat field is, of course, very desirable, and Mr. Bennett is of opinion that the modern anastigmat is in this respect a great improvement on the older lenses. As to the position of the camera, it ought to be about 5ft. to 6ft. from the ground, as a higher elevation might very often be detrimental to the picture. Owing to the long exposures generally necessary, the absolute steadiness of the camera is of great importance, and, in order to secure this, Mr. Bennett recommended a tripod stay, one or two of which are on the market, although they are but seldom bought. In the absence of a proper tripod stay, a large rug will do good service. Mr. Bennett considers the backing of the plate essential. As to development, he invariably begins with what would be generally called a normal developer, and changes the same, as soon as the picture appears, according to requirements. He does not recommend (although this may appear safer at first sight) a diluted developer to begin with, as in this case it would be frequently very difficult to build up density afterwards. With regard to printing, very few negatives of this class can be printed without modifications of some sort. Mr. Bennett recommends covering the negative with tracing-paper; to cut out the highest lights and the deepest shadows with a second layer of tracing-paper. He protested against the word "faking" being applied to an operation of this sort, which is indispensable in order to get an harmonious picture. Touching upon the question of pictorial effect generally, Mr. Bennett was glad to notice that there was a growing tendency to consider this point more and more. Pictorial effect is, however, not inconsistent with sharpness throughout; and he protested strongly against that section of the photographic community which found salvation in "out-of-focus" effects. The suggestion of distance is just as important in a picture of this class as in landscape photography, and an otherwise satisfactory photograph might often be spoilt through its absence. There are photographs in the London exhibitions now which show this defect, and this is all the more regrettable in those cases where it might easily have been avoided, as, for instance, in photographs of church entrances, where the effect could have been obtained by opening the door instead of keeping it shut. Another defect which one frequently meets with (even in photographs that have passed the selection committees of our principal exhibitions) is the want of completeness. To be a success, the picture must be continuous; the principal object must not take too much space, or be only partially shown.

MEREDITH'S ADJUSTABLE SPANNERS.

THE illustrations show some patterns of adjustable spanners patented by Mr. J. E. Meredith, of Birmingham. A flat-section lever is provided at



one end with a metal loop formed of sheet metal folded centrally, thus forming a loop of two thicknesses of metal, which are arranged to embrace between them the end of the flat-section lever. The loop and lever are jointed together by a cross-rivet or pin, so that the loop can turn about the pin in a plane parallel with the face of the lever. The interior shape of the loop is hexagonal, or is a hole with two of its sides making an angle of 60 degrees, so as to suit hexagonal nuts. The end of the lever near which the looped part is jointed is so shaped and curved that when the looped part is turned in such a position as to project from the side of the lever, the latter does not protrude at all (or but very little) across the opening in the loop, and thus the latter will take a large nut, which will be pressed against the two inclined sides of the interior of the loop by the curved end of the lever acting like a cam when the lever is turned to turn the nut, thus securely holding the nut between the two inclined sides of the loop and the curved end of the lever. When the looped part is placed on a smaller nut, and the lever is turned to turn the nut, the curved end of the lever protrudes farther across the opening of the loop, thus diminishing said opening and pressing the nut against the two inclined sides of the loop as before. Thus the opening in the loop will suit various sizes of hexagonal nuts by merely turning the loop to such a position on the lever that the curved end of the lever fits against one of the flat sides of the nut and presses the nut against the two inclined sides of the loop. When the invention is applied to a double-ended spanner, Figs. 2 and 3, the lever is made curved at both ends, and each end is fitted with one of the said looped parts. When the spanner is not in use the looped part, or looped parts, can be turned and folded against the body of the lever so as to embrace the same, and thus occupy but little space.

DEEP PUMPING IN MINES.

DECIMAL twenty-two of a penny, or less than a farthing per ton of water raised, is not a bad performance for deep pumping in colliery operations. This is the record of the Commissioners appointed by Act of Parliament for the public drainage of the South Staffordshire coalfield, in respect of the past year's operations, and the

Commissioners may be fairly congratulated on the issue. The total amount of water raised has been the enormous aggregate of over seventeen million tons, of which more than thirteen and a half millions has been raised by the Commissioners' own engines, and the balance by private pumps and engines under agreement with the central authority. These facts came out at the annual meeting of this unique, and, in many respects, remarkable engineering body a few days ago, when also it was stated that the output of minerals in that portion of the drainage area where the big pumps are at work in the deep levels known as the Tipton district had been 680,000 tons, showing that twenty-five tons of water had been raised for every ton of mineral. Taking the entire coalfield over which the Commissioners operate, the mineral assessed for general drainage rates for the year aggregated somewhat over three and a quarter million tons, and, although the output in the Tipton district alone was an increase of 100,000 tons upon last year, what the pumping authorities want to make the district solvent, and to render the deep-pumping scheme all that can be required, is a further additional output of 200,000 or 300,000 tons, so that the output from the Tipton district alone may reach a million tons annually. With this object, the commissioners are doing all in their power to encourage the Staffordshire mine-owners to redouble productive efforts. A sum of £20,000 has been borrowed to improve the surface works by the laying down of a number of surface-pumps in various parts of the district, to prevent the water from going down into the deep. But for the starting of these light pumps the Commissioners are waiting the commencement of operations by a local electrical supply company, since the engines are to be worked by electric power. When these pumps get to work a considerable economy in the present cost of pumping will, it is believed, be effected. Mechanical and mining engineers alike the world over will wish for this dauntless mining body ultimate complete success.—*The Engineer*.

DETECTION OF BLOOD BY MEANS OF THE GUAIACUM REACTION.*

THE importance of a trustworthy means of identifying blood or blood constituents like hemoglobin, methemoglobin, and hematin in numerous judicial cases, and the value of a combination, on many rather difficult occasions, of the spectroscopic test and of the methods of preparing the characteristic crystals of hemin (as described by Teichmann, Hoppe-Seyler, Brucke, and Preyer), with the "ozone-transferring" action of the colouring matter of blood towards guaiacum, has induced me for many years to pay special attention to the last-named blood-test.

While others have mainly recommended to mix the blood solutions (obtained by extraction of a fresh or old bloodstain with small quantities of water (either alkaline or acidulated with acetic acid) under suitable conditions, first with an alcoholic guaiacum solution, and then with transferable oxygen in the form of hydric peroxide, or of the analogous compound contained in old and isolated turpentine oil (for instance, the liquid of Hunefeld, v. i.), and to observe the formation of the so-called "guaiacum blue," the method which I have proposed aims at the preparation of an intimate and durable mixture of the colouring matter of blood derived from the bloodstain with guaiacum resin. This mixture may be conserved for an indefinite time as a *corpus delicti*, and at every moment strikes a very intense blue colour by contact with one or another of the liquids containing loosely combined oxygen, provided that errors are cautiously avoided by check experiments. The proceeding, wanting but a short explanation in reference to the more explicit description in the paper quoted, chiefly consists in mixing the blood solution, obtained by extraction of bloodstains, with an alcoholic solution of guaiacum resin (or, as it has been lately proposed by O. Dobner, with a similar but weaker solution of guaiaconic acid). It is preferable, in this case, to use a solution of about 5 per cent. of resin instead of the alcoholic guaiacum tincture (1 to 2 per cent.) mentioned by Schonbein as the common reagent, in order to secure an easy secretion of resin in presence of small portions of blood. In this case a milky secretion results of the previously dissolved resin constituents, which, in these conditions, partly attract, fix, and precipitate at the same time the dissolved or suspended colouring matter of blood (either in the state of hemoglobin and methemoglobin or of hematin). In this way a mechanical combination of the secreted resin with the said blood constituents is formed, which process reminds us in some way of the well-known method by which some ferments, like pepsin, are secreted by means of an indifferent precipitate caused in the ferment solution and afterwards extracted. If, then, we separate the precipitated resin (or the above-mentioned constituent acting as reagent) by thoroughly dense filters (especially the newer "hardened filters" of commerce), the hematin compounds are fixed on the surface of the filter in extreme division together with the particles of resin. These filters, when well protected from light and air even during the filtration process and then cautiously dried in the exsiccator, may then be conserved for any length of time. But a small piece of them is wanted, to cause in a few moments an intense blue coloration in a porcelain dish or watch-glass on white paper, after it had been moistened with a little spirit of wine, and then a small quantity of Hunefeld's liquid (mixture of so-called "ozonised" turpentine-oil with alcohol, chloroform, and a little acetic acid) has been added. This process is equally applicable to bloodstains, and to the detection of blood in urine, and other similar objects, and may be used as well for the research of relatively fresh blood as for that of old dry stains, owing to the fact already observed by Schonbein—viz., that the colouring matter of blood altered by exsiccation even in higher temperatures still shows in unimpaired degree the different "ozone-transferring" properties, and even seems to act more intensely in some respects—for instance, towards a mixture of peroxide of hydrogen and cyanine.

Since the publication of this modification in the methods of detection of blood by means of guaiacum, some observations on different points of solubility of the red-coloured blood constituents, especially in dry blood, have taken place, which lead to new propositions concerning a reliable, very short, and direct way for the detection of blood, and therefore may be communicated in this *Journal*, after having been briefly related in the pharmaceutical section of the annual meeting of German naturalists at Brunswick in 1897. By occasion of former studies and experiments on the physical and chemical behaviour of chloryl hydrate, a special solvent power of highly concentrated—that is to say, 65 to 80 per cent.—aqueous solutions of the said compound has been observed, not only for several bodies already known, like starch, but also for very various different substances, like certain resins, colouring matter, stearoptenes, and also albuminous matters, especially the colouring matter of blood. In fact, experience showed that bloodstains which have become dry even for a long time on linen or other similar materials are extracted in a relatively short time by impregnation and contact with a chloral hydrate solution of about 70 per cent. and more thoroughly dissolved than by any other treatment. Even bloodstains many years old may, by this operation—after a somewhat longer contact with the solution—be removed to such a degree that their trace is but hardly discernible on the linen. It may be observed on this occasion that the solution of the blood constituents by aqueous chloral hydrate is much facilitated if the blood spots have been previously wetted with small quantities of concentrated acetic acid. The use of this acid is not only admissible for itself, as the guaiacum-blue is not affected by it, but even offers a certain advantage concerning a reaction of control to be mentioned later on.

Inasmuch as guaiacum resin, as well as the guaiaconic acid, specially concerned in the formation of "guaiacum blue," are both easily soluble in the concentrated chloral hydrate solution, a simple method may be devised for the extraction of bloodstains and the subsequent detection of the colouring matter of blood.

In fact, the guaiacum blood test can be prepared and managed on the simplest terms in this way, that first the coloured spots in question, after moistening with a little acetic acid, are extracted either with a 70 per cent. chloral hydrate solution or directly with a 1 per cent. solution of guaiacum in aqueous chloral hydrate, containing 70 to 75 per cent. of the latter. In regard to the fact that the resin constituents concerned in the subsequent reaction show a marked tendency for spontaneous oxidation—as is sufficiently proved by the well-known change of colour in the air and light—this latter method, on the whole, seems less preferable than the first named, which consists in first extracting the blood by means of chloral solution and then adding to the resulting blood solution about an equal volume of the guaiacum chloral solution. If in this process the bloodstain has been moistened with acetic acid previous to the treatment with chloral hydrate, the addition of guaiacum chloral solution to the chloralic extract of the stain to be tested for blood will permit a control reaction, inasmuch as the casual presence of nitrites (as, for instance, nitrite of ammonia) in the respective stain would at once cause a more or less intense blue colouration of the mixture owing to the decomposition of these salts by the acetic acid, the nitrous acid colouring guaiacum—viz., guaiaconic acid—blue even in high dilutions. Moreover, if the chloral extract of the stain contains only blood, the addition of the brownish-yellow guaiacum chloral solution to the pale red liquid derived from the stain will give a pale brown mixture exceedingly well adapted for a decisive zone reaction indicating the presence of hematin. To this blood guaiacum solution in aqueous chloral hydrate a stratum of the already mentioned turpentine solution of Hunefeld or of an adequate solution of hydric peroxide (the indifference of which towards guaiacum tincture being previously stated) is carefully added without mixing, then an intensely blue and rapidly-increasing zone appears, with extraordinary sensibility, in the place of contact and diffusion of the two solutions, while by sudden mixture a less pure blue colouration of the liquid results. The method may also, in suitable cases, be so modified that the blood solution is first mixed with Hunefeld's liquid and then added to the guaiacum solution. This process can just as well be conducted to obtain a zone reaction or also a capillary reaction.

In cases of extraordinarily small bloodstains, so as to necessitate, in a certain measure, a micro-chemical operation, or where the respective residue of blood has to be tested on its natural place, it is advisable to digest the stain on a flat porcelain dish with strong chloral solution (v. s.), having first moistened with a small drop of acetic acid, and, after an hour's contact, to pour on the digested spot first a corresponding small quantity of guaiacum chloral solution, and then, after having thoroughly mixed, a few drops of the one or other liquid containing the peroxide. With this method also a more or less intense blue coloration is seen to appear on the light-coloured underground. Experience has shown me that even very old bloodstains and exceedingly small parts of such may be identified in this manner, provided a sensible guaiacum chloral solution, prepared with quite fresh resin, and at the same time a liquid of Hunefeld or hydric peroxide solution of right composition and controlled in regard to their activity, are used. A solution of Hunefeld suitable for the purpose may easily be prepared, mixing f. i. 15c.c. of turpentine oil, exposed to light and air for a certain time (but which ought not to change directly blue in the guaiacum tincture), or 15c.c. of a 3 to 5 per cent. hydric peroxide solution, free from acids, with 25c.c. of alcohol, 5c.c. of chloroform, and 1·5c.c. of glacial acetic acid. The zone reaction surpasses the other older methods of testing by special purity of the blue colour resulting from the formation of the so-called "guaiacum blue"; besides that this purer colour is more durable, according to the fact that in the measure of progressive mixation of the active substances of the two layers (hematin as the oxygen-transferring body, hydric peroxide or essential oil as the source of oxygen and guaiaconic acid as the oxidable compound) small quantities of the intensely blue coloured oxidation product are formed gradually. It is true, however, that the "guaiacum blue," especially in the presence of organic reducing agents, is not very stable, inasmuch as this compound, to use an expression of its first investigator, C. F. Schonbein, contains loosely combined, movable and active oxygen in the ozonide state.

The foregoing shows, as it seems, the usefulness of the modified guaiacum blood-test when cautiously applied; on the other hand, it cannot be denied that the reaction is liable to certain misinterpretations, in cases where some other organic or inorganic substances are present, instead of blood. It is scarcely necessary to mention in this place the numerous compounds which, as, for instance, nitrous acid, free chlorine, bromine and iodine, chromic anhydride permanganic acid, peroxide of lead, the ferric and cupric salts, quinone, &c., directly colour blue the guaiacum resin; because first of all, many of these bodies are exempted à priori in the majority of materials submitted to the blood-tests, and secondly, because in their presence the liquid extract of a stain to be tested for blood would at once strike a blue colour when mixed with a little guaiacum tincture before the addition of Hunefeld's peroxide solution. In regard to these facts, the somewhat superficial notice of some text-books—viz., that the guaiacum blood-test is not reliable, "because many substances change guaiacum for themselves," cannot be taken as a warning against the use of the said method, since, certainly, no careful analyst will ever neglect to avoid mistakes by availing himself of the control-reactions indicated in each case! Yet, such substances of inorganic or organic origin, as share the "ozone-transferring" quality with the contents of the blood cells—viz., the colouring matter of blood, might in some single cases lead to a false interpretation of the guaiacum-blue-reaction. Among organic vegetable substances, bodies of the class of ferments may be named, as well as hydrolytic ferments (enzymes in the stricter sense of the word) chiefly so-called oxidising ferments, as they occur in numerous parts of plants, especially in mushrooms and plant seeds, while among animal substances in the first line saliva, extracts of some organs, the contents of white blood cells and pus cells, &c., show analogous properties. These albuminous substances of the character of ferments, existing in vegetable and animal cells, and exerting in a more or less manifest degree a catalytic and at the same time "oxygen-transferring" action towards hydric peroxide, strictly differ from the colouring matter of blood in that the last-named action is cancelled, or at least most strikingly weakened by heating to 100° C., or also by contact

* By Dr. Edw. Schaer, Strasburg Pharmaceutical Institute University.

with diluted hydrocyanic acid. In case the extract of a pretended bloodstain contains such a substance of the class of ferments, instead of ingredients of blood, it will cease to show the guaiacum reaction, even after a shorter digestion at the temperature of the water-bath; and also a control experiment with addition of hydrocyanic acid during the extraction of the stain will give essentially negative results.

However, the avoiding of all possible mistakes becomes rather difficult in such cases, where the presence of even the smallest quantities of ferrous oxide or other ferrous compounds can occur, as, for instance, in the testing of suspected stains on rusty iron materials. If the rust, even in the absence of blood, contains small portions of certain ferrous compounds—viz., ferrous carbonate or other ferrous salts—they could, by extraction, be introduced into the filtered solution, even in case the latter had not taken up any ferric hydrate or basic ferric salt; yet such an extract of a stain, even with the slightest trace of ferrous oxide, would cause the guaiacum-blue reaction after subsequent addition of guaiacum resin and hydric peroxide. A strict distinction of ferrous oxide and of the colouring matter of blood is not very easy in such cases, because the first-named compound manifests, even in the smallest quantities, the same intense "ozone-transferring" power as hemoglobin or hematin, which also contain iron. It will, therefore, form the object of further experiments to find out how the mentioned casual mistaking in the guaiacum-blood reaction may be eliminated. On occasion of such further researches concerning the reaction discussed in this paper, the question would have to be treated whether blood, which, after drying up in slow decomposition on certain materials, like stone, clay, or rough metallic surfaces, and after disappearance of the organic substance by the action of air and water, leaves but rusty spots, can generate in these conditions seizable quantities of ferrous compounds.

The above-described method of extraction of bloodstains with concentrated solutions of chloral hydrate, which, as is well known by this time, are also good solvents for resins, has induced some experiments in order to ascertain whether, by using the process mentioned in the first part of this essay, chloral solutions containing blood and guaiacum may, by precipitation with water and subsequent filtration, give a resinous secretion containing blood constituents, showing the mentioned behaviour and applicable to the guaiacum-blood reaction after any time of conservation. It may here be stated, by the way, that the trials performed in this manner have but led to a moderately satisfactory result, probably because even a diluted chloral solution still acts as a solvent on the resin in a low, but perceivable, degree, and besides, as I am induced to believe, because the colouring matter of blood is less easily precipitated by the secreting resin from a chloral-blood solution than from a chiefly aqueous liquid. But, notwithstanding the loss of material caused in that way, by the use of this method resin-covered filters can be obtained possessing the properties quoted in the beginning of this paper.

Lastly, it may be mentioned that—as it could be expected—the guaiacum blood-test executed with chloral solution is thoroughly applicable to a control-reaction—viz., to the chemical identification of the hemin-crystals, which are of high importance in judicial cases. A specially pure blue colouration is obtained when, instead of the ordinary guaiacum solution of guaiaconic acid in 200 to 500 parts of chloral-solution (v. s.) is used, and the reaction is observed in a glass tube as a zone-reaction. The guaiaconic acid, proposed as a substitute for the natural resin by O. Doebner in his interesting essay on guaiacum resin and "guaiacum-blue," is just as well liable to spontaneous oxidation in light and air with changes of colour; and, according to my observations, its use is more convenient for the described zone-reactions than for experiments in watch-glasses or dishes, where greater surfaces get into action. It is, moreover, obvious that this special experience cannot interfere with the certainly desirable use of the guaiaconic acid, as being the active constituent of the resin, in the numerous other guaiacum reactions. I cannot but feel convinced that the reactions with guaiacum resin have not, in all respects, met with the consideration they deserve, neither in general nor in medical and pharmaceutical chemistry, so I thought it advisable to publish this little contribution to the question in this convenient place.—*American Journal Pharmacy.*

ROLLER BEARINGS.

ROLLER bearings are preferred to ball bearings by many machinists, and one especially adapted for bicycles and machinery has been invented by Mr. St. Louis, of Carmel, Wisconsin, which, it is claimed, besides being cheap in construction, cannot bind or become disarranged. In Fig. 1 the bearing is shown applied to a bicycle, and in sectional side elevation. Concentric tracks are employed, secured to the axle of the bicycle-wheel, between which tracks is a bearing-ring formed or fastened on a cap attached to the hub of the wheel. Two sets of flanged rollers are employed, lying between the bearing-ring and the concentric tracks. The flanges of one set of rollers roll upon the flanges of the other set, the concentric tracks being grooved alongside their bearing-surfaces to receive the flanges, but without contacting with their peripheries. When the axle of the wheel is turned, the sets of rollers, being in contact with the inner and outer surfaces of the rotating bearing-ring, are made to turn in opposite directions, and roll upon the fixed concentric tracks. The flanges, besides separating the rollers, cause them to turn in unison. By arranging the parts in this manner the bearing-ring is placed between two sets of bearing-rollers, thereby forming double bearing-surfaces sustaining the weight equally. The load is directed against the outer set of rollers at the bottom, and bears against the inner set at the top, thus reducing the friction to a minimum, so far as the vertical stress is concerned.

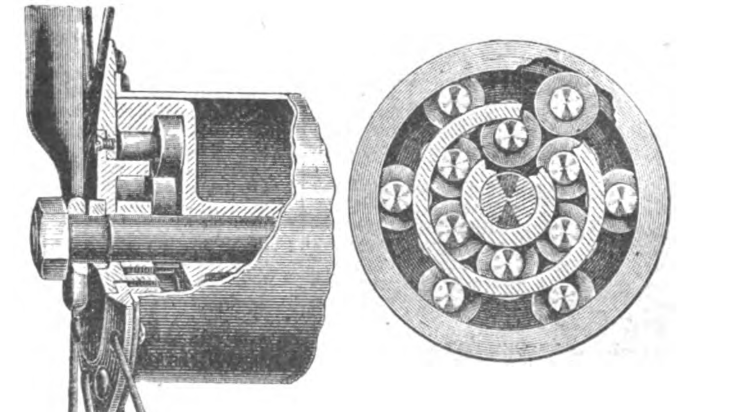


Fig. 1

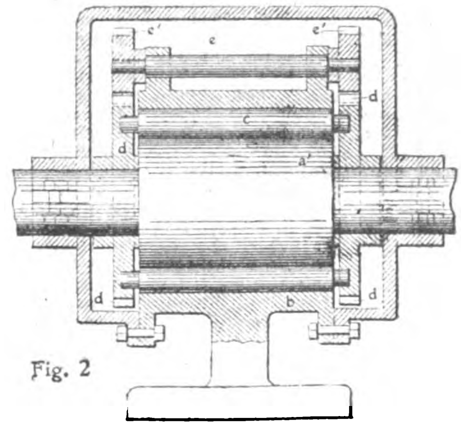


Fig. 2

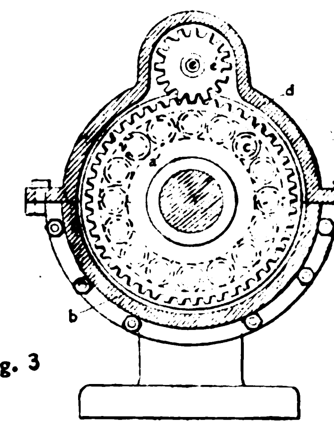


Fig. 3

In Figs. 2 and 3 a roller bearing patented by Mr. Horace Brown, of Reading, Massachusetts, is shown—a device which is said to be practically perfect. In Fig. 2, *a* is the journal, *b* the bearing-surface, and *c c* the rollers, which project over each end of the journal, and their projecting portions are turned to a smaller diameter, and fit so as to turn freely in holes in revolving rings *d* at each end of the journal. The holes in the rings are so spaced as to place the rollers as near as possible to each other round the journal without their actually touching. These several parts being in their correct positions and relations to each other, it is only necessary for the correct working of the system that both rings should revolve in unison, and that neither should ever be the least behind or in advance of the other. The edges of both rings are provided with gear-teeth, and these teeth are in mesh with two pinions *e'*, secured to each end of the shaft *e*. This, of course, insures the uniform rotation of the rings, and the correct action of the entire system. The trunnions on the ends of the rollers are intended to bottom in the holes in the rings, so that the larger shoulders do not touch the inner surfaces of the rings. The outer casing may have an oil-pocket which will carry oil at such a height as to insure lubrication of the roller trunnions and other parts that may require it.

THE FIRE-WALK BY EUROPEANS.

THE fire-walking "test" amongst savage nations has always been a performance that has puzzled experts, and the following notes in the *Athenæum* by Mr. Andrew Lang will be interesting:—Some weeks ago I condensed in the *Athenæum* a description of the Fijian fire-walker (Umu Ti), written by Dr. Hocken, F.L.S. Mr. Tregear, the well-known author of a Maori dictionary, now sends me Col. Gudgeon's account of his own adventure as a fire-walker. In the *Journal* of the Polynesian Society (Vol. II., p. 105) Miss Teuira Henry described the rite as practised at Raiatea in Society group, adding the ritual song chanted, and a photograph (not published) of the performance. In No. 1, Vol. VIII., p. 58 (March, 1899), of the *Journal*, Col. Gudgeon, British resident at Rarotonga, late a judge in the native Land Court, and an accomplished student of the Maori speech, records his own experience. A Raiatea man, young, but of the fire-walking clan, officiated. (This clan is analogous to that of the fire-walking Hirpi of Mount Soracte.) The date was January 20, 1899. As usual, a large fire had been blazing on a foundation of stones; the burning logs were hooked out, and at 2 p.m. Col. Gudgeon found the glowing stones ready for the ceremony. The officiating Raiatea man pointed out to his native pupil that two stones were not hot, they having been taken from a *marae* or sacred place. Nothing was done by way of magic except that the Raiatean spoke a few words (not reported), while he and his *tauira*, or pupil, thrice struck the edge of the oven with witch branches of the *ti* (Dracæna). "Then they walked slowly and deliberately over the two fathoms of hot stones." The pupil handed his branch to Mr. Goodwin (on whose land the performance took place) and said, "I give my *mana* over to you: lead your friends across." The word *mana* means a kind of "magnetic" or magical force which individuals are supposed to possess in differing proportions. Mr. Gladstone had plenty of *mana* from a non-Polynesian point of view. So, in a more absolutely Polynesian sense, had D. D. Home, the "medium." Perhaps "power" is the best English equivalent for *mana*.

Col. Gudgeon, before these performances, had asked that the glowing stones "should be levelled down a bit," as his feet "were naturally tender," and so the stones were "levelled flat." In walking across three white men accompanied him—Dr. W. Craig, Dr. George Craig, and Mr. Goodwin. Col. Gudgeon "got across unscathed." He says:—

"I knew quite well I was walking on red-hot stones, and could feel the heat, yet I was not burned. I felt something resembling slight electric shocks, both at the time and afterwards, but that is all."

As to the heat, the oven is made for the purpose of cooking the *ti*, which is put in after the rite. Half an hour after that performance a green branch

thrown into the oven blazed in a quarter of a minute. The *ti* (*teste* Col. Gudgeon, who ate his share) was well cooked. He walked "with deliberation," and "the very tender skin of my feet was not even hardened by the fire." He offers no explanatory hypothesis. The ceremony is not now practised in New Zealand; but when Col. Gudgeon's paper was read to some old chiefs of the Urewera tribe they said that their ancestors could also perform the ceremony.

In this case (1) no preparation of any kind was applied to the feet; (2) they were not hardened by walking unshod; (3) no abnormal psychical condition was involved. Three stock explanations were therefore put out of court. I have none to offer; but the facts appear to illustrate the mediæval ordeal, as well as certain other curious phenomena handed down from of old.

THE ACTION OF HEAT ON INDIA-RUBBER.

FROM more than one point of view, a consideration of the alteration which indiarubber, both pure and vulcanised, undergoes on exposure to temperature above the normal, is of interest and importance, for not only are some of the statements on this head to be found in textbooks erroneous and misleading, but practical questions of great import are involved in the use of indiarubber valves, hose-pipes, &c., in connection with high-pressure steam. An apology, therefore, is hardly needed for referring at some length to the subject in order to correct some misapprehension arising from failure on the part of certain authors to interpret properly the results of experiments, even though the matter may not, perhaps, be of so much importance to the general engineer as to the rubber manufacturer, or to the compiler of textbooks on physics. Without saying more by way of introduction, but to dive at once *in medias res*, the following statement appears in one of the books just referred to:— "Indiarubber, unlike the great majority of substances, contracts when it is heated." Now this, in itself, does not represent the whole truth, for an important word is left out — viz., "stretched," because, indeed, rubber in a normal condition expands on heating, and it is only when it has been subjected to tension that it acts in the opposite manner. We are not suggesting that there is anything new in this announcement, for, of course, there is not; but there is plenty of evidence to the effect that the facts of the case are not clearly grasped by many of those who have had a good deal to do with rubber, to say nothing of those whose general acquaintance with rubber and its manufacture is but superficial. The literature at our disposal in connection with this matter is scanty. About forty years ago Lord Kelvin suggested to Joule that he should examine the curious fact that indiarubber, when stretched, gave out heat instead of becoming colder, as all metals do. Joule experimented on the subject, and his results are to be found in the *Philosophical Magazine* for 1857. We have also the well-known experiment described by Tyndall in his "Heat a Mode of Motion," in which it is shown that a tube of vulcanised rubber, stretched to three times its length, contracts considerably when it is heated. The experiment is simplicity itself, and depends entirely for its result on stretched rubber being used, and it is the overlooking of this detail that has given rise to the statement to which we have just made an objection.

It is generally known that sound Pará rubber is very elastic. This is easily seen by cutting a strip from the raw rubber in the crude state in which it arrives in this country, and pulling it out; moreover, the thread produced will remain in the elongated condition for any length of time, provided the temperature is not raised. If such a thread, however, to be exposed to heat, even to that of the hand, it will be observed to instantly curl up and resume its original dimensions. If, now, heat be again applied, it may be observed to expand, not to any great extent, but still perceptibly. In connection with making experiments of this sort, it is most important that the condition of the rubber experimented on be fully known. Perhaps the best-known form of pure manufactured unvulcanised rubber that comes in the way of workers in a physical laboratory, is the fine cut or spread sheet, to use the technical terms applied to them: and we may point out that most of this sheet is to a greater or less degree under tension. This is due, in the one case, to the action of the machine which cuts the sheets from the solid block of rubber; it follows, therefore, from what we have already said, that such sheet rubber, if heated, will contract—a proceeding which it is easy to see might lead to false deductions. This action is well-known to the manufacturers of goods from cut sheet rubber, and they will take care to get the rubber in a normal condition before cutting it up. To do this, they simply expose it for a certain length of time on a steam-chest, though the term "shrinking," which is usually applied to the process, is not a particularly happy one. The writer being somewhat sceptical as to the amount of shrinkage which resulted, made some careful experiments, the result of which showed that there was a decided gain in superficies, this arising at the cost of the thickness. With regard to spread sheet, that is, sheet rubber which is made by dissolving the rubber in naphtha and then spreading the mass out on a length of cloth, and allowing the solvent to evaporate; this is also frequently found under tension, the elongation being given in the process of stripping the rubber from the cloth on which it has been spread. If further proof were required of the expansion of rubber under heat, we have it in the overflow which always takes place at the junction of the two sections of the mould when a moulded article is being vulcanised. Conversely, we have the well-known fact of the contraction that takes place when a block of rubber is immersed in a freezing mixture. These facts tell their own tale, and there is no need to bring further argument to bear upon a statement which it is apparent has arisen from a misconception, and which we hardly suppose will find any champion.

Turning now to the chemical aspect of the action of heat on rubber. This is well known to be injurious, and if the heat [temperature] is at all high, or if the time of exposure be long, the rubber is quickly destroyed. That the action is some form of oxidation is taken for granted, though there is plenty of room for research on the matter. Rubber cannot be heated above 240° Fahr. without decomposition setting in, and even if this is not at once visible it shows itself in a few days' time or on exposure to air and light. That pure rubber is hardened by cold and softened by heat is, of course, well known, and, as far as the engineer is concerned, pure rubber hardly comes under his cognisance, the vulcanised rubber being always used by him. Now, in observing the action of heat on vulcanised rubber, the important factor of the sulphur has to be considered. The free sulphur, which is always present in mechanical rubber goods, is liable to oxidation into that destructive body, sulphuric acid, and this acts injuriously upon the rubber when it is heated, hence it is difficult to apportion the blame properly in cases of decay. In practice the destruction of vulcanised rubber by heat, notably in the case of packings for steam joints, must be attributed to over-vulcanisation, due to an excess of sulphur. It would be better if such goods were made without this excess of free sulphur; and, no doubt, the low limit of sulphur stipulated for in our Admiralty contracts has been fixed with the object of avoiding the injurious action of an excess of this element. The higher the temperature to which the rubber is exposed, the more injurious will be the action of the free sulphur, and as the tendency of the day is to use steam of higher and higher pressure, this defect in the rubber joint-rings, &c., is likely to be more and more serious. At the same time, it must be confessed that there is a tendency to expect too much from rubber. The manufacturer is always getting complaints as to failure of hose, as engineers seem to think that there is no limit to what rubber should be able to do. Take, for instance, the modern practice of heating railway carriages by steam from the engine; complaints are rife that the rubber does not last long. Well, it is difficult to see how it should do, especially as the steam from the engine is not regularly passed through a reducing valve. The convenience of rubber hose as regards bending gives it a great superiority over flexible copper piping for this purpose, though the latter has now had an extended trial. Probably rubber will continue in use, but those who buy it must be prepared to find that it has only a limited life. Various modifications of rubber hose have been introduced of late years to meet the demand for a reliable high-pressure steam article, but the modification of the old rubber hose consists chiefly in introducing other bodies to replace the rubber. This is the only course, indeed, in which success is to be looked for, until the long-sought-for elixir, which is to preserve rubber against the ravages of heat, has been found.

The temperatures to which vulcanised rubber is exposed in practice do not reach that of destructive distillation, a chemical reaction which converts the solid hydrocarbon into a number of isomeric liquid hydrocarbons. This distillation process cannot be said to have any practical interest, for though these oils have been, at one time and another, used in small quantities for certain purposes, they have now in all cases been superseded by something cheaper. It has been mentioned that vulcanised rubber is less susceptible to heat than is pure rubber, though it would not be superfluous to add "properly" as a qualifying term; for if the rubber be not properly vulcanised, that is neither underdone nor overdone, its ability to stand heat is much reduced. It is not always easy to hit the proper mark, and though it is not difficult for a buyer of rubber goods to see whether such are under-vulcanised, it is quite the reverse to say with certainty that they are over-vulcanised. There is still a good deal of difference in opinion as to the desirability of giving a short time at a high heat or a long time at a low heat, though for certain classes of goods one process is more suitable than the other. The ordinary temperature is from 265° Fahr. to 280° Fahr., 275° Fahr. being the most usual figure. Quite recently it has been suggested that, instead of using the above temperatures with times of one to three hours, a much higher temperature should be used for a very few minutes. This process has been practically tried on the Continent and seems to have answered expectations; but the goods will require the test of time before the practicability of the method can be considered as demonstrated, and cautious people will wait for this test before attaching too much credence to what they hear on the matter. One thing is quite certain: the work will have to be carried out by reliable workmen, as any excess of time at the temperature proposed must prove fatal to the goods.

It is now a long time since Goodyear observed the change which sheets of rubber undergo on exposure to sunlight, and it cannot be said that his prognostications as to the employment of the sun to effect this change, to which he gave the name of "solarisation," have been fulfilled; in fact, the light of experience tended to show that this change produced by the sun was but the beginning of decay, and any such exposure had better be avoided. This can easily be seen by anyone for himself, if he take two pieces of rubber and expose them to the rays of the noontide sun, after covering one piece with a protective coat of paint or varnish. Seeing that exposure to heat is injurious, the fact that elastic rubber goods give out heat when they are extended is not without some significance as a possible factor in cases of early decay. Take, for instance, elastic thread. If a piece is stretched quickly over the bulb of a delicate thermometer, a rise of temperature may be noted; and if we imagine this alternate heating and cooling action continually taking place, it is quite within the confines of plausible conjecture to imagine that such physical change may be answerable for certain obscure cases of deterioration. At any rate, the point is one which seems worthy of further attention, especially in connection with elastic thread—a substance which in many of its applications very quickly loses its title to the adjective by which alone it is generally known to the public.

It may be further mentioned that, as in the case of the cotton manufacture, atmospheric conditions play a not unimportant part in the rubber manufacture, or, at least, in connection with the preparation of fine sheets from solid blocks of rubber. Where the heat is at all excessive, the rubber becomes too soft to be cut, a fact which certain Continental works, which endeavoured to compete with the English, found out to their cost. The freezing of the blocks of rubber in a mixture of ice and salt was not found a complete panacea, and one English firm of recent years decided to convert the whole workroom into a refrigerating chamber, and thus be able to work without stoppage through any spell of Tropical weather that might arise. It was in connection with this that an investigation into the specific heat of rubber was carried out by Gee and Terry, and the account of their experiments is to be found in the *Transactions* of the Manchester Literary and Philosophical Society for 1891. The figure found as the mean of a number of experiments was ·48, identical with that for turpentine. The knowledge of this constant may not be of the greatest importance, but the reference to it here may be useful, as the figure has not, to the best of the writer's knowledge, yet been included in any table of specific heats.

In conclusion, some apology may be considered due for the lack of continuity with which our subject has been handled; but it was thought, on consideration, that it would prove of more general interest to touch lightly on various issues of practical importance, rather than to attempt any exhaustive treatment of a particular point, or to indulge in the somewhat risky procedure of theorising on a subject of which so little is, as yet, known with certainty.—*Engineering.*

PLATING AND COLOURING ALUMINIUM.

METHODS of plating and colouring aluminium have been recently patented by M. B. Ryan, of Catford, Kent, and, according to specification, the invention relates to the electro-deposition of metals on aluminium and its alloys, and comprises a process for fixing on the surface of the alluminium a metallic amalgam, whereby a base is provided on which the "striking" solution may act positively, the amalgam base so intimately adhering to the surface of the aluminium that, after passing through the striking solutions, the metal may be rolled, drawn, or otherwise handled without causing any separation of the deposited metal film. The process to which the aluminium is subjected, preparatory to the application of the amalgam, is designed to be of such a nature as to preclude the formation of metallic salts between the surface of the article and

the metal deposited thereon. The claims are, the method of treating aluminium and its alloys preparatory to the electro-deposition of the final coating thereon, consisting of the alternate immersion in alkaline and acid solutions as follows: Whale oil soap, muriatic acid, cyanide of potassium, phosphoric acid, and the solution containing a muriatic salt, whereby the surface of the aluminium has fixed thereon an amalgam of mercury before being immersed in an electrically-operated solution. The process of electrically-depositing metals on aluminium and its alloys, consisting in cleaning the surface, then dipping it (1) in a muriatic acid solution having a gravity of substantially 15° Baumé, (2) in a cyanide of potassium solution having a gravity of substantially 20° Baumé, (3) in a phosphoric acid solution having a gravity of substantially 50° Baumé, (4) in a solution containing bichloride of mercury, and (5) then into an alkaline solution, (6) passing it through suitable electrically-operated striking solutions, and from thence (7) into the electrically-operated solutions for depositing thereon the final coating of metal. The process of plating aluminium comprising the following steps—after suitably cleansing it—(1) dipping in muriatic-acid solution having a gravity of substantially 15° Baumé, (2) dipping in cyanide of potassium solution having a gravity of substantially 20° Baumé, (3) dipping in a phosphoric acid solution having a gravity of substantially 50° Baumé, (4) dipping in a solution comprising one gallon of water, 2lb. of salammoniac, and 1oz. of bichloride of mercury, then (5) dipping in an alkaline solution as caustic potash, (6) and thence through the electrically-connected whitening or striking solutions, and then (7) into the electrically-connected solutions containing the metal to be deposited. The method of preparing aluminium for deposition of the final metallic coating thereon consisting in chemically cleaning the surface, applying an amalgam of mercury to the surface, and then passing the metal through electrically-operated and progressively-graded whitening solutions, whereby it is adapted to receive a final electrically-deposited coating of any suitable metal.

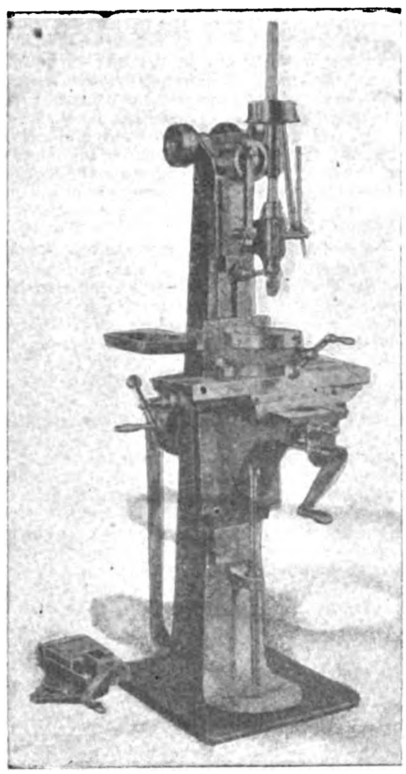


Fig. 1.

spindle is run in a taper bearing at the lower end, 5in. long and 1¼in. and 1⅜in. diameter respectively at the ends. The upper part of the spindle is ⅞in. The spindle has a taper hole with thread at the bottom for drawing in arbors solid. The sleeve for the spindle is operated by rack and pinion, with a movement of 4in., and is instantly clamped by a lever at the side for milling. The sliding-head, which is solid and stiff, has a vertical adjustment of 12in.

To this machine has now been added a slotting attachment, the details of which will be readily understood by reference to Fig. 2. A box 5in. long is attached to a wing of the sliding head; the vertical slide, square jibbed, is 8¼in. long and 3in. wide. The box is adjustable 5° each way from the vertical. The slide has a stroke of 2in., which may be made more or less if necessary. The tool-post takes ½ by ⅝in. steel, and has a spring-actuated relief motion on the up stroke. On the crank-shaft, which runs in an eccentric sleeve, is a bronze worm gear of forty-four teeth, which meshes into a quadruple thread worm of hardened tool steel on the milling spindle, thus giving a movement of 1 to 11. The eccentric sleeve is turned by a short handle at the back end of it for throwing the worm gear in or out of mesh with the worm. The normal speeds of the milling spindle are 300, 600, and 1,200 per minute, and the strokes of the slotter, therefore, 27, 55, and 109 per minute. The tool cuts ½in. in width easily. The back of the column of the machine is open, and can be used as a closet for tools and small parts. A swivel vice is furnished with the machine. It is built by R. M. Clough, Tollond, Conn.—*American Machinist.*

PHOTOGRAPHY APPLIED TO TEXTILE DESIGNS.

In the course of his introductory address at the opening of the twenty-sixth session of the evening classes at the Textile Department of the Yorkshire College, Prof. Beaumont gave an account of the new photographic method of preparing textile designs, invented by Jan Szczepanik, which he had recently been studying in Paris. The object of the appliances, it was explained, was by mechanical means to enlarge the artistic sketches of the designer, and to transfer the design to ruled or point paper, marked with millions of dots arranged in the order proper for the development of the

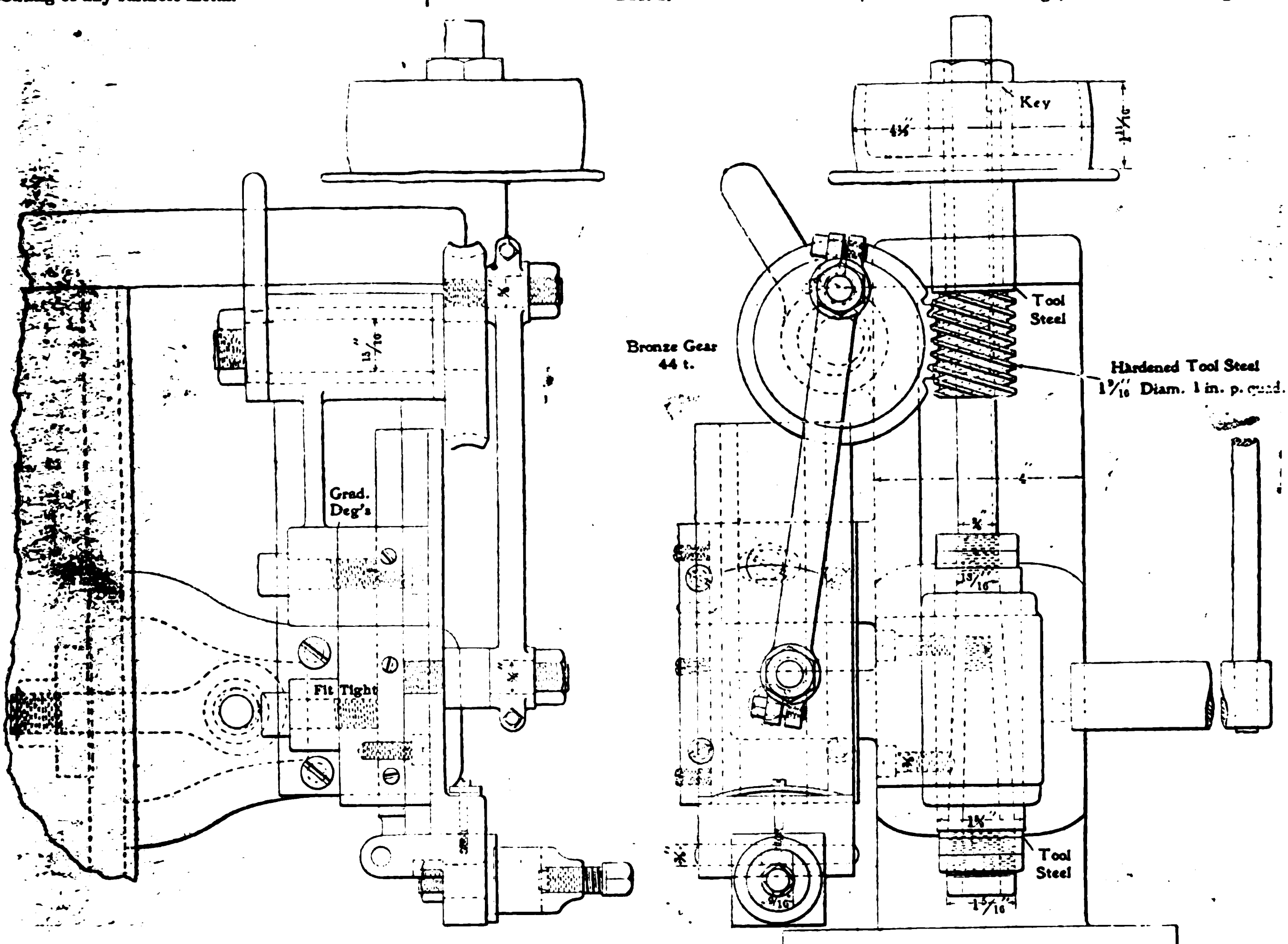


Fig. 2

COMBINED MILLING, DRILLING, AND SLOTTING MACHINE.

The beautiful little machine shown in the half-tone is almost an ideal machine for a fine tool-room, for the little shop where small experimental and model work is done, or for the high-toned amateur machinist. The machine is normally a vertical milling or profiling machine, and therefore also a driller, and as such has been made and sold. The machine, as will be seen, has a table similar to that of a universal milling machine. It is 20in. long, 7in. wide, with ⅜in. T-slot, and a movement lengthwise of 12in., crosswise 6in., and 18in. vertically. Adjustments of a thousandth of an inch are readily obtained by either screw. The milling

pattern in the weaves. Szczepanik printed the design by a photographic process on sensitised paper, and by his method the process of applying the weaves was governed, not by the skill of the artist or his assistants, but by natural laws. Inaccuracies in shading were thus made impossible, for the change in the weave is absolutely identical with the toning of the negative. Designs which now took weeks, and even months, to prepare for the loom, would by this new method be mechanically worked out in a few hours. For instance, in six hours a design in silk tapestry, 176 square centimètres, or about 35sq.in., in extent had been prepared. It might be imagined that this ingenious and novel invention was calculated to have an important influence upon the branches of the weaving industry, relating to the manufacture of all elaborately figured fabrics, especially if the designs worked out photographically were legible for all practical purposes. It was recognised, of course, that there must be limitations to its utility, as there were to all mechanical and automatic appliances. Yet, if it could be employed in accelerating the process of designing large patterns, it should have the serious attention of all who desired the further development of the weaving industries. It was a mistake to think that, if the invention became commercially useful, the sphere of the designer would be considerably restricted. In the long run, innovations of this kind, though at first they might dislocate certain branches of employment, enriched the industry in whose interests they had been introduced. The place of the designer, the brain-worker in textile factories, could not be assailed by inventions of this kind. The chair at the lecture was occupied by Mr. G. H. Nussey, vice-chairman of the Textile Industries Committee, and over 500 manufacturers were present from all parts of the country.

OLDEST ELECTRIC STREET RAILWAY IN EUROPE.

UNITED STATES Consul Hugh Pitcairn, who is stationed at Hamburg, Germany, describes in a late Consular report the electric street railway system of that city, which is the oldest and most complete in Europe. The road was built by the Hamburger Strasseneisenbahn Gesselischaft, with a capital of 21,000,000 marks, or 4,904,000dol. It is of the overhead trolley type, and operates 500 motor-cars and 400 "smoking-cars," or trailers. On account of the narrow streets, poles were prohibited in many places, and the span-wires supporting the conductors are anchored to the houses. For this accommodation the company paid the houseowners the cost price of the poles avoided, 11dol. 20 cents for a one-wire anchor, and 15dol. for a two-wire anchor. Where poles are used they are neat in appearance, and also serve as electric-light posts. Where the street was too narrow for two tracks only one was laid: but to avoid loss of current a double-contact wire was suspended.

The smoking-cars referred to are simply the old horse-cars utilised as trailers, and about every third trolley-car has one of these trailers attached to it. It should be stated that about ten years ago, and before trolley-cars were thought of, the Hamburg Electricity Works obtained a concession from the State for a monopoly in supplying "electric currents" and appliances on the public highways. While this was intended only to apply to electric lights, it was not so specified, and the railway company had to arrange with the old company accordingly, and the latter enlarged its plant so as to supply the current necessary. The Hamburg Electricity Works pays to the State of Hamburg 20 per cent. of its gross income for the monopoly, and the electric works charges the street railway company 12½ pfennigs, or 2·97½ cents per K-W. hour for electric power furnished. The State of Hamburg refunds to the railway company 20 per cent. of this price, leaving the net cost 2·38 cents per K-W. hour.

As compensation for the use of the streets the railway company pays the State 1 pfennig, or 0·238 of a cent for each passenger carried. As the average fare for each person is 2·74 cents, the State receives 8·7 per cent. of the gross income of the railway company. In addition to this, the railway company must keep up the paving between its rails, and for about 12in. outside of each track. The company is not at liberty to fix its own fares, but must forward passengers according to a tariff fixed by the Board of Public Tariff and approved by the Senate. All lines are divided into zones of 2,000 mètres, or 1·24 miles each; for the first two zones, or 2·48 miles, the fare is 2·38 cents; but for each two zones, or parts thereof, it is 1·19 cents, or 10 and 5 pfennigs in the two cases. The tickets issued differ in colour, according to the zones to be travelled over, and in price they run up to 20 pfennigs, or 4·76 cents, for a six-zone distance. The zones are numbered on the sides of the ticket, and the proper number is torn out by the conductor as a check on the distance paid f... as a check on the honesty or carefulness of the conductor, a "controller" is liable to board the car anywhere and count the passengers, and compare them with the list of tickets sold, which the conductor must fill out at the end of every two zones. If there is a discrepancy, the passengers must show their tickets, and the passenger having no ticket must pay again, whether he says he has or not, and the conductor is fined 1 mark, or 24 cents, for the first offence, 3 marks for the second, and for the third offence he is at once discharged.

A peculiar commutation-ticket system is in operation. As many people use the cars several times a day, these tickets are divided into two classes. The first class entitles the holder to use any one line in both directions as many times as he pleases, including Sundays. The second class of commutation-tickets are good for use on all lines, and as often in a day as required. These tickets are good for three to twelve months, and the price is so low that if the ticket is used three times a day the fare for each trip is less than 1 cent. In addition to this, combination-tickets are issued good for one line and part of another line; the tickets for school children cost only ·95 of a cent per trip.

The trolley-cars seat twenty to twenty-eight persons, and four passengers are allowed on the front and five on the back platform. As soon as every place is taken, however, the conductor lowers a sign of "Besetzt," or "occupied," and no one is allowed to come aboard until room is provided by someone leaving the car. This rule is very strictly enforced, and if the police detect a conductor carrying one more than his quota the conductor is fined 3 marks (72 cents), to be deducted from his wages and paid over to the police board. If the controller detects a surplus of passengers, the conductor is fined the same amount, and the money goes to a charity fund divided once a year among needy employés of the company.

SIMPLE TRICKS WITH COINS.

By Ellis Stanyon.

The Balanced Coins.

NO particular dexterity is necessary to perform the trick I am about to describe, although considerable care must be exercised for its successful execution. In effect it is as follows:—The performer having obtained the loan of three pennies (the trick loses half its effect if other than borrowed coins be used, and even then unless care be taken to satisfy the audience that no change is made) places them in a row, lengthways, on the palm of the left hand, inviting inspection of the coins as they lie. He then, with the thumb and third finger of the right hand, grips the edge of the outermost coins, raising all three into a perpendicular position, one on top of the other.

Having seen the trick performed, many will doubtless try their hands at it forthwith, and much amusement will be caused by their repeated failures. It is quite impossible to obtain the balance without a knowledge of the secret. While writing I call to mind various evening parties where I must have been the means of the sweeper reaping a rich harvest on the following morning.

Well, here is "How it's Done." The trick is performed with the actual borrowed coins, but its success depends upon the introduction of a little accessory which must never meet the eyes of the audience. This is a little strip of thin wood ¼in. wide, and in length about $\frac{1}{16}$in. longer than the combined diameter of the three coins. At the commencement this strip of wood is held concealed in the left hand, being gripped between the base of the thumb and the first joint of the middle finger. The three coins are laid carefully along this strip of wood, in which position they may be viewed by the curious with little chance of the secret being discovered. Now, by gripping the edges of the outermost coins together with the ends of the piece of wood, no difficulty will be found in securing the effect described above.

In conclusion, the coins are again laid carefully in the left hand, then tossed, with apparent carelessness, into the right hand, and forthwith handed to the owner for identification. The stick was, of course, "palmed" in the left hand, as already described, in the act of tossing the coins into the right hand.

Florin v. Penny.

Under this heading I shall give a series of sleights simple of execution, forming a most brilliant piece of sleight of hand. Two particular movements are necessary to bring about the desired results, and these I will first explain.

The Finger Palm. — This consists of secretly holding a coin between the first and second joints of the two middle fingers. The feat must be done with equal facility with either hand. With the coin in this position, the fingers being slightly bent, the palm may be shown without hesitation, which at once gives the impression that the hand is perfectly empty. N.B.—To show the hand with the fingers a trifle bent is much more natural than to stick it out stiff like a board.

The Thumb Palm.—This consists of secretly holding a coin between the first and second joints of the thumb. N.B.—A very little practice will make any person tolerably proficient in either of these sleights, which will be found of general utility in connection with coin tricks. It will also be seen that by a very simple movement, difficult to explain on paper, the coin may be readily transferred from the "thumb" to the "finger" palm.

I shall now pass on to the main part of the trick under consideration.

1. Having palmed a penny in the right hand ("thumb palm"), the performer obtains the loan of a florin, which he takes between the fingers and thumb (horizontally) of the left hand (held palm upwards). While showing the florin in this position, he secretly transfers the penny (in the right hand) from the "thumb" to the "finger" palm. He next announces that by merely stroking the florin a wonderful change will take place, and, suiting the action to the word, he passes the fingers of the right hand over the face of the coin. The thumb of the right hand is very naturally brought under the florin, which at the third or fourth repetition of the movement is palmed after the manner described, the penny being left in its place.

2. The change is made once again, but this time the penny in the left hand, instead of being "thumb" palmed, is allowed to fall to the position of "finger palm" *in the left hand;* this, obviously, for purposes of mis-direction. The palms of both hands should now be shown after the manner explained.

3. The change is made a third time. This time the florin is first openly transferred to the right hand. The left then makes the change, the florin being allowed to fall to the position of "finger palm" *in the right hand.* The palms of both hands should once more be shown to be empty.

4. The penny still held between the fingers and thumb of the right hand is now thrown, visibly, several times into the left hand; at the third or fourth time it is "thumb" palmed, the florin being thrown in its stead. The left hand is, of course, closed immediately the coin reaches it. Now while pulling back the sleeve a little, apparently to show there is no deception in that direction, the penny is quietly dropped into the breast pocket of the coat, and upon the left hand being opened the penny will seem to have changed to the florin.

The above series of sleights have been beautifully arranged under cover of natural movements, each one in order being of a more convincing nature than that immediately preceding it; the last forms a veritable *grand finale*, as the closest investigation of the hands and sleeves fails to disclose the whereabouts of the "trickery" coin.

Electrical Coin Transportation.—This is another excellent trick of the non-apparatus order. In effect it is as follows:—A number of borrowed coins are dropped audibly into a tumbler on the table; the tumbler is then covered with a borrowed handkerchief, and placed on one side of the room. A second tumbler, filled in like manner, is next placed on the opposite side of the room. These arrangements completed, the coins are commanded to leave the tumbler in which they were placed, and to appear in the empty one. The command is instantly obeyed, the handkerchiefs are removed, and the transpositions seem to have actually taken place.

The secret lies in the use of a third tumbler placed in readiness on the *servante* (a little shelf at the rear of the table), immediately behind the one on the table. Having obtained the loan of, say, six pennies, the performer holds them between the tips of the fingers and thumb of the left hand; he then appears to take them in the right hand, but really lets them fall into the palm of the left, which is forthwith lowered behind the rear edge of the table. (This pass, which is known as the "tourniquet," is of frequent use in sleight of hand. The noise of the coins as they fall into the left hand is quite natural under the circumstances.)

Still seeming to hold the coins in the right hand, the performer makes a motion as if placing them in the tumbler on the table, at the same moment he drops them into the tumbler on the *servante*. This movement constitutes a perfect illusion. Immediately after the coins strike the hidden tumbler the performer picks up the one from the table, grasping it for obvious reasons near the bottom, and covers it with the handkerchief. When covering the second tumbler, the performer, under cover of the handkerchief, adroitly changes it for the one on the *servante*, which, it will be remembered, contains the coins.—*Hobbies.*

FACING TOOL.

THE following description of a facing-tool was contributed to the *American Machinist*, by Mr. J. H. Gill, instructor in Machine and Tool Construction, University of Minnesota, Minneapolis:—I inclose a sketch of a tool that, for the work for which it was made, is about the simplest that I ever saw. It was used in our machine shop to face the flange of a 16in. cylinder which had been

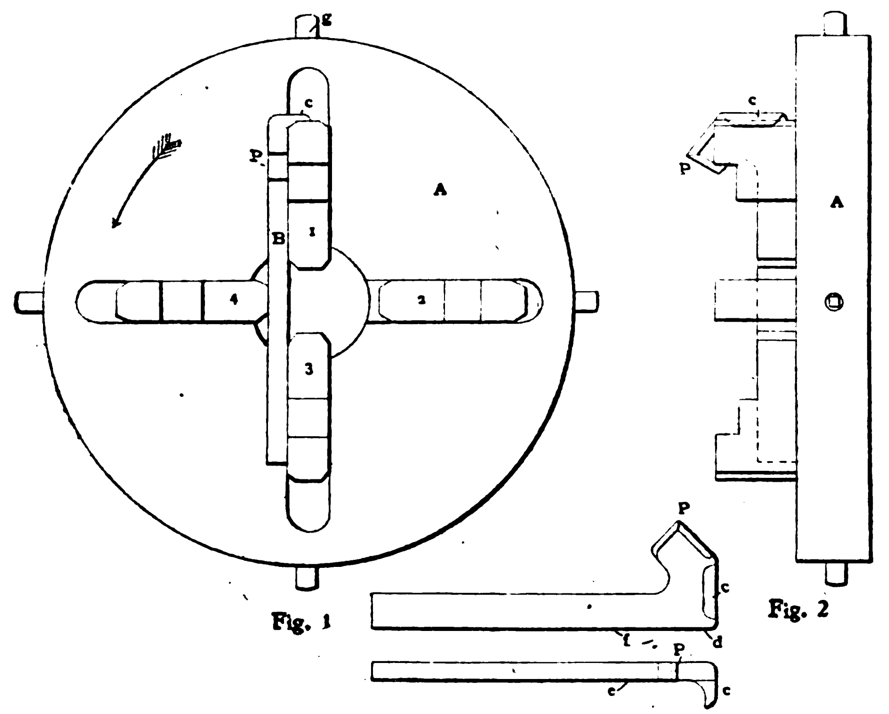


Fig. 1 Fig. 2 Fig. 3

bored with a boring-bar in the usual way. The cylinder only required to be faced on one end. The tool is shown as forged in Fig. 3. The steel (⅝in. by 1¼in. in this case) is bent back on itself, so as to throw the point P back of the heel *d*. The height of P should be a little more than that of the chuck jaw, as seen in Fig. 2. The toe *c* is drawn out and bent over as shown, so as to bear on the end of the chuck jaw. Figs. 1 and 2. The bottom *f* and the side *e*, Fig. 3, should be straight, and also square with each other.

To use the tool, remove the boring-bar and screw the four-jaw independent chuck on the spindle. Place the tool B against the face of the chuck, and also against the jaws 1 and 3, and clamp with jaw 4, Fig. 1. Do not clamp so tightly that the tool cannot slide. Begin at the inside of the flange and feed out by using the chuck-wrench on screw *g* every time it comes round. A star feed could be easily applied, if enough work was to be done to warrant it. Of course, the toe *c* could be on the other end of the tool, and then feed from the outside towards the centre, if desired.

If the tool seats well on the face of the chuck, and bears well on the side of the chuck-jaw, it will be found a very efficient tool, which requires the least fuss to use of anything I have seen for occasional jobs.

PULVERISED FUEL AND SMOKE PREVENTION.

THE attention which is now being directed towards the prevention of smoke in connection with the generation of power by the combustion of coal has awakened renewed interest in the possibilities of pulverised fuel. An exhaustive review of the past and present practice in this branch of engineering appears in a series of articles in the *Schweizerische Bauzeitung*, and in view of the schemes which have recently been discussed, this review is of present value.

Pulverised fuel has been the subject of experiment since 1831, when Henschel, at Cassel, charged air with coal-dust and used it for firing brick-kilns, and for welding and other smithy operations. Nearly 30 years later Pütsch attempted to use coal-dust firing for glass furnaces in England, and in the '70's Crampton made a number of applications of the principle to metallurgical operations.

In America the experiments of McAuley about 1881, and Hathaway in 1886, are well known, and at the present time the experiences of Wegener and others in Germany and elsewhere are attracting considerable attention.

Three fundamental principles are laid down for the successful use of pulverised coal as fuel. (1) The combustion-chamber must be maintained at a high temperature; (2) the powdered fuel must be delivered into the midst of the entering air current, and the intimate admixture of air and fuel delivered into the combustion-chamber in an uninterrupted stream; (3) the particles of coal must be maintained suspended in the air until they are fully consumed.

This last condition is very important, since if the particles fall out of the air current to the bottom of the combustion-chamber, mere coking will take place instead of a complete combustion.

A distinction must be made between powdered fuel and the ordinary coal-dust which is found at every mine. The coal for use in air-blast firing without grates must be finely ground in a mill, so that it will pass a sieve of 900 meshes per square centimètre (0·155sq. in.) and must be entirely free from any larger particles.

The first of the above conditions requires especial consideration in connection with internally-fired boilers, since the proximity of boiler-surface to the burning dust will chill the furnace to an extent sufficient to make the combustion imperfect. In order to avoid this it is necessary to line the furnace with firebrick, which by attaining a high temperature prevents the chilling of the flame, and acts to equalise the temperature. There is no loss of heat by using such a lining, as the firebrick occupies only an intermediate position, and the heat is ultimately transferred to the boiler surface.

The second condition, that of mixing the fuel with air, and feeding the mixture into the combustion space, is the one which must be fulfilled by the construction of the apparatus, and the ingenuity of designers is mainly exerted in this direction.

The third condition is mainly dependent upon the fineness of pulverisation, and it is the cost of grinding the coal to the necessary degree of fineness which usually limits the commercial application of any process.

The Wegener furnace, about which much has been said of late, is an attempt to apply pulverised coal methods similar to those which have been used successfully with low-grade hydrocarbons, and with petroleum refuse, in Russia. In this apparatus the finely-powdered coal is distributed into the incoming air by a revolving sieve, and the mixture is then driven into the combustion-chamber by a steam jet. A firebrick lining permits the high temperature to be maintained, and as this soon becomes white-hot, any slight inequality in the rate of firing does not permit a sudden chilling. The ash which exists in the coal is mostly fused to a liquid slag, which runs out at a tap-hole below, and it is found that there is no greater accumulation of dust in the boiler-flues than occurs with ordinary firing.

A number of tests, conducted with especial regard to smoke-prevention, have been made in Germany, and the details of these do not show any extraordinary evaporative performance, from 8lb. to 9lb. of water per lb. of coal being the average result. The absence of smoke was practically attained in all cases, however, whenever proper precautions were taken to provide sufficient fireclay surface in the combustion-chamber to prevent chilling of the flame. This has been found difficult of accomplishment in the case of water-tube boilers, unless an entirely separate combustion-furnace is constructed, since the presence of the tubes containing water checks the combustion to an extent sufficient to cause smoke to be produced.

The use of pulverised fuel can hardly be recommended on the score of economy, as the evaporation is little if any higher than that obtained by ordinary firing, while at the same time the cost of grinding the coal must be included. When, however, it is imperative that no smoke be produced, it appears that this is one of the various methods by which that desirable result may be attained.—*Engineering Magazine.*

THE MOON AND THE WEATHER.*

A BELIEF that the moon has a potent influence on weather changes is well-nigh universal. The moon's appearance goes through such marked changes each month that it would be very natural to attribute weather changes to these. In this way undoubtedly such sayings as these have arisen:—"The weather won't change till the moon changes," "If the moon lies so that water cannot run out we shall have a drouth," "A wet moon is one upon which a huntsman can hang his horn," &c. Diligent inquiry at one time as to the popular belief regarding this question brought out the view, more persistent than any other, that more rain will occur at the new than at the full moon. Singularly enough, in Connecticut, on Long Island Sound, there does seem to be such a law; but it does not hold in the interior of the country, and a test on the Pacific coast showed, if anything, exactly the opposite. At London, where observations have been made more than a century, a careful computation for the whole period has shown no effect.

If we reflect that the moon is dead and does not have any air, even upon it, that it always shows the same face to the earth, that its changes are simply due to changes in its position as respects the earth and sun, and that its varying appearances are all borrowed, we see how absurd the notion is that the moon does influence our weather. There is, however, another argument that appears quite valid at first sight. If the moon can raise a tide of 60ft. in the ocean, why may it not raise a tremendous tide in the extremely tenuous air, 800 times lighter than water, or a tide of about 48,000ft., and, if so, it seems easy to see that such a commotion would affect our weather enormously. The tide of 60ft. (the highest in the world) is experienced only in the Bay of Fundy and is due to the configuration of the Atlantic coast. In the open Pacific the tide is only a little over one foot. Most careful observations of a lunar atmospheric tide have been made at St. Helena in mid-ocean and have shown a tide a little more than ·001in. Since ordinary weather changes affect the pressure a thousand times as much, we see how extremely insignificant the moon's total effect must be.

There is a common saying, "The full moon has power to drive away clouds," and some computations seem to bear out this idea. If anyone will look to the east as the rising full moon shines through the clouds, he will often see the clouds disappear. There is a natural explanation for this, however, and in no wise dependent upon the moon. A long series of observations have shown a diurnal range in cloudiness with a minimum point or time of least clouds from 6 to 9 p.m.; hence we see that, as the full moon rises and advances in the sky during this period, there will often appear a diminution of clouds. Lord Rosse turned his big reflecting telescope (so big that a tall man walking erect in it could carry a spread umbrella) towards the moon, and found that, if anything, the earth received just a little chilling from the full moon. More recently the bolometer, an instrument which can measure less than one-millionth of a degree of temperature change, has shown that the earth receives a tiny bit of heat from the full moon. The evidence is cumulative and overwhelming that no weather changes can be ascribed to the moon.

Notwithstanding all these facts, repeated attempts have been made to find a supposed effect from the moon on our temperatures. The reasoning is as follows:—If we take the mean temperature for a few days at the time of new and full moon, we would obtain double the effect by subtracting one from the other. The latest effort of this kind has just come to hand, and was made with observations in London and at Blue Hill, Mass. The most remarkable result was that while the full moon seemed to have power to cool the air in London, it had just the reverse effect in this country. In one lunation in this country the full moon was 29° hotter than the new, and in eight lunations, for 88 per cent. of the time, the full moon was markedly warmer than the new. How is it possible to reconcile these extraordinary results with what has been said above? It should be noted that it is absolutely impossible for the moon in one part of its apparent diurnal revolution about the earth to cool the air, and in another part to heat it.

In studying a mass of statistics to obtain a suspected connection between dissimilar phenomena, it is very essential that three principles, at least, be distinctly borne in mind. (1) There should be data enough. "One swallow does not make a summer." (2) It should be possible to show by à priori reasoning how the relationship may exist. By the statistics the ancients were perfectly justified in their teaching that the earth was stationary

* By Prof. H. A. HAZEN, in *Popular Science*, N.Y.

and the whole universe revolved about it. Millions upon millions of such coincidences could not establish the true law. (3) The data must be homogeneous—that is, all sources of modification or variation must first be eliminated before study upon a suspected law or relationship can be begun. Statistics show that more adults die in winter than in summer, and we might conclude, contrary to almost universal testimony, that cold air is inimical to the best health. We find, however, that deaths in winter are due to exposure and not to the cold in itself.

To elucidate these points, let us take the temperature at Boston for 18 lunations, from January, 1898, to June, 1899, and arrange them as was done at Blue Hill—that is, the day of new or full moon shall be the middle of seven days, the mean temperature of which is taken for that lunation; then, subtracting the mean temperature at full moon from that at new, we shall have the figures following. In these a plus sign shows the new moon hotter than the full, and a minus sign the reverse:—

Lunation ..	1	2	3	4	5	6	7	8	9
Difference..	+3	+4	−8	+4	+8	+7	−1	−4	−4
Lunation ..	10	11	12	13	14	15	16	17	18
Difference..	−10	+2	−6	−6	−19	−1	+1	+1	+5

These figures show nine lunations in which new moon was the warmer, and exactly the same number when it was cooler than full. This was to be expected if the moon had no influence on temperature. If, on the other hand, we pick out the eight lunations—namely, from 7 to 14 (the ones used at Blue Hill)—we find that 88 per cent. show the new moon cooler than full. Finally, the greatest difference (−19°) at Boston (−29° at Blue Hill) occurred in February, 1899, and at just the time one of the severest cold waves ever experienced was felt in the eastern United States, and this remarkable cold at the time of new moon was due entirely to this cold wave, and in no manner whatsoever to to the moon. Thousands of statistics of this kind have proved beyond doubt that the moon has no appreciable effect upon terrestrial temperatures.

Just what influence the moon may have upon the electric condition of the atmosphere may be considered in doubt. It is a common belief, on Long Island Sound, that no thunderstorm can come up while the tide ebbs; also there seems good evidence to show that there are more thunderstorms during new than full moon. We may be absolutely certain that the moon has no appreciable effect on any commonly recognised meteorologic element.

DODGES IN ARITHMETIC.

By William Schooling.

THERE are many dodges by means of which calculation may be greatly simplified; some of these have been mentioned in our correspondence columns, and some more may now be given, accompanied by brief explanations.

Some of these dodges only consists in recognising what actually takes place, when the calculation is performed in the ordinary way, and in doing precisely the same thing rapidly instead of slowly. An instance of this may be found in the rule for multiplying two numbers by 11, which, briefly stated, is, "Between the figures write their sum." Thus 52 × 11 = 572; the sum of 5 and 2 is 7, and this number written between the 5 and the 2 gives the answer. If the sum of the two numbers exceeds 9, the unit figure of the sum must be written in the tens place and 1 added to the hundreds: thus, 58 × 11 = 638.

To multiply a number containing any number of figures by 11 it is only necessary to put down the right-hand figure, and then add each figure in turn to the figure immediately on the left of it, being careful to carry over when the addition of any two figures exceeds 9, thus 4,572 × 11 = 50,292; this result is obtained from right to left by first writing down the 2; after which 2 + 7 = 9; then 7 + 5 = 12, put 2 in the hundreds place and carry 1; then 1 + 5 + 4 = 10, put 0 in the thousands place and carry 1; then, finally, 1 + 4 = 5: this is obviously what is done if the sum is done by ordinary multiplication. Thus:—

```
  4572
    11
 -----
  4572
 4572
 -----
 50292
```

When a number has to be multiplied by some multiple of 11 it is very simple to split the multiplier into factors one of which is 11, and having first multiplied by the other factor, then multiply the result by 11 in the way just described: Thus 50,292 × 66 = (50,292 × 6) × 11 = 301,752 × 11 = 3,319,272.

Instantaneous Multiplication.

Another very convenient method of abbreviating work may be employed for multiplying together numbers of two figures each when the tens are the same and the units added together make 10. The rule is to multiply the units together, to obtain the units and tens of the answer, then add 1 to one of the tens, multiply the result by the other ten, and put the product to the left of the first two figures of the answer—thus 72 × 78 = 5,616. This is obtained as follows:—

```
      8 × 2 =  16
(7 + 1) × 7 = 56
             ----
   Answer 5616
```

There is, of course, no need to put down any figures for working out such a result as this, which is obviously the same thing as is done in ordinary multiplication, in which the process is—

```
 8 × 2   =                16
70 × 2 }
70 × 8 } = 70 × 80 =    5600
70 × 70}                ----
                 Answer 5616
```

A somewhat similar method may be employed for multiplying any two numbers that both end in 5. The rule here is to multiply the tens together, add to the result half the sum of the tens, and write 25 to the right of the result—thus, 65 × 45 = 2,925, obtained as follows:—

```
(6 + 4) ÷ 2 + (6 × 4) = 5 + 24 = 29
                          Add    25
                                ----
                       Answer  2925
```

This is only a shorter way of doing what is done by ordinary multiplication, in which the process is—

```
 5 × 5             =    25
60 × 5 } = 50 × 10 =   500
40 × 5 }
60 × 40            =  2400
                      ----
               Answer 2925
```

If the tens added together make an odd number, half the number next smaller than their sum must be odded to the product of the tens, and 75 instead of 25 be written to the right of it. Thus 85 × 35 = 2,975, obtained thus—

```
5 + (8 × 3) = 29
     Add      75
             ----
     Answer 2975
```

A Useful Dodge.

Another dodge of far-reaching utility is the application of the formula $(a + b) \times (a + c) = a(a + b + c) + bc$; thus suppose we want to multiply 402 × 408, we split the figures up so that 400 = a, 2 = b, 8 = c; then we have 400 (400 + 2 + 8) + (2 × 8) = (400 × 410) + (2 × 8) = 164,016.

Such an example as this can easily be worked mentally, and a very little practice enables the rule to be applied very extensively; it will be seen that it is only necessary to choose as the common base, here called "a," some convenient number by which it is easy to multiply, and then to add to one number the difference between the other number and the base; multiply this result by the base, and add the product of the differences between the numbers and the base. Take as another example, 106 × 108 = 11,448; here the base is 100, and we add to the number 106, the difference between the other number and the base; this gives 114, which, multiplied by the base, is 11,400; the product of the differences between the numbers and the base is 8 × 6 = 48, which, added to the previous result, gives 11,448.

The Master and the Schoolboy.

It is equally easy to multiply together two numbers which are less than a common base: the formula is $(a - b) \times (a - c) = a(a - b - c) + bc$. Take, for example, 197 × 192; we split the figures up so that 200 = a, 3 = b, 8 = c; then we have 200 (200 − 3 − 8) + (3 × 8) = (200 × 189) + 24 = 37,824. It will be seen that the rule here is to take the differences between the numbers and the base, subtract their sum from the base, multiply the result by the base, and add the product of the differences between the numbers and the base. An amusing instance of the application of this rule occurred to the writer when he was a little boy at school. Having become familiar with all kinds of dodges in arithmetic he possibly irritated the master by showing off; whereupon the master, thinking to floor him entirely, ordered him to square seven billions minus one. The boy chuckled, for nothing could well be simpler; on the face of it 6,999,999,999,999 × 6,999,999,999,999 looked formidable, but seven billion times seven billions minus seven billion times two with one added at the end was perfectly easy, and almost by the time the words were out of the master's mouth the answer was written down—

48,999,999,999,986,000,000,000,001.

Sad to relate, the answer was not taken seriously. The master considered that the figures were written down at random, and the boy got a licking.

Lightning Calculators.

If anyone wishes to pose as a lightning calculator it is perfectly easy, by attention to a few rules of this kind, to earn a considerable reputation. It should, however, be added that smartness of this kind of thing comes from mere knack and practice, and involves no mathematical ability.

As a final rule we may take the multiplication of two numbers, of which one is above and the other below some convenient base. Here the formula is—

$$(a + b)(a - c) = a(a + b - c) - bc;$$

thus—

$$106 \times 97 = 100(106 - 3) - (6 \times 3) = 10{,}300 - 18 = 10{,}282.$$

Where the two numbers have the same difference from the base, the process is even simpler, since the result is the square of the bas minus the square of the difference, thus—

$$63 \times 57 = 60(63 - 3) - (3 \times 3) = 60^2 - 3^2 = 3{,}591.$$

There are, of course, innumerable other dodges by which calculations may be made very easily and quickly, and anyone who cares to devote a little time to such matters soon finds himself able to see on the spur of the moment some convenient dodge for getting the result of almost any sum that is put before him. The essential thing in rapid calculation is to get out of one's head all notion of rules; and, although rules have been spoken of in this article, it is in no way suggested that the examples here given should be treated as rules of at all the same kind as most of us were plagued with at school. By adherence to rules arithmetic becomes a nuisance, and is a means of hindering calculation rather than helping it.—*Pall Mall Gazette.*

USEFUL AND SCIENTIFIC NOTES.

A useful catalogue of tools and appliances for mechanics, especially for amateurs, has been issued by Messrs. R. Melhuish, Sons, and Co., of Fetter-lane, E.C. It contains illustrations of all sorts of tools, and is more than a mere price list, as it gives directions in many cases as to the best method of using the tools. It is just what many amateurs in the country districts require. There must be very few useful tools which are not illustrated in this catalogue.

The Phenomenon of Pain.—The New York correspondent of the *Lancet* writes: — "Dr. Macdonald, of the United States Bureau of Education, has published the results of experiments in measuring pain by means of a peculiar instrument invented by him, and called a 'temple algometer.' He finds that the sensibility to pain decreases as age increases; the left temple is more sensitive than the right, and in that respect accords with former experiments that the left hand is more sensitive to pain than the right hand. There is reported an increase of obtuseness to pain from ages 10 to 11 years, then a decrease from 11 to 12 years, then an increase from 12 to 13 years; from 13 to 17 years, while the right temple increases in obtuseness to pain, the left temple increases in acuteness. Again, girls in private schools, who are usually of wealthy parents, are much more sensitive to pain than girls in public schools, so that the hardihood which the great majority must experience seems advantageous. University women are more sensitive than washer-women, but no less so than business women."

Platinum Toning.—Under the heading of "Printing Processes," Prof. Valenta contributes a paper to the *Archiv für Wissenschaftliche Photographie*, and in it refers to his experiments with various amines in the preparation of toning baths. Very favourable results were obtained with M-phenyl-endiamine, the formula for which is—

$$C_6H_4 <^{NH_2\ (1)}_{NH_2\ (3)}$$

It is obtained by reduction from m-dinitro-benzole with tin and hydrochloric acid. Although this substance decomposes solutions of gold chloride very quickly, which renders it useless for gold toning, it acts very slowly upon the salts of platinum. A very suitable platinum bath for toning matt papers may be prepared with it, and Brandt and Wilde's Anchor matt celloidin paper has given excellent results. Prof. Valenta recommends the following formula:—Water, 100 parts; potassium chloro-platinite solution (1 : 100), 10 parts; M-phenyl-endiamine solution (1 : 100), 10 parts. The prints should be vigorous, and washed slightly before immersion in the bath. Fix with 10 per cent. hypo. solution, and wash in running water. The tone is an intense black with pure white. If blue-black tones are wanted, the prints, after the first washing, should be slightly toned with a borax bath (water, 100c.c.; borax, 10 grammes; fused acetate of soda, 10 grammes; chloride of gold solution, 40c.c.) They should then be well washed, and toned with the platinum bath. The whites will suffer if the prints are insufficiently washed between the two toning baths.

SCIENTIFIC NEWS.

THE comet (*e*, 1899) announced to have been discovered by M. Giacobini, of Nice, is calculated by Herr J. Möller, of Kiel, to have passed perihelion on Aug. 27, and as it is receding its brightness is little more than half what it was at time of discovery. Its position on Oct. 19, Berlin M.T., was R.A. 16h. 57m. 8s., N. Dec. 0° 46·4'.

The Vienna Academy of Sciences has despatched a strong expedition to India to make observations of the Leonids during Nov. 14-15. The director is Herr Weiss of the Vienna Observatory.

The Lincolnshire County Committee have given their consent to the erection of an observatory in the keep of the old castle at Lincoln. A set of very valuable astronomical instruments has been offered by the executors of the late Canon Cross, of Appleby. The committee promoting the scheme propose to raise the funds for the erection and maintenance of the building by public subscription, and to ask the Lincolnshire County Committee to receive the whole of the property, including the instruments, in trust for the county.

We have occasionally in this country some extraordinary rainstorms; but unless there are some typographical errors in the following note, Boston, Mass., is beaten in record rainfalls only by the stations in India. It is asserted that on Sept. 20 last, the city of Boston, Mass., U.S.A., was visited by a remarkable rainstorm. There are three rain-gauges in the city, separated from two to four miles. They registered respectively 5·21in., 5·40in., and 5·85in., with the following extremes: 5in. in 7h., 4in. in 5h., 3in. in 3h., 2in. in 1h. 40m., and 1in. in 30m. There is probably some error in the reading of the gauges, for an inch of rain means 100 tons per acre.

A meeting was held in Newcastle-on-Tyne last week in support of the scheme for completing the building of the Durham University College of Science, Newcastle, which, it is estimated, will cost £50,000. Earl Grey presided, and said that the Newcastle College of Science stood next to Owens College, Manchester, in point of number of students. The comparison of the cost of work showed that Newcastle averaged £28 per student, as against an average of £51 per student at other colleges in Britain. It was no longer possible to provide accommodation in the existing buildings of the college for the increasing number of students. He appealed to firms on the Tyne, Wear, and Tees to follow the example of Birmingham in contributing from their profits, and hoped that before the year was out £100,000 would be raised. On the motion of Mr. J. W. Spencer, seconded by Alderman W. H. Stephenson, and supported by Sir I. Lowthian Bell, a motion was passed approving the movement to complete the buildings.

The total amount received towards the establishment of the University of Birmingham is £315,400, and at the meeting held recently at Mason University College it was announced that a letter had been received from Mr. Charles Holcroft, of Kingswinford, offering to give £20,000 to the scheme.

At a meeting of the Governors of the University College, Liverpool, it was announced that Mrs. George Holt and her daughter, Miss Emma Holt, had each sent a cheque for £5,000 to be devoted to the purposes of the physical laboratory. These ladies had already subscribed £2,000 to the medical school and £3,000 to the anatomical school.

Lord Farrer, who died last week at the age of eighty, was one of the most distinguished students of economic science the world has known. For many years he was permanent under-secretary to the Board of Trade, which office he resigned in 1866. Three years previous he received a baronetcy, and he was made a peer in 1893. In the early years of the London County Council, Lord Farrer was one of the most prominent and useful members of that body, acting for some years as vice-chairman. Trained as a barrister, he was very precise and clear in his arguments, a trait which was perhaps accentuated by his liking for economic topics. Like Sir Robert Giffen, he took a sanguine view of the future of Free Trade, and was always ready to do battle with anyone who challenged the doctrines of Cobden or the gold standard. His published works include "Free Trade v. Fair Trade," and "Gold Credit v. Prices." He was also the author of a pamphlet on "What is a Bounty," issued quite recently by Messrs. Cassell and Co. His remains were cremated at Woking on Saturday, and the ashes were deposited in the family vault at Brookwood Cemetery.

The death is announced of Dr. Alexander Wallace, of Colchester, in his seventieth year. He was born in Guilford-street, Russell-square, and practised in Colchester as a consulting physician. He was well known as an accomplished botanist and entomologist, and for his work in connection with the silkworm culture (sériciculture). The firm of Wallace and Co. introduced many novelties in lilies, &c., from Japan, Colorado, California, &c., and he was an authority in the horticultural world on the plants which he made his hobby. He wrote several works on his favourite subjects, and probably no one knew more about the plants of Japan than he did.

Dr. Oscar Baumann, who for a number of years held the position of Austro-Hungarian Consul at Zanzibar, and had acquired reputation as an African explorer, is dead in his thirty-fifth year. In 1885 Dr. Baumann, who was a native of Vienna, joined the Austrian Congo expedition, subsequently visiting the island of Fernando Po, the Cameroons, and parts of East Africa. Other expeditions followed, in one of which he fell into the hands of hostile Arabs, and was only released on the payment of a ransom. He was intrusted with the command of an expedition fitted out in 1889 by a German anti-slavery association. In the following year he explored the Usambara, and made preliminary observations for the purpose of tracing a projected railway in that region. In addition to a map of the Congo and numerous contributions to the reports of the Geographical Society of Vienna, Dr. Baumann published three books dealing with his travels and observations in Fernando Po and Usambara, and with the rising in German East Africa. He is credited with the discovery of the real source of the Nile—that is, the Kagera Nile—which, flowing from the Mountains of the Moon, is the largest feeder of the Lake Victoria Nyanza. He discovered the sources of that river in August, 1891.

Chief Justice C. P. Daly, who took much interest in geography and botany, is reported dead at the age of eighty-four. He was president of the American Geographical Society for thirty-six years.

The death is reported of Mr. Hamilton Y. Castner, from the Adirondacks, New York State. Mr. Castner, who was an American citizen, came over to this country about twelve years ago to work his patented process of producing sodium, which enabled aluminium to be produced at a comparatively low price. Perhaps the more important work accomplished by Mr. Castner was the establishment on a manufacturing scale of a process for the electrolytic production of alkali and bleaching-powder from common salt. This discovery of a practical and economic method of applying electricity to the decomposition of common salt is of the highest commercial importance, and Castner's process bids fair to eclipse altogether the purely chemical reactions by which hitherto these two products, so essential to the well-being of modern society, have been obtained. Mr. Castner was also the inventor of a cheap process of making cyanide, which is largely used for the extraction of gold in S. Africa. He was about forty-three years of age.

Vice-Admiral Philip Howard Colomb died on Friday, in his 68th year. He was not only an able commander of a fleet, but did perhaps more than anyone to introduce scientific principles into the work of the navy. He invented the system of "flashing" signals which is now used in all the navies of the world, and was the most distinguished naval critic (from the scientific side) that the century has produced.

Mr. William Ellis Metford, who died on Saturday, was the son of a Somersetshire doctor, began his career as a civil engineer, and was for many years on the staff associated with the late Mr. I. K. Brunel. In 1856 he went out to India to take up an appointment on the East Indian Railway; but his hobby was rifle-shooting, and when he returned to this country he devoted himself to the improvement of the rifle. Experimenting with the old match-rifle and smaller-bored weapons, he brought our military weapon almost up to its present pitch of perfection. Enfield has put on the finishing touch, but Mr. Metford was the discoverer of the essential principle—that of shallow grooves. "It is one of the first essentials in a rifle," writes Major the Hon. T. E. Fremantle, "that the bullet should fill the bore entirely as it passes up it, so that there may be no leakage whatever of the powder gases past it. It was Mr. Metford who discovered that this result could be obtained with much more ease and certainty by using a bullet of hardened lead and keeping the grooves quite shallow; and his method, which had other advantages. . . brought about a revolution in the practice of rifle-makers." Bullets, indeed, were a favourite study of his, and he was the true inventor of the Pritchett bullet. He was an advocate also of the increasing spiral, which, says Major Fremantle, is the only really scientific system, although the practical results following from it are not sufficient to make up for sundry little inconveniences to which it leads. Mr. Metford, like Sir H. Halford, was a highly-skilled mechanic.

The Council of the Institution of Mechanical Engineers will hold monthly general meetings during the session in the Institution House, Storey's Gate, St. James's Park, commencing with the ordinary general meeting on Friday evening, Oct. 27, when the chair will be taken at eight o'clock by the President, Sir William H. White, and the following papers will be read:—"The Incrustation of Pipes at Torquay Waterworks," by Mr. William Ingham, member; and, if time allows, a contribution by Prof. William Ripper, on "A Continuous Mean-Pressure Indicator for Steam-Engines." The dates of the other meetings are Nov. 24, Dec. 8, Jan. 26, annual general meeting Feb. 22, March 22, April 26. The annual dinner will be held on April 25. The graduates' opening meeting will be held on Oct. 30, and continued on the second Monday in each month.

An electrical omnibus with some novel features has recently been put on the streets of Berlin. It carries twenty-one persons, and weighs, with batteries and passengers, 6½ tons, of which the accumulators only weigh 1½ ton. Two motors are used on each axle, making four in all. These are so arranged that the wheels are driven independently. The motors drive by means of single-reduction gearing, with a ratio of 1 to 7·5 on the front wheels, and 1 to 8 on the back. The regulation is effected by means of series-parallel controllers in the usual way. The most important feature of the omnibus, perhaps, is its provision with a collecting bow so that a charge of electricity can be taken from the overhead wires of the tramway company.

According to a news par from America, Signor Marconi's work in connection with the yacht race has had an interesting development. It is stated that he has discovered that wireless telegraphy is facilitated by fog.

With reference to the establishment of sanatoria for the treatment of pulmonary diseases, the council of the National Association for the Prevention of Consumption has passed the following resolution:—"Having understood that apprehension is entertained as to the spread of consumption from sanatoria established for the treatment of this disease, the council desire to express their opinion that there is no danger of communication from any well-conducted hospital for consumption, or from any sanatorium where the open-air treatment for this disease is properly carried out; and, further, that the inhabitants of houses in the immediate neighbourhood of such institutions are perfectly safe from local propagation from this source."

It is stated that the Indian Government has under its consideration a somewhat comprehensive scheme for the establishment of research laboratories in various parts of India, and the appointment of health officers to the charge of them. The present laboratory at Muktesar will, it is understood, be further developed and the staff increased, the establishment becoming the central research laboratory for India, and health officers will be appointed to the charge of laboratories at Calcutta, Madras, Bombay, Agra, and Lahore, the new department of bacteriology manned by officers of the Indian Medical Service.

It is reported that numerous earthquakes have occurred recently in the vicinity of Lake Taupo, North New Zealand—almost daily.

Prof. Riccò has contributed a summary of the seismological report of the commission appointed

by the Italian Government to inquire into earthquakes to the *Rendiconti* of the Accademia dei Lincei. Prof. Riccò states that the earthquake of 1894 may be regarded as an after-shock of the great earthquake of 1783.

According to the American papers, Capt. Watkins has given an explanation of how the *Paris* got on the rocks off the Cornish coast in May last. It appears that one officer entered in the book that Cape La Hogue had been passed at 6.38 p.m., and another officer had recorded the passing of the Casquet Light at 7.35 p.m. The second officer wrote a much bolder hand than the first, and when Capt. Watkins entered the chart room to make his calculations for the run to the Lizard the dim light caused him to misread the 7.35 as the time of passing La Hogue. That mistake put him 18 miles out in his reckoning and sent the ship ashore.

At St. Helen's a glass manufactory has been started in which the old system of blowing is replaced by an automatic arrangement of moulds and blowpipes worked by compressed air. It is said to be capable of turning out 5,000 tumblers a day, lamp chimneys at the rate of 3,000 and 4,000 per day, and larger articles in proportion. Under the old conditions a gang would turn out only about 400 tumblers a day, against 5,000 by the machine process.

Seeing by Wire.—Out of Poland comes the realisation of that dream of inventors, a device for seeing at a distance, for transmitting vision over wires. Jan Szczepanik (pronounced Shtépanik) finds himself to-day, after starving and struggling through many vicissitudes, lifted from the obscurity of a Galician schoolhouse to a fine eminence, with scientists envying him, news-gatherers pursuing him, and capitalists tendering him millions—all at the age of twenty-seven. Almost as far back as he can remember Szczepanik had it in mind to invent a machine for seeing at a distance. Thus, on leaving the school at Crackow, where his aunt had placed him, he told a certain dark-eyed sweetheart, in all seriousness, that it was his intention to invent a machine which would allow him to behold her fair face however distant she might be. The "distance-seer" or "electroscope" is beautifully simple in its underlying principle. It depends on this familiar fact: that any vision or image produced on the retina of the eye is only the blending together of an infinite number of points projected separately from the object, seen by separate rays of light. For instance, when we see a man or a house we really receive in the eye perhaps a million, perhaps ten million, distinct pictures of distinct points on the surface of that man or house. Szczepanik has found a way of separating any image that may be formed, by an ordinary photographic lens, into its component luminous points, of transmitting these points separately, but with enormous rapidity, over wires, and of letting the eye reconstitute them at the other end into the original picture.—*Pearson's.*

Crustaceans for Curative Purposes.—The Rev. Thos. R. R. Stebbing, F.R.S., contributes to the October number of *Knowledge* another of his sparkling articles on the "World of Crustacea." Referring to the Pill-Millipeds, he says:—"In the latter genus the animal faces danger by rolling itself up into a ball. Here, then, was a little shining pill, evidently moulded by Nature for curative purposes. Modern human prejudice rejects the useless remedy with disgust, whereas the better-informed barndoor fowl eats this small game with avidity, not as a medicine, but as a substitute for the unattainable lobster. The Amphipoda have won rather more appreciation as food for man. Thus Risso, in 1826, describing the curious *Phrosina semilunata*, remarks of it that the flesh is tender and well-tasted, and that it might well supply a dish to those who dwell on the shores of the Mediterranean, where it occurs in abundance. Risso does not say that either he himself or anyone else ever had such a dish; but, for all that, an English author subsequently cites him as affirming that 'these crustacea are eaten as a luxury, and, moreover, serve as an article of food to the inhabitants on the shores of the Mediterranean.' It would be a tempting improvement to declare that those inhabitants never eat anything else. It is more to the purpose to repeat the Prince of Monaco's recommendation to the shipwrecked not to neglect the species of Hyperia, which may be obtained from jelly-fishes in the open sea. That the great amphipods, which abound in Arctic waters, would pleasantly satisfy man's appetite on an emergency can scarcely be doubted. The indiscriminating seal swallows them whole, as we know by specimens recovered in good condition from the seal's stomach. The amphipods, in revenge, if they meet with a dead seal, make short work of its carcase—a devouring crowd compelled by the nature of their jaws to savour and enjoy every morsel of the much-divided feast."

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no moe than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

DR. LEWIS SWIFT—STELLAR PARALLAX—ABSOLUTE ZERO OF TEMPERATURE — VISIBILITY OF DISTANT OBJECTS AND THE VAGARIES OF REFRACTION—AN IMPOSSIBLE DIAL —LIGHT IN AN OBSERVATORY— EQUATORIAL ADJUSTMENT— HERTZIAN WAVES — WIRES FOR FINDER — A "GHOSTLY" PHOTOGRAPH — THE GREAT GLOBE AT SWANAGE: THANKS — PAPERS IN THE "PROCEEDINGS" OF THE ROYAL ASTRONOMICAL SOCIETY— BICYCLES AND PERAMBULATORS— LIGHTING THE WIRES OF A TRANSIT INSTRUMENT—THE COMES TO ALDEBARAN — CRATERLETS NEAR TIMOCHARIS.

[42928.]—Astronomers will, I feel convinced, learn with real regret that that veteran observer Dr. Lewis Swift has been compelled practically to relinquish his so-long-continued and valuable work in the discovery of nebulæ and comets, owing to failing eyesight. It is only the other day that I was commenting, half-jocularly, on the number of medals which had been won by the indefatigable head of the Lowe Observatory (letter 42776, p. 88), and now comes the melancholy news that the original discoverer of so many of those celestial objects, to which his observations and attention have been chiefly devoted, will have to bring his protracted researches to a practical end. The proprietor of the Echo Mountain Observatory will be fortunate indeed if he succeeds in finding a worthy successor to the man who has so enriched our knowledge of the more mysterious constituents of the bodies studding the celestial vault.

In an attempt to make a fresh determination of the parallax of 61 Cygni, Dr. Schur, of Göttingen (*Astronomische Nachrichten* No. 3590), during the years 1897, 1898, and 1899 selected four comparison stars, which for our present purpose may be called *a*, *b*, *c*, and *d*, and, on reducing his results, discovered that while *c* and *d* remained sensibly at the same distance from each other, an annual parallactic displacement was visible between *a* and *b*, whence he deduced the parallax of *a* as being = 0·6″, the probable parallax of 61 Cygni itself being, it will be remembered, only some 0·40″ to 0·45″. Prof. Schur intends to reinvestigate the parallax of this star *a*. It will be situated approximately on January 1900 00 in R.A. 20h. 55m. 14s. and in 38° 9′ 28″ North Declination.

The question put by "F. J. G." in letter 42903 (p. 185) is not a very easy one to answer. Everyone must feel, with your correspondent, the difficulty of conceiving what I perhaps may call an abstract zero of temperature; just as it seems impossible to imagine that space can be otherwise than infinite. But, as far as we know, the physical constitution of liquids and gases would be so wholly changed at the temperature of − 461° Fahrenheit, that no comparison could be instituted between the existing condition of things and that which would then obtain; so that anything like a conception of *differential* temperature then would seem impossible. I am no merely blind follower of all Lord Kelvin's hypotheses; but I think that in this particular case his reasoning is sound. Of course, though, we do not know what might happen when we began to approach his theoretical zero.

I should like to say, in connection with reply 96601 on p. 187, that Mr. Garbett considerably underestimates the height of Beachy Head, which is, in reality, 575ft., while the distance from there to Boulogne in a straight line differs but little from 59 miles. Taking the average amount of refraction, then, from Beachy Head to the visible horizon would be 32·83 miles, and from that point to Boulogne 16·77 miles, in all 49·6 miles—a considerable departure from the theoretical distance. But every observer must be familiar with the pranks played by abnormal refraction. Most people must remember Dr. Vince's account of his observation on August 6, 1806, when, at 7 o'clock in the evening, he saw Dover Castle apparently brought over on to the Ramsgate side of the Deal promontory, and, as he adds, the image was so strong that the hill could not be seen through it! So again, more recently (i.e., on May 10, 1868), the dome of the Cathedral at Boulogne and Napoleon's Pillar could be discerned from the Crescent Walk at Dover with the naked eye, while, with an ordinary telescope, the entrance to the port, the lighthouse, the shipping, the surrounding houses, the valley on the hillside of Capecure, and the little fishing village of Portel were all distinctly visible; while, on the eastern side, all the landscape, the lighthouse on Cape Grisnez, and the adjacent windmill, &c., stood out with extraordinary clearness. Meanwhile a locomotive was seen to leave Boulogne and travel towards Calais, the puffs of steam enabling its course to be followed. In connection with refraction, by the bye, the *Comptes Rendus* for July 31 contains an account of a series of investigations and experiments on the displacement of the horizon by refraction, made by M. Forel at the surface of Lake Léman (the Lake of Geneva). The position of the horizon was determined by observations directly and by reflection, and M. Forel found that the angular distance between the true and apparent horizon varied from + 501″ to − 272″, or a total variation of 12′ 53″, a very notable quantity indeed in calculating the Dip, or the like.

Seeing that all that a dial can indicate is the angular distance of the sun (or moon) east or west of the Meridian, "Achernar" (query 96789, p. 192) is making a senseless request even as far as sunrise and sunset are concerned, and *a fortiori*, one impossible to answer in connection with a body whose R.A. and Declination change so rapidly as do those of the moon.

"Oculus" (query 96802, p. 192) should only use one thickness of red silk over the bull's-eye of his lantern. This is what I do when observing delicate objects, and I never have the slightest difficulty in reading books or tables with it.

I am afraid that the next query (96803) put by the same correspondent is unanswerable without a personal inspection of his instrument. There must be an extraordinary and inexplicable amount of unequal wear of the ends of the declination axis to produce an error of 3′ or 4′.

I would recommend to "H. B." (query 96804, p. 192) the same book I advised "Curious" to obtain (in letter 42838) on p. 134—viz., "Light, Visible and Invisible," by Silvanus Thompson, published by Macmillans. It contains an excellent rudimentary account of Hertz's experiments, and will serve as an introduction to the work recommended on p. 213 by Mr. Bottone.

Mr. MacLachlan (query 96810, p. 193) will find fine wire the best material to employ for the cross-wires of his finder. Spider-lines, hairs, &c., are much too fine, and are wholly invisible save on a very bright moonlight night. A tiny drop of solder will fix them to the brass ring.

The Editor of the English Mechanic has very kindly forwarded to me four curious photographs taken by a gentleman named Panton at Levant. They appear at first sight to be ill-defined pictures of the seated statue of a female; but I am informed that they were taken from an image thrown on a blind by the sun's rays passing through a distorting pane of glass, such distortion being caused by a curved line in it of the kind often seen in the old-fashioned blown window-glass. Mr. Panton is under the impression that this may throw some light upon, or possibly help to explain, the very astonishing photograph of the "ghost" of a deceased peer which was so fully discussed in your LXVIIIth volume; but, while thanking him for the suggestion, it seems to me that the totally different circumstances under which the two apparitions became visible form a very serious barrier to the institution of any comparison between them. All the same, the illusion in the case of your correspondent's photographs is a very remarkable one.

Let me thank Mr. Carr-Greg (letter 42921, p. 210) for the information he kindly gives with reference to the Great Globe at Swanage. Since I asked for details concerning it, an old friend and ex-President of the Leeds Astronomical Society has furnished me with particulars concerning this curious and valuable monument. It is just one of those things that appeal to the unlettered man in a vivid fashion, and tend to establish the truth of Horace's dictum that: "Segnius irritant animos demissa per aurem, quam quæ sunt oculis subjecta fidelibus."

If Mr. Wood (letter 42924, p. 211) takes any interest in the papers, contributed to the Royal Astronomical Society, but imagines that they are subjected to no criticism, he is curiously mistaken, and I strongly advise him forthwith to subscribe to the *Observatory*, which gives a monthly detailed report of the society's meetings, and of the discussions which ensue there on the papers read before them. To suppose that the *printed* dicta are "never challenged by the members" is an entire mistake; but, of course, none of the oral criticisms and comments ever appear in the *Monthly Notices*, so that unless any

Fellow sets himself to combat views advanced in one paper by a formal reply in another, the outside public knows, and can know, nothing of what the opinion of either a majority or minority of the Fellows really is on the original thesis.

"Rota" (reply 96759, p. 212) may read with advantage 5 and 6 William IV. c. 50 sec. 72, the Local Government Act, 1888, sec. 85; the Towns Police Clauses Act, and the by-laws framed by the county council of the locality in which he is resident. A perambulator is a wheeled carriage, just as much or as little as a Bath-chair or a bicycle, and if the police proved before me that a perambulator obstructed the pavement in the very smallest degree, I should convict without any hesitation whatever. In strict law the road is the place for perambulators, and not the pavement at all. I must repeat that the police wink at the presence of perambulators on the footpath, but that does not make the practice any more *legal*.

I suspect that the lantern employed by "R. A." (query 96834, p. 214) gives but a very feeble light, because a proper one should afford ample illumination through a hole ⅜in. in diameter in the transit axis. Is there a lens (as there should be) covering the aperture in the pivot? If other means fail, a little disc of bright tin about the size of a threepenny-piece might be soldered on to a wire and placed at an angle of 45° in front of the object-glass. This might be lighted from the side, so that the light would be transmitted by the objective simultaneously with that from the star. By the bye, I suppose that the diagonal reflector in the middle of the telescope tube is all right, and that its reflecting surface is intact?

In reply to query 96860 (p. 215), I can find no measurement or estimation of the magnitude of the *comes* to Aldebaran later than that given in the last edition (1894) of Webb's "Celestial Objects," where it is described as being of the 11·2 mag. This *ought* to be glimpsed without difficulty with 3in., or even 2¾in. of aperture, on a moonless night—if Aldebaran itself were hidden. The distance of the twin star in 1877·9 was, according to Burnham, 113·9″. As α Tauri itself has considerable proper motion, this distance is increasing. I have not myself measured this star for x years, and it is for obvious reasons not very favourably placed at this time of year.

In redemption of the promise I made to "R. P." (in letter 42896, p. 184), I examined the lunar formation Timocharis on the night of the 13th inst. The sun was rather more than sufficiently high upon it; but I saw, of course, without the slightest difficulty, the small crater to the N.W. which both Elger and Neison describe and figure, and a corresponding one at nearly double the distance to the S.E. of it. Nothing whatever, though, was discernible in the shape of a craterlet either due W. or S.W. of Timocharis. Is "R. P.'s" lantern-slide properly orientated?

A Fellow of the Royal Astronomical Society.

ON THE OBSERVATION OF THE INTERIOR PLANETS, WHEN NEAR SUPERIOR CONJUNCTION, WITH COMMON TELESCOPES.

[42929.]—It is usual for telescopic observers to regard the period of superior conjunction as a sort of close time for Mercury and Venus. At, or near, this time it is taken for granted that even equatorially-mounted instruments cannot be used to any good purpose, and that instruments not so mounted cannot be used at all.

Now I think that this diversion of telescopic endeavour from the study of these planets during this period is too absolute, and that perhaps more might be attempted with advantage. And, first, as to the possible value of observations made about the time of superior conjunction.

Apart from the consideration, which, perhaps, may be more curious than practical, that these planets when seen (as with good instruments they may be) within a degree or two of the sun's limb, are shining through the corona, and may possibly have something to teach us about it, there is an important practical fact. Schiaparelli has obtained his best views of Mercury when that planet has been near to superior conjunction. "The defect in diameter," he remarks, "is compensated by the possibility of seeing nearly all the disc, which, under these circumstances, is more strongly illuminated."

Moreover, the observation of the interior planets at the time of superior conjunction need not be left entirely to the users of equatorials. The recent occurrence of a superior conjunction may even be regarded as a blessing in disguise for the telescopist who wishes to pick up Mercury or Venus in the daytime with an altazimuth-mounted instrument. The method by which this end may be sometimes accomplished shortly after superior conjunction might be called "the method of the trap," since it simply consists in setting an optical pitfall in the path of a planet. It requires no apparatus but a clock or watch. It is suitable to any kind of telescope, and requires neither circles nor a meridian landmark. In my own case the instrument used is an achromatic of 2$\frac{1}{10}$in. aperture on the ordinary tripod table stand, and it is used from the window-ledge of a top window in a town house overlooking neighbouring chimneys. The only requisites for success are (1) a telescope which will remain pointed where it is placed without the tube dropping down, as it generally does in cheap telescopes; (2) a clear sky—the deep blue line between solid-looking cumulus cloud is good; (3) a declination in the case of the planet not very widely differing from that of the sun. Nothing more is needed but to be handy in managing the telescope, to have care and patience, and a little good luck. *Experto crede.*

On September 28 a study of the *Companion to the Observatory* and of a celestial globe showed that Venus was 13 days past superior conjunction, that she was within about 4° of the sun, and that her diameter was almost at its minimum figure, being only 9·8″. Her declination, however, was nearly the same as that of the sun, and she followed him with a difference in R.A. of nearly 15 minutes. A view was obtained of her as follows.

At about 2 p.m. the telescope, armed with a power of about 20, having a field of 1½°, was directed at the sun, and, a dark glass being held before the eye, was carefully focussed on a group of small spots. The sun having been placed in the centre of the field, the telescope was left for nearly a quarter of an hour. The field was then examined; but, as was expected, was too bright. Re-examined with a light screen-glass, it showed nothing. A power of 40, having a field of about 45′, was now substituted, and the group of spots again used to secure an accurate focus. The eyepiece was provided with a light green screen-glass, the sun brought to the centre, and the instrument again left for 15m.

This time, on returning to the telescope, the tiny pearl-white disc of Venus was immediately detected in the middle of the field. It was now found that the planet could be seen without difficulty when the screen-glass was removed, but the sky background was unpleasantly bright.

In the use of this method it is very important to have the telescope accurately focussed beforehand, so that the object of search may stand out sharply and catch the eye. A blurred or diffused image is easily passed over in a bright field. Also, although a large field has an obvious advantage in grasp of space, its advantages are much diminished by the small image which it gives, which, when faint and seen on a bright background, is easily overlooked. With Venus as she is at present, a power of 40 with a field of 45′ seems to answer better with 2$\frac{1}{10}$in. object-glass than a power of 20 with a field twice as big.

Even when the declination of the planet differs from that of the sun more than it did on Sept. 28, the same method of search may be successfully employed. Note carefully the direction taken by the sun in passing across the field of the finder (do not forget to hold a dark glass before the eye), focus carefully, put the sun in the centre of the field of the finder, then move the telescope in the direction required along a line at right angles to that taken by the sun. The extent of the movement is estimated by the known diameter of the sun's disc, and by that of the field of view of the finder.

For example, on October 8 the declination of Venus was 1° 16′ more S. than that of the sun, and the difference in R.A. was about 23m. The sun was allowed to traverse the field of the finder to give the direction of a declination parallel. It was then placed on the centre of the cross-wires, and the telescope moved at right angles to that direction till the sun's limb was at the margin of the field. The semidiameter of the field of the telescope being 90′, this was equivalent to a shift of 1° 16′ (very nearly). On looking into the telescope after the proper lapse of time, the planet was found to be in the field. On October 9 Venus was again found by the same method. When examined with powers of 65 and 80, "the uninteresting little disc," as the writer of your excellent "Astronomical Notes for October" severely calls it, appeared to be not quite circular, but, of course, showed no other detail, though definition on October 8 was very sharp.

I have not hitherto succeeded in picking up Mercury in the same way, although I have tried several times. With a diameter of disc only about half that of Venus at present, and with an albedo which is only about one-fourth that of Venus, he is probably beyond my small optical equipment. I hope that others may be encouraged to give a trial to this method, which, I think, deserves to be better known among amateur telescopists than it is at present. **R. J. Ryle, M.D.**

15, German-place, Brighton.

LUNAR RAINBOW.

[42930.]—About 9h. 5m. this evening, as I was beginning observations of variable stars, I was rather suddenly surprised by some raindrops pattering on the telescope. On going out to close the roof of my little observatory, I at once saw a very pretty lunar rainbow in the N.E. quarter of the sky. It was sharp and well defined, but colourless, or nearly so. It was projected on a nearly clear sky, in which the stars were shining. Altitude about 1° or 2° less than that of Capella at the time, and the line joining the ends of the arc on the horizon must have subtended approximately a right angle—altogether a very pretty sight. It only lasted about two minutes.

At 9h. 25m. ± rain clouds came up, the moon was for a few moments hidden behind a passing small cloud, and as soon as she shone forth the bow again appeared; this time not complete. The end nearest the north was most perfect. It was projected on a dark background of cloud now, and looked quite brilliant for a few moments or so. It might have been some curved beam of electric light (if that were possible) or the curved tail of some great comet bending up from the horizon. The other end of the bow towards the east was not so distinct; this time I should say it lasted some five minutes.

I suppose the phenomenon has been seen and noted hundreds of times and by hundreds of observers, so, on principle, I record my sight of it; the more so, as it is the first time I have ever had the good fortune to witness the delicate beauty of the ghostly-looking bow so exquisitely symmetrical in shape, and as I saw it under such favourable circumstances, albeit I did get my overcoat a little damp over the observation.

The moon was just past her first quarter, and shining serenely in a clear part of the S.W. sky, somewhat low down.

E. E. Markwick, Colonel.

H.M. Gun Wharf, Devonport, Oct. 12, 1899.

[42931.]—It may be worth while to record that two lunar rainbows were observed here this evening between 6.30 and 7 o'clock. A stormy afternoon was followed by a clear evening, with brilliant moon shining over the sea. At 6.30 a few heavy rain clouds blew up from over the land, and the rainbow was projected right across these in a perfect arc, followed after a short interval by another, but less perfect, one as fresh clouds came up over the horizon. The wind was about N.W., rather fresh. No colour was observed but a perfectly distinct white arc. Directly overhead the stars were shining, but a shower fell shortly after. **Ch. Mallett.**

Lower Penn, Otterton, South Devon, Oct. 12.

ε LYRÆ.

[42932.]—Those of your readers who are interested in the group of ε Lyræ, will find a fine sketch of the same in the "E. M.," No. 603, p. 117, with a very interesting and exhaustive letter by Mr. Albert P. Holden. **C. M. Gaudibert.**

Vaison 1, Vaucluse, Oct. 14.

METEORS AND THUNDERSTORMS.

[42933.]—In my letter (49211) I made a slip as to the rate of approach of meteors. But let us make it 5,000,000 of miles per day, and the conclusion will be the same if these bodies are of the very small dimensions usually assigned to them. Moreover, a meteor may strike us on the return from perihelion as well as on its approach to it—in which case it has been exposed to more intense solar heat before the collision than we have. Why, then, should it be cold when it enters the atmosphere?

As regards thunderstorms, I think, when they pass overhead, they should take as long to recede as to approach; nor do I see the necessity for a change in the direction of the wind at the surface at the moment that the thunderstorm passes overhead. What occurred to me was that the thunderstorm might arise (at least, in part) from the electricity developed by the friction of two masses of air moving in opposite directions—the long roll of the thunder indicating the travelling of the electric disturbance along the region of friction. With regard to this roll of the thunder, I heard a perfect reproduction of it during the blasting operations for the extension of the Dingwall and Strome Ferry line some two or three years ago. At the first instant the sound of the explosion was not like that of thunder; but afterwards the resemblance was perfect. At Strome Ferry it was no doubt the reverberation of the explosion among the surrounding hills. Is there any similar reverberation in the case of ordinary thunder?

I have not a copy of Kaenitz's Meteorology at hand, but I think he saw reflected lightning in the sky at distances exceeding 200 miles. The conditions of this reflected (or heat, sometimes called sheet) lightning require further investigation.

Since writing the above I met with a copy of the *Glasgow Weekly Herald* of Oct. 7, which enabled me to trace part of the track of the thunderstorm which visited Dublin on Sept. 30 (in the afternoon). At Fraserburgh it commenced about four o'clock on the morning of the 29th, and was very violent from six o'clock to 9 o'clock, after which hour it died away. At Forfar the sky became overcast in the S.E. about two o'clock in the afternoon, and the storm reached its height about half-past four. At Kinross the period is given at 4 p.m. to 10 p.m. At Perth a church was struck apparently after dark, for the report speaks of the mischief having been

discovered in the morning. I should be glad of any further information on the subject. It is curious that the sky at Forfar should have become overcast in the S.E., as the storm was evidently coming from the N.E. W. H. S. Monck.

METEOR.

[42934.]—A very vivid meteor was seen in Lancaster on Friday, Oct. 13, at 5.17 a.m. G.M.T., by Mr. P. Mulligan, of Mill-street Dry Dock. By his account it lasted between two and three seconds, and passed across the sky with an illumination sufficient to throw deep shadows. The colour was of a vivid green, and it left a distinct trail in its course. The radiant point was a little south and preceding ψ^1 Orionis, and the vanishing point was 28° south-west of the astronomical South.

You may probably obtain notifications of this meteor from other sources, or they may be elicited by this letter. John Bone, F.R.A.S.

St. Thomas Vicarage, Lancaster.

[42935.]—The meteor mentioned in your last issue (42912-3) was seen here on Sunday week (the 8th inst.), rising almost from the horizon about half a point W. of S.W., passing overhead, and disappearing almost on the horizon about N.E.

Scayne Hill, Hayward's Heath. L. B. B.

ROTARY ENGINES.

[42936.]—The Toennes rotary engine, illustrated and described on p. 202, seems to differ little in principle from many that have gone before. The question is, Will it work economically? An economical steam rotary engine (not a turbine) is now wanted for motor cars. Is there any place where they can be seen and tested? B. L. Smith.

IMPROVEMENTS IN ROTARY ENGINES.

[42937.]—"W. D. G." (letter 42925) asks for some amplification of the few notes in my earlier letter. I give these with pleasure; but they are from memory only, for I have but little print relating to those early days. I well remember that Mr. Wimshurst used to go to Messrs. Silverlock and Co., printers, of Waterloo Bridge-road. Perhaps they may be able to help him; but the experiments began about 1840, and not the "fifties," as he supposes.

First, then, the Brynton engine was difficult to keep tight: the packings at the angles of the piston, and at the shaft, gave trouble; then the top packing, which rubs on the internal drum, becomes really a friction brake.

These same faults exist in the second rotary, which has the four pistons. Moreover, considerable friction occurs by reason of the pistons *sliding* through the internal drum.

The engine with six pistons had an improved shape to the piston-ends, and improved packing. Moreover, the pressure on the pistons was carried upon anti-friction rollers, and having so many pistons there was no packing fitted to rub on the internal drum. This engine, when completed by the Butterly Co., was first tested by a 10ft. diameter wheel keyed to the shaft, and a lever brake; this would not scotch it. Next it was placed over their coal-pit, 172 yards deep; an unbalanced rope and chain with load of coal was connected to the 10ft. wheel or drum. The load was 90cwt., and was lifted the 172 yards in 32 seconds.

Then it was put into the s.s. *Zingaree*, and gave equally good results. The run from Gravesend to Blackwall was quite unintended. The *Zingaree* was out to test some small matters, she dropped anchor a little above the Town Pier, and refreshments were being served in the cabin when I saw the p.s. *Meteor* leave the Terrace Pier. I went to the skylight, and asked should we run up after her; the reply was "Yes." I at once went to the engine-room, gave word to open up the fires, shut the doors, and then go ahead. Then I got the men to the patent capstan to lift the anchor. My fear was that it would come into contact with the screw, for the speed of the vessel caused it to show abaft the ship. The result was we reached Blackwall first.

Disputes upon mechanical matters then caused the rotary engine to be taken out of the ship, and a well-known firm fitted ordinary engines, when, with the same boiler and propeller, her speed was reduced to eight knots.

As to modern men repeating the work of others, we daily see this, sometimes with, and sometimes without, improvement. For instance, a fan or turbine engine is often spoken of, yet, speaking of fifty or fifty-five years back, I well remember seeing in a warehouse, at the upper end of the Surrey Canal Docks, the actual propeller of the *Archimedes*, placed in a large tank of water, and driven by a fan or turbine engine, the revolutions by the fan engine being ten revolutions more than the ordinary engines of the *Archimedes* had driven it when in its place in the ship.

The Editor recently stated that when space admitted, certain papers referring to the early introduction of the screw-propeller should be reprinted in these pages. When they appear, they probably will contain some dates which may be useful to you. J. W.

GILBERT'S NEW POWER MACHINE.

[42938.]—One would have thought that much less than 20 years would have sufficed to convince Mr. Gilbert that man is not capable of creating energy, which is the only possible solution of the perpetual-motion problem. His devices, which are merely variations on those of the Marquis of Worcester, Jackson, and a host of other early experimenters, quite fail to achieve the result he aims at. Surely a little consideration should show him that the circumferential weights are of no use as a source of motive power, the additional energy exerted by a weight further removed from the centre being only obtained at the expense of the energy necessary to move it into position, and his wheel, if once set in motion, would run much longer wanting all these devices, which only serve to introduce additional friction. I would sincerely urge Mr. Gilbert to abandon the futile pursuit of a "will-o'-the-wisp," and devote his talents and energies to attacking the many problems in practical mechanics which lie ready to his hand, the solution of which would redound to his credit and be of service to his fellow-men;—a consummation never to be achieved by vain endeavours to make something out of nothing. W. J. G. F.

[42939.]—As A. E. Gilbert invites ventilation through your columns as to the "long forsaken problems of perpetual motion," I venture to ask, Has the problem been long forsaken? I think not, because the subject crops up very frequently. The pity is that it has not been forsaken for ever. This perpetual-motion system has been attempted for years past, long before the present generation, and always with one end—viz., non-success, and it always will be, from the very nature of it. If A. E. Gilbert would but just calmly think for a moment and ask himself the question, Can I obtain power from nothing? which is the absolute fact necessary to be done, I am inclined to think he would see the absolutely impossible feat and forsake the business altogether. The drawing he gives, Fig. 1, appears to me to be incomplete, as he does not show how or to what the levers for lifting the weights are hinged. If they are hinged to the spokes they would travel with the wheel and be inert; and why does A. E. G. lighten the weight (by which the machine is apparently supposed to operate) by making holes through a portion of the weight? From the drawing there are five weights doing useful work, which are supposed to be lifting eight similar weights on the opposite side of the circumference, and raising vertically two others outside the circumference at an increased rate of motion, which effort alone would probably absorb all the power exerted by three of the useful five weights, leaving two weights only to elevate the eight inert ones. Now with regard to Fig. 2, it appears that A. E. G. has two 2ft. diam. solid weights to lift perpendicularly. The friction of and power required for lifting these against gravity must be enormous, and, moreover, the first and last weights which we will suppose have been lifted have very little effective use; the three nearest the horizontal line would, of course, be doing the most work, and although the idea may be ingenious, yet A. E. G. may rest assured that the machine will not only never even start by itself, much less develop any useful power. I shall be anxiously looking out for Nos. 3 and 4 drawings; but unless A. E. G. can devise some totally different method to that shown in No. 1 and 2 the efforts put forth and energy absorbed by A. E. G. will, I fear, have been totally wasted, and I cannot help saying that, in my opinion, it is a pity A. E. G. does not exert his undoubted abilities to a more profitable object.

The problem to be solved is (as doubtless A. E. G. may know) to make a machine or some part of it commence to shift its normal position from a state of absolute rest without any exertion from an outside source being applied to it. If A. E. G. or any other body can do this—well! next the Millennium.

Dudley. Webster Michelson.

MOTOR CYCLES.

[42940.]—The writer of the interesting and instructive series of articles on the above subject says, in issue of July 21, p. 497, discussing the subject of ignition and dealing with the coil:—"The platinum contacts on the vibrating armature must be especially heavy, to withstand prolonged use with as little burning as possible."

Is not a vibrating armature in this case entirely unnecessary?—as it appears to me the make-and-break of the primary circuit by the ignition-cam does all that is necessary.

I had just decided on the making, during the winter, of a motor cycle, when the footnote to the final article in Oct. 6 issue made me pause and wonder which I should prefer—that, or a motor car. I should like to suggest that the first article should include a general drawing of the finished car; a statement as to whether the engine already described will be the one used, or, if not, if parts can be obtained from the same firm or—? My reasons for suggesting this are that if we wait to the end of articles running through several months to see the finished result, most, if not all, of the available winter evenings will be gone, whereas otherwise progress can be made week by week if the latter is decided on.

Plymouth. E. H. Micklewood.

AERIAL NAVIGATION—PILCHER'S FATAL ACCIDENT.

[42941.]—As the dead cannot defend themselves, and as Mr. Thos. G. Challis has sent you a letter appearing in your issue of the 13th inst., calling in question the skill of a practical engineer and devoted student of aëronautics, will you grant me a small space to defend him, and to point out that Mr. Challis is not qualified to pass judgment upon him, either on the grounds of theory or practice? As a fellow-engineer, but as a personal stranger to Mr. Pilcher until he left Glasgow for London, my defence is solely based upon the merits of his public work, his enunciations, and upon the personal explanations to me of his views, and his showing to me both his designs and models. I might add, also, his specially designed dynamometer for gauging the thrust of the propeller, which was quite a departure from the form used by Mr. Maxim. This latter disclosure was made to me quite recently, therefore I feel that science has lost a devoted worker in many branches.

Now, first, Mr. Challis must accept my assurance of wishing to give him credit for sincerity, and although the vague references he has made in other scientific journals as to his own plans indicate that he himself is a long way off grasping this important solution of aërial locomotion, yet I wish him success in his efforts.

Then, secondly, in respect to Mr. Pilcher's work, his principles and methods for the demonstration of aërial support (viz., "soaring," which was all he intended to demonstrate) were perfectly true in all respects; but for some reason, whether oversight or other cause, the mechanical construction and carrying out of those principles were faulty. Scientifically, he was no more to blame than the driver of an engine on land or water would be if some part of the engine broke and caused destruction to the train or ship. The true causes of the fatal result were two:—First, the neglect of providing sufficient strength in the tail-piece and connection to the wing-body. Second, the excess of wing area in proportion to the load-weight, and the placing of part of that load-weight so near to the plane of support. It was this question of "wing-area" and position of load-weight which was the chief factor in causing the death of De Groof, at Chelsea, many years before Maxim did any public demonstration.

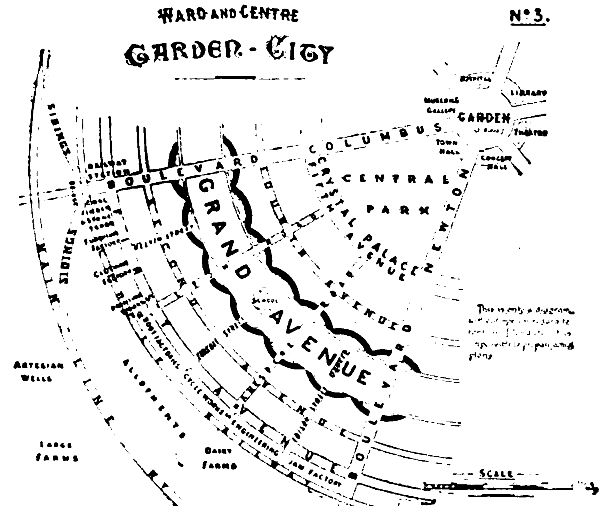
Mr. Challis makes two other mistakes. First, to sneer at the use of gas-support for aërial navigation, by saying no "gas-bags" will be required for it. Secondly, by asserting that the perfect flying-machine can be produced by himself only, and by ignoring the sudden and overpowering disturbances of air and the atmospheric elements of rain, snow, and lightning. It is self-evident to every competent mechanic or man of science that unless a flying-machine (a purely mechanically-supported and propelled machine) is capable of supporting and balancing itself safely without motive power, it is unfit for safe use, because otherwise any accident or stoppage of the motor—even momentarily—would destroy the equilibrium beyond recovery. Hence true mechanics and competent men—like Langley, Maxim, Lilienthal, and Pilcher—direct their first efforts, not to fly, but to prove "plane" support by various devices. Aviator.

MAGNETO IGNITION.

[42942.]—In reply to "Monty." Whether with or without coil, the larger the armature, the lower the speed required to produce a given result: the power exerted remaining practically the same. Our firm is perfecting a new form, which shall be shortly illustrated in this periodical. Till then I must crave your indulgent patience. S. Bottone.

GARDEN CITY.

[42943.]—Mr Garrett, in your issue of Oct. criticises the diagram of Garden City as shown in "To-Morrow," and gives one which he, as its author, naturally prefers. I do not propose to follow his criticisms upon my plan, for really I regard that plan, and still more the names given to the roads and avenues, as very far from being essential features of the project, merely using the diagrams in my book and in my lectures as showing what may, if contours admit of it, be done in the way of affording suitable and conveniently-placed sites for parks, schools, factories, workshops, stores, &c.



But perhaps your readers may like to make a comparison, and to help them in this I send you one of my diagrams.

But there is one really fatal criticism, if Mr. Garbett could substantiate it—namely, that I have made no provision for growth of population beyond the limited one of 30,000. Now, this is precisely what I have been very particular to do; but to do in such a way as to prevent altogether the evils which now ever attend the growth of our cities, and to secure for all time the combined advantages of town and country life. Perhaps the city of Adelaide affords the best illustration of the principles I advocate. South Adelaide is inclosed by a wide belt of green called "Park Lands," and the further growth of the town takes place by leaping over these park lands, and by building beyond them—hence North Adelaide. In a sense, therefore, it might be said of Adelaide, as Mr. Garbett says of Garden City, that its growth is checked by the Park Lands; but in truth it is not: its growth is simply made healthy, natural, and beautiful. I have carried out, but to a somewhat greater extent, the same principle. Garden City is surrounded by, say, 5,000 acres of agricultural land, and when it has filled up the 1,000 acres assigned to it, it will grow by leaping over the 5,000 acres which surround it, and by building a new city which will in fact, though not in name, be a part of the same community—a process which may continue till there is a whole group of cities, forming, in fact, one; for every resident of each will, owing to a system of rapid communication, be, in truth, a resident of one large city, and yet have ever the beauty of the country within most easy access.

There is another most essential feature of the project, compared with which the question whether a road shall be called "First Late Cheap" or "Boulevard Columbus" is as the dust of the balance. When starting to build on a new area as I advocate, it is most essential that provision be made that the whole of the added value given to that area by the presence and the energy and the industry of the inhabitants shall be, not the property of a few favoured individuals, but the property of the whole community. On these principles I show how a rent (less than under ordinary conditions would be paid for the ground on which the factories, shops, and houses, would stand) would, if paid to the community, meet not only the interest on the purchase money, and provide a sinking fund, but would suffice to carry on all the public services of the town; so that all its residents would be for ever free of rates. In my book I show how these results can be secured, while giving to the inhabitant the largest measure of freedom; the area of choice, so far from being curtailed, being, in fact, vastly extended.

These advantages (and many others which I must not occupy your valuable space by dealing with) are so real, and appeal so strongly to the common-sense of the people, that they will hasten to avail themselves of them; and thus, by a healthy and natural process of evolution, will two urgent problems which now confront our statesmen be completely solved—the housing problem, and another closely connected with it—how (in the words of Sir John Gorst) "to back the tide and stop the migration of the people into the towns, and get the people back to the land."

The first annual meeting of Garden City Association will be held at Memorial Hall, Farringdon-street, on Thursday, Oct. 26, at 7 p.m., Mr. I. H. W. Idris, J.P., L.C.C., chairman of the council, in the chair, and in view of the importance of the subject, I hope all who read this will make a point of being present. E. Howard.

11, New-court, Carey-street, W.C.

GARDEN CITY.

[42944.]—As honorary secretary of Garden City Association formed to consider the project of Mr. Ebenezer Howard, allow me to say a few words on Mr. Garbett's proposed improvement, leaving professional experts to deal more fully with it on some subsequent occasion, either in your columns or elsewhere. To those who are acquainted with the scheme, it may be sufficient to say that it is one for a concerted migration on a large scale to some agricultural land, purchased in the open market, laid out under the best professional advice according to a careful plan, and made subject to conditions securing the increased value of the land to the settlers themselves. Now assuming that I rightly understand Mr. Garbett's plan, the following objections to it suggest themselves to me. (1) The future extension of the city beyond a population of, say, 32,000 is eminently undesirable. (2) The splendid parks provided by the Howard plan are not visible anywhere. (3) Nearness to work, to the parks, to the public buildings, to the allotment gardens, in fact to every part of the estate, is not attained. (4) Railways through the town would be an annoyance, not a convenience. Water-ways and tramways are suggested by Mr. Howard in his book "To-Morrow."

If those who think with Mr. Garbett will join the Association, and help us to discuss this and other matters, we may hope to discover what plan is really the best. May I add that our first annual meeting will be held at Memorial Hall, Farringdon-street, Thursday, October 26, 7 p.m.?

Francis W. Steere, Hon. Sec. G. C. A.

4, Stone Buildings, Lincoln's Inn, London.

CHARLES BABBAGE.

[42945.]—I WAS much interested in your article last week on Babbage and his wonderful machine, and imagine many other readers were also. Some of them may perhaps like to read one or two anecdotes about Babbage, which I lately came across in a volume entitled "Recollections of an Octogenarian," published anonymously, and apparently for private circulation only, and printed at the Chiswick Press. I picked the volume up at a second-hand bookstall, and if I am inadvertently infringing any copyright, I tender my excuses to the unknown author, if he has not by this time joined the majority.

"Charles Babbage was an honourable, just, truth-loving, kind-hearted man. He had his failings (so have you and I). Jealousy was not one of them. A Swede came over with a calculating machine which he had contrived. Babbage did not act on the old adage 'two of a trade,' &c. He made much of the Swede, and everywhere praised the ingenuity of the contrivance. Poor Babbage doubtless had his life embittered by his inability to persuade Spring Rice, Chancellor of the Exchequer, to advance some thousand pounds for the completion of his calculating engine. Spring Rice took advice from the Astronomer Royal. He told him, 'The calculations we have to go through are very laborious; but you can get a charity boy to do them.' 'But he may be wrong.' 'Get two charity boys.' And so economy got the better, and our country lost the opportunity of abridging human labour in about the same proportion that Napier did by his glorious invention of logarithmic tables. Few have any conception of the amount of labour in physical problems. Hutton wanted to ascertain the specific gravity of the earth. He suspended a pendulum near the mountain Schehallion in Perthshire, and observed how much the pendulum was drawn from the perpendicular. The mountain was not a very regular figure, and it was composed of five or six irregular masses of different rock, each with its own specific gravity. The computations covered hundreds of quires of paper; and the result, 'Specific gravity of the earth, 5½,' came out at the end of *twenty-two months*. A noble ironclad, the *Captain*, was being built. When near completion some alteration was ordered which would alter her stability, or, as Scott Russell used to call it, her stand-up-at-iveness. She was hurried to sea to join the Channel Squadron before the computations of her stability under the altered build were completed, and in the first heavy gale she capsized. Two months after she was lost the computations were finished, which showed she could not bear to be heeled more than so many degrees—I forget what—without being upset. Her fate was that of Madame Blaise—

> 'The doctors found, when she was dead,
> Her last disorder mortal.'

Babbage's engine would have made the computations in a couple of hours. And so a splendid ship, a noble captain, a fine crew, and £400,000 or £500,000 of money went to the bottom of the Bay of Biscay, because the Astronomer Royal thought a charity boy cheaper than a calculating engine.

"Babbage carried his analytical mind into every-day life; into his charities. He told me when he was accosted in the streets by a person with a long story, and 'Oh, sir, if you would come home to our poor house and see my wife and seven children,' he used to take the man at his word and go home with him, and invariably found there was imposture. He determined never to give to street beggars. But by so doing he might be neglecting a deserving object, and he had to guard against encouraging in himself a habit of niggardliness. Accordingly, whenever he was so accosted he refused, but when he went home he threw a shilling into a drawer. Whenever this fund had accumulated to twenty, he put a sovereign into the box of St. George's Hospital, and began again.

"Babbage loved fun, and was ready in answering. One day Sidney Smith called upon him. 'Babbage, I have discovered that there is an eleventh commandment wanting.' 'What is it?' 'Thou shalt not be found out.' 'Then what on earth is the use of the other ten?'

"I happened to call on him just as the news came of Sir Charles Napier's rapid victories and his annexation of Scinde. Many thought the latter to be a mistake, that our empire was already wide enough. Of that mind was Babbage. I said, 'Napier's despatch might be very brief—Veni, vidi, vici.' 'Oh, it might be shorter,' said Babbage; 'he should have written simply, Peccavi—I have Scinde.'

"I was talking to him one day of the schism in the Church in consequence of many divines, with Maurice at their head, revolting at the idea of eternal condemnation. Babbage asked, 'Who is there on the other side?' 'Why,' said I, 'there is the Archbishop of Canterbury.' 'Oh,' said he, 'is the archbishop in favour of eternal damnation! Then let him be damned eternally.'

"He took me one day into his workshop. He pulled down a parcel of toothed wheels. 'There are,' said he, '40,000 of these wheels, and (pulling down another parcel of smaller wheels) there are 40,000 of these; and if *any one* of the first be fitted to *any one* of the second, I will engage they shall do their duty.' They were finished to the thousandth of an inch. And when Babbage began the construction of his engine, there were no mechanists in the country who could grind brass to the required accuracy; he had to create engineers before he could begin on his engine. Mr. Forster told me Babbage went all round his works at Stourbridge. His head engineer told him afterwards, 'Wonderful man that be, Sir; knows more of machinery than me: odd name, like cabbage.' . . . .

"Herschel and Babbage, like many great mathematicians, used to amuse themselves with deciphering and inventing ciphers. Herschel invented one which he thought would baffle the most acute. He wrote a letter to Babbage in this cipher, which ended with, 'If you can make out this, you are the devil himself.' Babbage, in a forenoon, deciphered it, and answered Herschel in his own cipher, signing himself 'Diabolus ipse.' Such are the pleasantries of profound mathematicians. But the palm for deciphering must be awarded to Wheatstone. Among the papers of the luckless Charles I., which fell into the hands of the Parliament, many were in cipher, and have long been read. But there was one in the British Museum which had baffled all. Sir Henry Ellis, the Keeper of the MSS., applied to Babbage, who advised him to put it in Wheatstone's hands. I happened to call upon him (Wheatstone) the day on which, having completed the solution, he was writing it out for the press. The ink was wet when he put the last sheet in my hands. And now that I know the key, the more marvellous does the achievement appear. In the first place, in what language is it? After much labour, Wheatstone found it was in French, and to make matters worse, very bad French, for Charles wrote 'as tur' for 'à cette heure.' The symbols were all numerals.

The first line runs, 42 . 56 . 90 . 93 . 83 . 99 . 20 . 95 . 43 . 60, and so on for seven folio pages. The numerals are about three hundred. Some represent alphabetic letters, many representing the same letter; thus there are nine ways of representing *e*. Then some numerals represent the more common words, as 'les,' 'que,' 'pour,' 'comment,' &c. And again some numerals represent a name, as 'Prince of Orange,' 'King of France'; no division between words or sentences. The document itself is of the highest interest historically. It is a despatch from Charles to his minister at the Hague, in which he instructs him to persuade the Prince of Orange to enter into a league with him and France. France was to send over 2,000 cavalry and 4,000 infantry in transports, protected by fifteen or twenty men-of-war, to bring his subjects to reason. The Parliamentary debates of the time show that this was suspected; but Charles declared on the word of a prince that there was no truth in them. For the deciphered despatch, see 'Memoirs of Wheatstone,' published by the daughters."

Kappa.

MOSQUITOES AND MALARIA.

[42946.]—This subject is now engaging attention. There can be no question or doubt that flies of various kinds carry the germs of disease—as with the blowfly that has left putrefying offal to settle on a sore in a living being. While in Egypt in the year 1856, on several occasions on awakening in the morning I found myself nearly blind with purulent ophthalmia. This was caused by flies coming from the eyes of natives suffering from a similar complaint. Frequent applications of zinc lotion and the use of gauze goggles soon cured the evil. When we got into localities where flies were scarce, we were not afflicted with ophthalmia, although mosquitoes might be abundant. These horrible pests do not necessarily live by sucking human blood; the majority of them never have a chance of obtaining this food. I have seen them settle on the flesh and drink the blood of a recently slaughtered animal, and, in fact, a piece of raw meat placed near a sleeper serves as a protection, and attracts them in preference to attacking the sleeping man. I have also seen them congregated on putrid carrion, from which they might bring to us the germs of dangerous fevers and malaria. Their indiscriminate mode of feeding leads to the idea that they might be effectively poisoned in the same way as our common house-flies by means of a suitable kind of bait. Of course, the experiments could not be tried here, but must be carried on in countries where mosquitoes abound. For alleviating the irritation of a bite, I used immediately to touch the spot with a dot of moistened cyanide of potassium, which counteracted their poison.

F. H. Wenham.

STEREOSCOPIC VISION—THE BALANCE.

[42947.]—There is one curious circumstance in connection with the above which appears to me to be entitled to a note in passing. It has come under my observation as a result of the extensive employment of photography in modern illustrated journalism. Given a subject well adapted for stereoscopic effect, a pillared portico, a lavender field, or something of that sort, with the lines running well into the foreground, I should like to ask any of your readers who can trust the evidence of his own senses, whether the stereoscopic effect is not much improved and increased by the use of one eye in preference to two. For my own part I think that binocular vision produces a distinctly flattening effect in such a case.

I have often looked for some description of the balance in your columns; the conditions which determine the perfection of its working both in the simpler and more complicated forms, &c.

Carlos.

The first electric locomotives exported from the United States were recently shipped from the Baldwin Works to Japan. The machines weigh nearly five tons each in working order.

Messrs. Webster Michelson and Co., of the Eve Hill Works, Dudley, send an illustrated catalogue and price list of their electrical appliances, notably dynamos and motors, which contains a great deal of information that will be useful to those who desire to set up electrical plant, either for lighting or for motive-power purposes.

Cornell University is the only college in the United States which has a forestry department. A year ago it secured 30,000 acres of woodland in the Adirondack Mountains for the exclusive use of the University's forestry department. The land has been divided into a number of sections, and several seed-beds have been laid out, in which there has been planted over a million small trees of different varieties. The students of forestry will study the theory of the subject from October to April, and from then until commencement they will study the practical side of forestry.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96555.] — **Equation.** — Surely Mr. Burgess knows the difference between an exact and an inexact number. The expression $\frac{2}{3}\sqrt{7}$, for instance, is a surd which can only be represented by an interminable row of decimal figures—and then it won't be exact. Now, if in the original given equations we put x = the above expression, it might pass in the first equation, as only the square of x appears, which is an exact number; but in the second and third, on substituting the above inexact expression for x, impossible equations are the result, as you cannot have an equation between several numbers one of which is a surd. Again, looking at the first of the given equations, the smaller the second term is the greater will be the first, and if the second were nothing at all, x would work out to a little over 3; it can never be greater than this, whatever y and z may be. (Note that x, y, z are either all positive or all negative.) Consequently the long row of possible candidates for the value of x as given by Mr. Burgess dwindles down from 20 to 2; the two being $\frac{1}{2}$ and $\frac{2}{3}$ as given by me. This method will be more easily understood if we take one of Mr. Burgess's own derived equations (see p. 187)—$n = \frac{q\,a - b\,p\,m^2}{p\,c - b\,m\,q}$. Instead of finding n in terms of m, let us find m in terms of n. Then, restoring the numerical values of the letters and working out the quadratic equation, we get—

$$m = \frac{5}{9}n \pm \sqrt{\frac{25}{81}n^2 - \frac{25}{21}n + \frac{100}{81}}$$

Or—

$$m = \frac{9}{5}n \pm \frac{5n}{9}\sqrt{1 - \frac{27}{7n} + \frac{4}{n^2}}.$$

Now, as in the other case, the terms under the radical sign must be a square number, putting $n = \frac{p}{q}$, where p and q are whole numbers, these terms will be $1 - \frac{27q}{7p} + \frac{4q^2}{p^2}$. Now, in order that these three terms may be added and subtracted, as indicated by the signs, the denominators must be equal, and therefore—

$$p^2 = 7p, \text{ or } p = 7.$$

The expression therefore becomes—

$$\frac{49 - 27q + 4q^2}{49}$$

Now, to make the numerator also a square number we can put it in the form—

$$(7 - 2q)^2 + q, \text{ or } (7 - 2q)^2\left[1 + \frac{q}{(7 - 2q)^2}\right]$$

The terms in brackets represent a square whole number; therefore the denominator must = 1, or $q = 3$, and the whole expression reduces to 4, which is a square number. Thus $n = \frac{p}{q} = \frac{7}{3}$, the radical term becomes $\sqrt{\frac{4}{49}}$ or $\frac{2}{7}$. Hence m will be found $= \frac{5}{3}$. As $m = \frac{y}{x}$, and $n = \frac{z}{x}$, and $z^2 = \frac{p}{a + b\,m\,n}$ (using Mr. B.'s symbols), where $p = \frac{27}{4}$, $a = \frac{2}{3}$, $b = \frac{3}{5}$, the values of x, y, and z are easily found. From the above it will be seen that the third given equation is not required at all. It is a mere sequence of the other two.

Bath. M.I.C.E.

[96599.]—**Cutting by Circular Saws.**—Saws should cut "down" on the work, as a rule, because if they cut upwards there is always a risk of slewing the work; but if that is clamped firmly there is no choice in the matter. As a rule, girders, rails, &c., are cut with the saw running against the bed, and so having something solid to work on.

T. M. L.

[96633.]—**Green Water.**—I cannot tell the querist (p. 211) where to send the water for analysis; but I presume there is a county analyst. It is possible that a little alum in powder would cure the greenness, or some permanganate of potash. The question is certainly peculiar, as it is quite unusual for water to turn green, especially when derived from a chalk well, meaning a well in the chalk (about the purest source we have), and I should like to know something more about this matter, as it is rather curious. I do not know what analyst's fees are, but it would be interesting to learn why the water turns green.

M. T.

[96633.]—**Green Water.**—This greenness is undoubtedly due to swarms of the little flagellated chlorophyll-containing infusorian *Euglena viridis*, which often occurs in such myriads as to give large volumes of water a brilliant green appearance. The analyst will not help "Quex," but any friend with a microscope can do so. If "Quex" will place some of the green water in a clear glass bottle, then cover all of it but a strip, he will find that the little organisms will crowd densely into the illuminated portion. If he will place a bottle containing them where light will impinge upon it through a prism, he will find that they will come to the blue and violet rays, forsaking the others. See any book on elementary biology.

J. Sinel.

[96637.]—**Catarrh.**—I suffered while in Egypt from this complaint, and at the suggestion of a German doctor cured the complaint with cold-water compresses on the stomach at night. I found the treatment safe and speedy and trust "Sufferer" may do the same.

Cairo.

[96728.] — **Gold.** — There is neither an atomic nor molecular difference between Australian and Californian gold, regardless of what Mr. Howse says. Australian gold contains: Gold, 99 per cent.; silver, 1 per cent. Californian contains: Gold, 90 per cent.; silver, 10 per cent.

W. Ewart Gibson.

[96750.]—**Spring Tides.**—The relative heights of spring and neap tides are about as 7 to 4. The interval between corresponding tides of successive days is less than the average, being only about 24h. 38m., and then the tides are said to be "prime." At neap tides the interval is 25h. 6m., which is greater than the mean, and the tides "lag." When the moon is in perigee tides are nearly 20 per cent. higher than those occurring when she is in apogee. The highest occur when a new or full moon occurs, at a time when moon is in perigee, especially if this occurs about Jan. 1, when earth is nearest to the sun. The "tide-raising" force varies inversely as the cube of the distance: slight variations in the distance of the moon and sun from the earth make much greater variations in the height of the tide—greater nearly in the ratio of 3 to 1. Beardmore's Tables also have much on the subject. Your lat. and long. indicate Isle of Anglesea, and with tidal ranges of 16, 17, 18, upwards, 19ft. curves, showing tidal range equivalent to 30ft. spring range from Liverpool. He gives Spring Tides Tables for river Mersey, 1844; also neap tides for twenty-four hours; also tides of Irish Sea; also a table for computing time of high water for twenty-four places, of which I take Holyhead as central for your locality.

Moon's transit.	Holyhead.
0h. 0m.	1d. 10h. 47m.
1 0	1 10 30
2 0	1 10 18
3 0	1 10 10
4 0	1 10 07
5 0	1 10 16
6 0	1 10 46
7 0	1 11 16
8 0	1 11 31
9 0	1 11 31
10 0	1 11 20
11 0	1 11 06

Shows the semi-menstrual inequality + a constant, representing interval between the moon's transit, two days preceding a London tide, and the time of high water, the moon's parallax being 57′, her declination 15°, the sun's parallax 8·8″ and declination 15°. Following is table of correction for the moon's declination and parallax. For moon's declination no correction from 14° to 16°; ditto parallax for 57.

Name of Port.	Moon's declination.					
	0° to 6+	9° + and 21° −	12° + and 18° −	24° −	27° −	30° −
Holyhead	·32	·29	·13	·49	·69	·90
	Moon's parallax.					
	54′	55′ − and 57′ +	56′ − and 58′ +	60′ +	61′ +	—
Holyhead	·70	·49	·24	·79	1 07	—

Constants to be added to or deducted from times and heights of high water, e.g.—

Ports.	M.S. Gauge.	Time.	Height.
Holyhead	16 1	—	—
Fishguard Point	11·8	3·15	45
Cardigan	—	3·10	—
Carnarvon	13·10	0·38	23

Perhaps these data may aid or suggest looking further.

Regent's Park.

[96724.]—**Oil-Engine Castings.**—First plane up the facings on the bedplate, &c., to the proper sizes; fit keeps and brasses to main bearings. Bore out the brasses $\frac{1}{32}$ smaller than crank-shaft. Turn crankshaft and bed in to brasses with red-lead and oil. Fit brasses into each end of connecting-rod, and bore them out to take crank-pin and gudgeon-pin respectively. Finish cylinder and piston, and put them in place, with connecting-rod attached to crank-pin. Now mark off holes on to

bedplate; tap them and fit studs. I don't know of what make your castings are; but if vaporiser and combustion chamber are a separate casting, fit on next, keeping the valves fair for the valve-rods. Grind in valves with fine sand and water, afterwards with chalk and oil. You can then fit flywheel and pulley, valve-springs, ignition-tube, and chimney lubricators, two to one gear, and the various cocks and connections. W. Ewart Gibson.

[96759.]—**Bikes and Prams.**—It has been decided in a court of law that bicycles are carriages within the meaning of the Act—consequently it is illegal to wheel a cycle on a footpath. Perambulators not being carriages, are controlled by local regulations. In return for this contribution, will "Rota" please oblige by ceasing to use the word "bike"? R. R.

[96778.]—**Barometer.**—So many accidents may happen to a barometer sent on a sea voyage without screwing up the cistern, that it is highly probable the instrument in question can only be repaired by the maker. If there is no fracture in the tube, it is possible that a particle of dirt or a bubble of air may have found its way into the tube, and in this case the instrument should be taken down and put aside in an inverted position for several hours, and on replacing it, it is possible that the obstruction will have disappeared. By inclining the barometer with the cistern uppermost and slightly tapping the tube, any air will also in this way be removed.

Nerps.

[96794.]—**Bluing.**—The steel-blue colour you mention can be given to iron articles as follows:—Clean and emery the articles to be blued carefully, taking care not to mark them with the fingers after emerying them; also be careful to keep them free from grease of any kind. Then place them in a sand-bath (preferably silver sand) and heat them carefully until they turn the desired blue, then dip them in linseed-oil and dry them out in a little hard-wood sawdust to which a small quantity of pencil blacklead has been added. The sand-bath I use is a simple affair. I knocked up a small iron box about 10in. by 5in., put four legs on same to keep it up off the bench, and placed an atmospheric gas-burner under it; a bar burner with holes along it is best, and gives an even heat with less trouble. T. W. L.

[96795.]—**Varnish and Stain.**—Pulverise and dissolve three parts of light-coloured shellac, two of sandarac, two of white resin, and half of camphor in 24 of alcohol of 80 per cent. Put first the shellac, sandarac, and camphor in the alcohol; tie up the vessel with a piece of wet bladder, and shake it for half an hour; then add resin, and let the mixture boil up several times in a suitable vessel. Filter the ready varnish while yet warm through cotton or felt, and to clarify it let it stand in a well-closed bottle for 12 hours. No more varnish than is to be used in two or three days should be prepared at one time, since age impairs its beauty and hardness. ("Standage on Varnishes.") One for wood naturally coloured or stained. Amber Varnish: Clear pale amber 6lb., fuse it, add of hot clarified linseed-oil two gallons, boil until it strings well; then let it cool a little, and add of oil of turpentine 4gal. or q.s. Nearly as pale as copal varnish, it soon becomes very hard, and is the most durable of the oil varnishes; but it requires some time before it is fit for polishing, unless the articles are stoved. When required to dry and harden quicker, drying-oil may be substituted for the linseed-oil, or driers may be added during the boiling. (J. Cameron, "Oils and Varnishes.") The following is said to defy action of boiling water:—Boil in untinned copper boiler 750 parts of linseed-oil. Suspend in this, in bag not touching bottom, 150 parts of litharge and 90 parts of minium. Let oil boil until it becomes dark brown, remove bag, replace by one containing 7 or 8 bulbs of garlic. Melt 500 parts of pulverised amber in 60 parts of linseed-oil over a strong fire; add it, while boiling, to the prepared linseed-oil, and let it boil two or three minutes longer, stirring vigorously. Take it from fire, allow to settle, pour off clear liquor, and when cold put into bottles and hermetically close them. To use varnish: Polish wood first, and give desired colour. When stain is dry, apply four coats of varnish with fine sponge (or perhaps soft brush may do), allowing each coat to dry. Nut-brown colour may be got by laying on thin coat of mixture of lampblack and oil of turpentine. Regent's Park.

[96808.]—**Dynamo Switchboard.**—I am sorry Mr. Bottone cannot give you the desired answer; but it may assist the querist to know a very clear engraving and full description appears in Mr. Allsop's article on "Electric Lighting" in his excellent book of that title, or Vols. LI. and LV. English Mechanic, pp. 280 and 493 respectively.

Twenty Years' Subscriber.

[96819.]—**Electric Bell.**—Yes, the over-driven staple would be the cause of your cells becoming crystallised; but in fitting bells, telephones, &c., the safest way is to staple the wires separately.

S. Elliman.

[96820.]—**Sand-Blast.**—I have a small sand-blast machine, and should be pleased to show it to your correspondent, if he can call.

C. Mitchell.

23, Blenheim-street, King's-road, Chelsea, S.W.

[96825.]—**Meteorites.**—Having had an occasion to-day for consulting the Reports of the British Association, I took the opportunity of more particularly examining the catalogues (by Mr. R. P. Greg) referred to in my former reply to this query (p. 214). I find they contain many more instances of British-fallen meteorites than does any other authority with which I am acquainted. Perhaps,

Date.	Place of Fall.	Remarks.
1360. —	Yorkshire	Stone-fall.
1628. April 9	Hatford, Berkshire	Weight 24lb. +; 5 p.m.; stone-fall accompanied by detonations.
1642. Aug. 4	Near Woodbridge, Suffolk	Weight 4lb.; 4.30 p.m.; stone-fall.
1676. —	Orkneys	Stone-fall; fell into a boat.
1680. May 18	Near Gresham College	2½in. diam.; stone-fall; several fell.
1695. —	Ireland	"A shower of unknown matter."
1723. Jan. 10	Tregony, Cornwall	Stone-fall.
1725. July 3	Mixbury, Oxfordshire	Weight 20lb.; stone-fall.
1731. Mar. 12	Halstead, Essex	Stone-fall (?) and fireball.
1779. —	Lettiswood, Westmeath	Weight 5oz.; stone-fall; 1771 (?).
1780. April 1	Beeston, Nottinghamshire	9 p.m.; stone-fall; April 11 (?); iron-fall (?).
1795. Dec. 13	Wold Cottage, Thwing, Yorkshire	Weight 56lb.; 3 p.m.; stone-fall; sp.gr. 3·70.
1802. Sept. 15	Loch Tay	Stone-fall; doubtful.
1803. July 4	East Norton, Leicester	Stone-fall (?); meteor and detonation (?); struck a building; electrical.
1804. April 5	Possil, near Glasgow	S.E. to N.W.; a.m.; stone-fall; day-time; sp.gr. 3·53.
1806. May 17	Basingstoke	Weight 2½lb.; stone-fall, after a detonating meteor.
1810. Aug. —	Moores-Fort, Tipperary	Weight 7¾lb.; 11 30 a.m.; stone-fall; sp.gr. 3·67.
(early part of) 1813. Aug. or Sept.	Malpas, Cheshire	1 p.m.; stones fell.
1813. Sept. 10	Adare, &c., Limerick	Weight 17 + 65 + 24lb.; E. to W.; 9 a.m.; stone-fall; sp.gr. 3 64; 6 a.m. (?).
1816. Aug. or July	Glastonbury	Stone-fall.
1819. —	Pulrose, Isle of Man	Stone-fall; light and scoriaceous; fell 1813-1819.
1821. June 21	Mayo, Ireland	Hailstones fell with a metallic interior.
1825. May 12	Bayden, Wiltshire	Iron-fall (?)
1827. —	Newstead, Roxburghshire	Weight 18lb.; found in this year; iron-fall.
1830. May 17	Perth	Stone-fall (?)
1830. —	Launton, Oxfordshire	Weight 2½lb.; N.E. to S.W.; 7.30 p.m.; stone-fall with noise and light; sp.gr. 3·625.
1842. Aug. 5	Harrogate	5 p.m.; stone-fall; very doubtful.
1844. April 29	Killeter, Tyrone	3.30 p.m.; stone-fall; no meteor; many small ones; musical sounds in the air; sp.gr. 3·76.
1846. Aug. 10	County Down	Iron-mass and meteor (?)
1860. June 9	Raphoe, Donegal	2 p.m.; stone-fall; size of duck's egg; June 8 (?)
1876. April 20	Rowton, near Wellington, Shropshire	Weight nearly 8lb.; two detonations; iron-fall.
1881. Mar. 14	Middlesbrough	Stone-fall.

therefore, it will be of assistance to the querist and of interest to some other readers if I supplement my last week's answer by abstracting the entries in question from these very extensive catalogues. Some further examples are added in order to bring the list more nearly up-to-date.

Clapham Common. Walter E. Besley.

[96829.]—**Women as Inventors.**—The idea that women lack the faculty of invention is a ridiculous one, and has been frequently refuted. Woman probably is a better inventor than man, but, from apparent causes, her capacity has lain dormant. As good a defence of women as inventors as I remember was contributed by Miss Gage to the *North American Review* in 1883. It was, I think, in the April or May number of that year, and can doubtless be seen at the British Museum library. Miss Gage claimed that bread-making was invented by Isis, who taught it to the Egyptians. The hunter's net, the warrior's axe, the art of making pottery, the method of manufacturing silk were all discovered by women. Lace-making is another pre-eminently womanly invention, and it is worth notice that the well-known "Venetian Point" lace originally invented in the thirteenth century, but afterwards lost, was reinvented by Signora Bessani, an Italian workwoman, who reaped, I believe, substantial sums from her patent. Pillow-lace making was invented by Barbara Uttmann; Cashmere shawl-making by the celebrated beauty, Nourmahal; and Japanese relief decoration by Kamejo. The important industry of straw bonnet-making in America is due to the genius of Betsy Metcalf, who made the first straw bonnet in 1798. The cotton-gin was the invention of Catharine Littlefield Greene, whose attention, as a planter's wife, was called to the matter by the frequent prophecies of the fortune that awaited any-one who could devise a mechanical plan for separating the seeds from the cotton. The cotton-gin gave an immense impetus to the cotton-production of the Southern States. One well-known American mower and reaper is the invention of Mrs. A. H. Manning, and her husband, who patented it, always acknowledged his wife's claim. A little girl invented the "gimlet-pointed" screw, which has probably made more money for its makers than any other modern patent. Hundreds of other instances might, I believe, be given. Kappa.

[96829.]—**Women as Inventors.**—All nonsense. Women are, in my opinion, superior to men as inventors. A woman of this town has just invented a very clever machine for shearing by means of electricity. A thin blade is made white hot, and cuts through the fleece like magic, without perceptibly burning the wool or the animal.

Bradford. T. C.

[96829.]—**Women as Inventors.**—Many of the greatest men are entirely devoid of inventive genius, so that invention cannot be taken as a criterion of superiority. However, as it happens, there are inventions patented almost every week the year round by women, as a man with any small knowledge of invention would know, for the names appear in the *Journal of Patents* every week.

A. R. F.

[96829.]—**Women as Inventors.**—Women contributed 683 applications for patents during last year, being more than 2·4 per cent. of the total number; about 150 relate to articles of dress, and 80 to cycling.

161, Albion-road, N. A. Clarke.

[96830.]—**To Practical Electricians.**—You will require about 50H.P. for driving five hundred 16c.p. lamps, and the dynamo will need to run at full speed, whether you have one lamp only or 500 in circuit. The amount of current sent through the accumulators, and consequently the energy stored, will depend entirely upon the size of the accumulators. The output of accumulators is not reckoned in volts, but in "ampère-hours"—i.e., if 10 ampères are passed through an accumulator for 1 hour = 10 ampère-hours, the accumulator will be capable of supplying a circuit with approximately this amount of current for the same period, or with 20 ampères for half an hour—the exact amount depending upon the efficiency of the accumulator. For 110-volt circuit you will require 60 cells. As there are a number of different types on the market, it is impossible to specify any particular make unless the nature of the factory and the work the battery will be required to perform is known. If the cells are properly insulated, the leakage is so small that it need not be taken into account; the cost will entirely depend upon the size of the battery. If the same is required to supply, say, 50 lamps for 3½ hours, or the equivalent, e.g., 25 lamps for 7 hours, or 100 lamps for 1¾ hour, the cost would be £114. Owing to the heavy cost of accumulators, the size is usually cut down to the lowest permissible limit. If you charge the accumulator direct from the dynamo you will require a voltage of from 130 to 150 volts; this would not, of course, be suitable for lighting the lamps at the same time unless the voltage were reduced by means of back E.M.F. cells or some

other method. Although it is difficult to say, without a knowledge of the size and plan of the factory, I should advise you to adopt either 100 volts, if the area of lighting is of limited extent, and, perhaps 200 volts if the lighting is extended. The dynamo would probably be best compound-wound if used chiefly for lighting the lamps direct, and the storage battery could be charged by means of a "booster," inserted in the charging circuit to raise the voltage to the requisite degree. I shall be glad to supply any further information.

G. W. LUMMIS-PATERSON.
Heaton, Newcastle-on-Tyne.

[96830.]—**To Practical Electricians.**—(1) Yes, it is quite feasible to charge and light simultaneously. (2) 100 volts. (3) 50 cells, size and type would depend upon the work they were required to do. If to run 250 lamps for three or four hours, each cell would require to contain about 38 plates, each having an area of about 2sq.ft. (4) "Electric Light," by J. W. Urquhart, C.E., Crosby Lockwood and Son; or "Electric Light Installations," by Sir D. Salomons, Whittaker and Co., might be of service. (5) The accumulator will return about 90 per cent. of the energy put into it, and cost, roughly, about £350. (6) To get 110 volts you would require 55 cells, and the dynamo would require to have a voltage of at least 120 volts. If querist cares to write to me, I will be glad to give him what further help I can, should he require it.

Moffat. W. J. G. FORMAN, C.E.

[96830.]—**To Practical Electricians.**—What you propose in your query can be done without difficulty; but five hundred 16c.p. lamps will require at least 50 B.H.P. If you use 110-volt lamps you will require 58 to 60 cells, and the probable cost can only be stated when we know the number of lamp-hours or ampère-hours' capacity you require. In case you have 60 cells, your dynamo must be for a voltage of 150.

WEBSTER MICHELSON AND CO.
Eve Hill Works, Dudley.

[96830.] — **To Practical Electricians.** — A dynamo to light 500 lamps of 16c.p. 110v. will absorb between 18 and 20 H.P. to drive it nicely. If your dynamo is properly wound, you may drive it at full speed, whether you have only 1 lamp or all 500 on, and you may have accumulators in parallel across the mains without affecting general results, provided of course you have one of our automatic cut-ins and cut-outs, to prevent back discharge in case engine turn slow, &c. If you charge accumulators at 110v., you can only charge 44 in series at a time, since each cell takes 2·5 volts to charge it, and since you can only get 2 volts per cell out, they would return you only 88v. You cannot better the E. P. S. type. See Allsop's "Electric Light Fitting." If by leakage you mean difference between energy expended and that recovered, it amounts to about 25 per cent. The cost will vary according to capacity of accumulators from £1 3s. per cell, up to £6 or more. To charge a set of 55 accumulators to give 110 volts, the dynamo must be capable of giving 137·5 volts, at least.

S. BOTTONE.

[96831.—**Cotton-Covered Wire for Coil.**—To MR. BOTTONE.—No use at all for sparking coils, and not much good for "shocking" ones.

S. BOTTONE.

[96838.]—**Chords of a Circle.**—If C be any chord of arc A or angle ϕ, d being the diameter, then—

$$C = \sin.\frac{\phi}{2} \times d.$$

For by Euclid, Prop. 47, Book I., C is the hypothenuse of the right-angled triangle whose base is the versed sine, and perpendicular the sine of ϕ, both $\times$ radius or $\frac{d}{2}$.

$$\therefore\ C = \sqrt{\left\{\frac{d^2}{4}(\sin.^2\phi + \text{vers.}^2\phi)\right\}}$$

But vers. $\phi = 1 - \cos.\phi$, and by two well-known formulæ we have—

$$\text{(i.)}\quad \sin.^2\phi + \cos.^2\phi = 1$$

$$\text{(ii.)}\quad \sin.\frac{\phi}{2} = \sqrt{\left(\frac{1-\cos.\phi}{2}\right)}$$

And $\sqrt{(\sin.^2\phi + \text{vers.}^2\phi)}$

$$= \sqrt{(\sin.^2\phi + 1 - 2\cos.\phi + \cos.^2\phi)}$$

$$= \sqrt{(2 - 2\cos.\phi)} = 4\sin.\frac{\phi}{2}.$$

$$\therefore\ C = d \times \sin.\frac{\phi}{2}.$$

If $A = \frac{1}{16}$, $\phi = 360^\circ \div 16 = 22\frac{1}{2}^\circ$, and—

$$\sin.\frac{\phi}{2} = \sin.\,11\tfrac{1}{4}^\circ = \cdot 19509.$$

$$\therefore\ C = \cdot 19509 \times d.$$

There are so many able works on trigonometry that it is really difficult to make any selection; but if "F. G. M." fancies an up-to-date book, wherein lines are described as "point-transferences" and angles as "revolutions" running into thousands of "degrees," he cannot do better than secure one of the very excellent treatises by the Rev. J. B. Lock, M.A. (Macmillan, 2s. 6d. and 4s. 6d.)

West Norwood. HENRY T. BURGESS.

[96833.] — **Wimshurst.** — To MR. BOTTONE.— (1) base 65in. long, 34in. wide, the case itself being 60in. long, 28in. by 66in. high; (2) sectors 4⅝in. long, ⅝in. wide at top, ¼in. at bottom, 36 on each plate; (3) 3½in. diameter, 3in. wide; (4) spindle diameter, 1in.; (5) large balls on dumb-bell conductors 2¼in. diameter, small sparkers 1in. diameter; (6) 18⅜in. long, 2in. in diameter; (7) 180 revs. per minute would be the hghest permissible speed with glass plates. The length of spark depends somewhat on the capacity of jars used. You would probably get from 12in. to 15in. sparks. We get 9in. to 10in. easily out of our 6-plate 12in. machines.

S. BOTTONE.

[96839.]—**Spark Coil.**—To MR. BOTTONE.—The thickness of the tinfoil would produce no appreciable effect on the result; but if you interpose thick glass, or even thick paper, between the tinfoil of the condenser, you injuriously affect the condensation, as the capacity of the condenser decreases. But you can hardly say what is amiss until you have put in a contact-breaker in parallel with the condenser.

S. BOTTONE.

[96840.] — **Microscope.** — Impossible to say, unless "Micro. Amateur" will describe his lenses in full—i.e., say whether they are convex or concave, &c. If he will do this, I will endeavour to help him. OPTICIAN.

[96841.] — **Decomposition of Mercury.** — Mercury is an element, and therefore cannot be decomposed by any known means. If mercury is confined, and a sufficiently powerful current of electricity is sent through it to volatilise it suddenly, this sudden expansion will cause an explosion, if the containing vessel is not strong enough to resist the increase in pressure.

S. BOTTONE.

[96841.]—**Decomposition of Mercury.**—Mercury is an element. How, then, can it be decomposed? It is a good conductor of electricity, being a metal, and would therefore simply allow the current to pass through it. OPTICIAN.

[96841.]—**Decomposition of Mercury.**—Mercury being an element, it is a physical impossibility to decompose it. W. J. G. F.

[96846.] — **Voltaic Cell.** — Any manual of electricity will give all the information needed; but as to the actual ingredients of the cell, particulars as to what it is wanted to do should be stated. A Leclanché would do best for bell-ringing, a Daniell for steady and continuous work, a Bunsen for special "energetic" work. In the Leclanché the carbon is usually placed in the porous cell, but it is not necessary; the positions of the zinc and carbon can be reversed; all which has been explained many times. VIDEO.

[96846.] —**Voltaic Cell.**—There is no "best." It depends entirely on what you want the cell for. A good all-round cell is made as follows:—Zinc in outside cell; carbon in porous pot. Chromic acid 3 parts, oil of vitriol 3 parts, and water 20 parts, in along with carbon; oil of vitriol 1 part, water 12 parts in the zinc compartment. Always remove zinc when not using the cell. S. BOTTONE.

[96848.]—**Failure of Dynamo.**—Your query is not very clear. We should imagine you have got your lamps in series instead of in parallel, or that your dynamo series winding is opposed to the shunt-winding. This is the most probable reason of the failure.

Dudley. WEBSTER MICHELSON AND CO.

[96848.]—**Failure of Dynamo.**—You do not say if, when the dynamo is running without any lamps in circuit or with one only, the full voltage is generated. If this is the case, the fault may be due to the belt slipping, or to the armature shaft seizing, or to the series coils being connected incorrectly in regard to the shunt coils. If the latter, the ends of the coils will need to be changed over at the terminals. If the full voltage is not obtained when first started, the speed may be insufficient, or the shunt coils may be short-circuited.

G. W. LUMMIS-PATERSON.
Heaton, Newcastle-on-Tyne.

[96849.]—**Board of Trade Exam.**—The querist says he has "served five years in the drawing office," and yet has to ask about becoming a certificated marine engineer. He must go to sea in the engine-room for at least a year before he can "sit" for the exam. He can obtain full particulars by referring to the indices of back volumes or from the Board of Trade (Marine branch) itself. Some sea service (in the engine-room) is a necessary qualification before sitting for the examination. No difficulty about it, provided the candidate has the requisite qualifications; but there must be some service at sea in the engine-room. M. T.

[96849.]—**Board of Trade Exam.**—Make application to the Chief Examiner of Engineers, Mr. J. A. Rowe, 79, Mark-lane, E.C.

REGENT'S PARK.

[96851.] — **Colouring Photographs.** — To "CURIOUS."—The prints you name are not coloured by hand. If you require paints to obtain a similar result, and will forward 2s. to J. Hunt, 454, Chester-road, Manchester, he will forward you seven liquid colours he has made for his private use, which are easily applied without any previous preparation to photographs, and they can be used on any photo paper. NO NAME.

[96852.]—**Bicycle Rims.**—What "Benvenuto" requires is the "Roman" rim. This would, I think, exactly suit him. R. R.

[96857.]—**Test for Diamond.**—Distinguishing characteristics of pure diamond:—Name and colour—white, pink, yellow, red, blue, green, black, orange, brown, opalescent. Lustre—adamantine, reflects prismatic colours. Specific gravity—3·4 to 3·6. Hardness—scratches all other precious stones. Composition—pure carbon. System of crystallisation—monometric or cubicle. Form of crystal—cube, octahedron, rhombic dodecahedron, tetrahedron, hexa-octahedron. Refractive index—white 2·455, brown 2·487. Dispersive power—0·38. Electric properties—acquires positive electricity by friction, non-conductor of electricity. Fusibility—infusible, volatilised by long-continued heat. Diaphaneity—transparent and translucent. Carbonate opaque. These may partly help, but possibly following may be handier, although unsafe. Put the stone into a leaden cup with some powdered fluorspar and a little oil of vitriol; warm vessel over fire where a copious draught to carry off noxious vapours evolved. When vapours have ceased, stir the mixture with a glass rod to fish out the diamond. A genuine stone will remain intact, but a fictitious one will be corroded by the hydrofluoric acid generated around it. Perform only in the open air—dangerous. REGENT'S PARK.

[96858.]—**Doublets.**—The power of scratching glass as a diamond will. Pieces of crystal with colour between them, also piece of paste or glass covered by veneer of real stone. The real diamond has iridescence when catching light at a certain angle, the pale sapphire rendered colourless by exposure to regulated heat for some hours does not, although passed off at times. When set doublets are difficult to detect. When under part is of glass, application of a file to under as well as upper surface shows the imposition;—frequently sold by Cingalese to Europeans. Sometimes blue glass cut into facets are sent from Birmingham and Paris to be palmed off. REGENT'S PARK.

[96859.]—**Precious Stones.**—All bosh!

OPTICIAN.

[96861.]—**Shortness of Breath.**—Dr. Ruddock, speaking in his "Vade Mecum," gives thus:—Dyspnœa or difficult breathing may result from wasting disease in lung substance. Adventitious deposits in these organs; false membrane in air-passages, as in diphtheria and in asthma; a spasm of the muscular coat of air-passages or tubes causing dyspnœa. Asthma: After giving symptoms, physical signs, diagnosis, causes, he gives epitome of treament for attack. 1. Acon., ipec., cup., lob., ac. hydrocy., nitrate of amyle (by inhalation). 2. Asthma of children: Samb., ipec., gels. 3. From suppressed eruptions: Graph., sulph. zinc. 4. Chronic asthma: Ars., nux v., sulph., arg. nit., cocc., plumb., K. hydrid. Accessory means:—During fit, striking relief may be often obtained by putting feet and hands into hot water; smoking stramonium at the commencement of fit removes it like a charm in some. Inhalation of aconite vapour more certain and efficacious; also of sulphur, turpentine, or common salt, either inhaled from hot water or by spray-producer. Coffee as strong as possible, and as hot as it can be taken, without milk or sugar, is sometimes palliative. Holding breath as long as possible helps to relax spasm. Relief often obtained by fumes of burning nitre on a plate, done by placing pieces of blotting-paper, about size of hand (you can buy at many chemists this kind of paper or skin), previously saturated in a solution of the nitrate of potash; one of these dried pieces ignited and diffuses vapour in chamber; influence soon felt. After fumigation open room window wide to obtain fresh current of air. Dietary:—He gives some pages. Condensed: Avoid pastry, highly-seasoned dishes, too great a variety or too great a quantity at one meal, coffee and heating beverages. Much may be done on the side of the stomach. Sometimes diet should be weighed, hours of meal fixed and adhered to. Important point to take last solid meal at such hour as to allow time for its complete digestion before retiring. Suppers generally injurious; but a cup of bread-and-milk or a small sandwich is desired at times and may be taken. Shower-bath valuable. Exercise in the open-air not within one or two hours after meals, &c. REGENT'S PARK.

[96863.] — **Sticking Solution.** — Many things sold by stationers, such as seccotin, stickphast paste, Huggins' paste. Magnesite, sold by oilmen and colourmen, is a good sticker, and dries slowly. If you prefer making something yourself, try this: Strong glue, 50; dissolve with a little turpentine in

q.s. of water over gentle fire. Add thin paste of 100 parts of starch; applied cold, and dries rapidly.
REGENT'S PARK.

[96865.]—**Laminated Drum Armature.**—To MR. BOTTONE.—It would be practically impossible to get a working current of 20 amps. at 50 volts pressure out of an armature 4in. long by 3in. dia., because the wire you would need use to get the voltage would be too fine to carry the current without excessive heating. (2) The quantity of wire to be used for armature should be 100yd. (say 4lb.) No. 16 d.c.c.; and the F.M.'s would require about 12lb. No. 22 d.c.c. As you see, you would not get this amount of No. 16 on the A.; and if you used a similar wire, the armature would soon burn up its insulation. S. BOTTONE.

[96867.]—**Silencer for Oil-Engine.**—There is a patented silencer for gas-engines, and presumably it will do for oil-engines. It consists simply of a box containing stones, and has been described many times in these columns. Perhaps the patent has run out (I do not know the date), but I do know that the method has been frequently described. Hence I can advise the querist to look through the indices. There is no difficulty in taking the exhaust in such a way that it does not "annoy the neighbours." One way is to increase the size of the pipe (suddenly, as it were); but taking the exhaust through a box containing stones is a perfect cure.
L. M.

[96867.]—**Silencer for Oil-Engine.**—Turn your exhaust into a tub buried in the earth, attaching a small pipe to the inside of it for ventilating purposes. This would deaden any noise.
Dudley. WEBSTER MICHELSON AND CO.

[96868.]—**Oil Engine, Dynamos, and Cable.**—To MR BOTTONE.—(1) Depends on whether the insurance company would allow you to do it. If not insured, there is practically no objection, if the insulation of cable is good, say, at least, 350 megohms. (2) Yes, a trifle; a hundred revs. per minute more would suffice. (3) If the dynamo be a good one, 2,000 revs. would push up the output to about 58 volts; the ampèrage would, of course, be $\frac{50}{x}$, in which x stands for the total resistance.
S. BOTTONE.

[96870.]—**Perambulators.**—A good distance between the oil-holes in centre of large wheels is 21in. L. W.

[96871.]—**Image in Mirror.**—There is no image actually formed behind the mirror. The image seen is a virtual one, and has no actual existence. The chief difference between a real and a virtual image is that a real image is formed by rays of light converging to a point called the focus, and a virtual image is seen when diverging rays entering the eye appear to diverge from a certain point. This imaginary point is where the image is said to be formed. In the case of a plane mirror rays of light diverging from a point five yards away falling upon it are reflected. After reflection the rays have the same amount of divergence as before, and consequently will appear to diverge from a point the same distance behind the mirror as the object is in front, which in this case is five yards. You can find illustrations showing the course of the rays in almost any book treating on light. C. A. NAYLOR.

[96872.]—**Telephone Wire.**—(1) Yes. (2) No. (3) Because it is stronger for a lesser weight, and a better conductor. S. BOTTONE.

[96872.]—**Telephone Wire.**—Yes, it will do; but I should advise you bronze. The reason bronze wire is used so extensively is that it offers very little resistance and lasts much longer. S. ELLIMAN.

[96873.]—**Whole-Meal Bread.**—A MR. W. T. Hibbard, of Gloucester, some years ago read a paper on flour blended to give an ideal loaf, sweet and nutty flavour, of good size and appearance, of fine bloom, to keep nice and moist for days.

	Per cent.
For sponge :—	
High-grade spring American patent....	20
" " from white Dantsic .	10
For dough :—	
High-grade Cones flour	25
Talavera straight grade	25
Fine winter American, or Polish patent	10
Fine Hungarian	10
	100

Hard spring Americans include Manitobian, North Minnesota, South Minnesota, winter Americans, soft wheat, and hard Kansas. In whole-meal breads, hydrochloric acid and sodium carbonate in the exact proportions in which they neutralise each other. They then not only evolve carbon dioxide gas, but also yield sodium chloride or common salt. Thus:—

$$NaHCO_3 + HCl = NaCl + H_2O + CO_2$$

Sodium bi-carbonate. Hydrochloric acid. Sodium chloride. Water. Carbon dioxide.

Salt formed lessens quantity which would have to be added to the bread. Great care requisite in proper mixing of acid and carbonate; with meal right proportions to be taken. A rough measurement of strength of acid may be made by taking weighed quantity, say, 1oz. of the bicarbonate of soda, dissolving it in a beaker of boiling water, and then adding a few drops of litmus solution. Hydrochloric acid should be measured, or else a quantity placed in a beaker and weighed in it; then add acid little by little until one drop changes colour of bicarbonate of soda from blue to red. Then weigh acid-containing beaker; the loss in weight gives quantity of hydrochloric acid, equivalent to 1oz. of bicarbonate of soda. Commercial acid usually sold with guaranteed density of 1·5, or about 30 per cent. of anhydrous acid. As 84 parts of sodium bicarbonate are exactly neutralised by 36 5 of anhydrous hydrochloric acid, and as this amount is contained in 122 parts of the commercial acid, the bicarbonate of soda and hydrochloric acid of this density should be in the proportion of 2 to 3 by weight. It has been recommended that 3lb. each of acid and bicarbonate be used to the sack of flour; these proportions leave, however, a considerable excess of carbonate in bread. The great objection to acid method is that commercial acid almost invariably contains traces of arsenic. (Jago on Bread.) Not so long ago there was a formula for Hovis whole-meal bread. REGENT'S PARK.

USEFUL AND SCIENTIFIC NOTES.

AN electric tramway is now in operation between Cannes and Mentone. The tramway owes its origin to English enterprise.

THE State authorities of Pennsylvania, U.S.A., the centre of the oil, coal, iron, and steel products of the Atlantic Coast, are urging upon Congress the necessity for deepening the river Delaware. It appears that the Delaware River has only a 24ft. channel, while Baltimore has a 30ft. channel, Norfolk a 29ft. channel, New York a 30ft. channel, and Boston a 27ft. channel. It is estimated that the cost of excavating a channel 30ft. deep and 600ft. wide from Philadelphia to the sea would be £1,187,000.

The Largest Railway Station.—Describing the new Waverley Station at Edinburgh, *Engineering* gives a table which compares it with those of the Great Eastern Railway Station at Liverpool-street, London, and the London and North-Western Railway Station at New-street, Birmingham. These three stations are assumed to be the largest in the kingdom. The Waverley Station at Edinburgh is the largest. It covers 23 acres of ground, one-half of which is under roof. Liverpool-street Station covers 22½ acres, or half an acre less than the Waverley. It has 6½ acres under roof, or 5½ acres less than the Waverley. New-street, Birmingham, covers 10¾ acres, or 12¼ acres less than Edinburgh. It has 8¾ acres under roof, or 2¾ acres less than the Waverley. So far as platform accommodation goes the Waverley Station also heads the list. Alongside its platforms 130 carriages could stand, while at Liverpool-street Station 103 could be provided for, and at New-street Station, Birmingham, 69. In Edinburgh Station the lines are worked from 565 signal and point levers. One of the four signal cabins is believed to be the largest yet constructed, containing as it does 260 levers. Liverpool-street Station has three signal cabins, containing in all 424 signal and point levers. New-street, Birmingham, has six signal cabins, containing in all 584 signals and point levers.

The Great Earth-Mill.—Writing under the title "Secrets of the Earth's Crust," Prof. Cole, in the October issue of *Knowledge*, says:—"The central axes of our mountains . . . where denudation has had full play, show us the crushed and crumpled rocks brought up by folding from below. In certain regions, again, such as Scandinavia and north-west Scotland, mountain ranges have been worn down to the roots, have been laid bare in horizontal section, and here we come into touch with some of the more intimate secrets of the crust. . . . Rocks composed of more perishable or softer materials naturally suffer in still greater degree from the earth-mill. Gabbros go to pieces, the augites becoming dragged out as bands of brown-grey powder, and the basic felspars forming a compact and almost porcellaneous ground. In a great complex series of rocks, subjected throughout to pressure-metamorphism, it may often become impossible to recognise the character and relations of the original constituent masses. . . . It is odd to look from our microscopic section to the map of Europe, and to trace in both the action of the great earth-mill. The waves of contorted rock, pent up against some pre-existing crystalline core, and broken against it in all the complexity of overfolds and regional faults—what are these but the features that mark a gigantic foliation in the crust? The massive breccias that occur along the thrust-planes appear as films of flowing mylonite. At one point, an 'eye' provides attractions for the Alpine climber; at another, the yielding ground-mass has been seized on by the peasant for his fields."

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

QUERIES.

[96876.]—**Model Yacht.**—I am thinking of making a model yacht as much as possible on the lines of the *Shamrock*, and I should be much obliged if some correspondent could give me the principal measurements. I propose to make the hull about 2ft. long.—HAROLD.

[96877.]—**Electric Light.**—I am thinking of putting the electric light into a shop. Can any reader give the consumption in units per hour of 16c.p. incandescent, the large incandescent, and 500c.p. and 1,000c.p. arc lights?—A. COLTMAN.

[96878.]—**Trigonometrical.**—A B C is an equilateral triangle, and P is any point in its plane. Having given that the lengths of P A, P B, P C are a, b, c respectively, find the length of the side of the triangle, both when P is within and without it.—RADIAN.

[96879.]—**Rainbow.**—To "F.R.A.S."—Will you be kind enough to explain the cause of three very remarkable rainbows which myself and others saw in Tunbridge Wells on the 11th inst., time just before and after four o'clock? The tops of two bows pointed towards the sun, a part of one appeared perpendicular in the usual natural position. The two were high in the zenith. I hope they were observed by yourself.—H. HARMAN.

[96880.]—**Refraction.**—To "F.R.A.S."—Will you kindly explain how to correct the mean refraction for barometrical pressure when observing on a plateau about 5,600ft. above sea level. Most tables only provide for cases in which the barometer stands at 28in. and over. I wish, very precisely, to correct for refraction on observation under the following circumstances—viz., app. alt. 14° 40′ 0″, external thermometer 35° Fahr., bar. 24·3in., attached thermometer 35° Fahr. Thanking you in anticipation—MINER.

[96881.]—**Malting Wheat.**—Would any reader tell me how wheat or wheaten bran is malted? I know how barley is malted, but I am informed that wheat is treated differently.—MERCHANT.

[96882.]—**Vinegar Plant.**—Will someone describe a vinegar plant and how to keep it?—F. A. M.

[96883.]—**Diamond.**—Will an ordinary diamond be damaged if subjected to fire? If so, what heat would destroy it?—CHUCK.

[96884.]—**Zincos.**—Can any of "ours" kindly inform me how to make printers' zincos., or name a good book on the subject?—J. L.

[96885.]—**Egg-Shaped Mallet-Heads.**—I wish to know the way to bore egg-shaped mallet-heads? And can they be bored with lathe?—H. F. Y.

[96886.]—**French Verbs.**—Recently looking over an old French grammar (1814) I noticed that regular verbs of the first conjugation—(in *er*)—take *ois* in the imp. indicative, also in the conditional. This struck me as being so remarkable that I am induced to ask my fellow readers for information on the subject. I presume the pronunciation has changed with the spelling?—W. B.

[96887.]—**Clocks.**—Will any reader kindly inform me where I shall find particulars of the old clock in the "Rotunda" at Woolwich Arsenal?—H. D. H.

[96888.]—**Mountains Quaking Without an Earthquake.**—In Exodus xix. 27 we read, "The whole mountain (Sinai) quaked greatly." But "F.R.A.S." assures us, any earthquakes at that time (p. 184) have their existence in the imagination of your correspondent only, for assuredly the Bible says not one syllable about them. But how does the mountain quake without the earth? Shortly afterwards, the earth swallowed up Korah and his company (Numb. xvi. 33). I know of no story of earthquakes more plain in any history.—E. L. G.

[96889.]—**Objectives.**—Will "F.R.A.S." kindly say what is the value of an object-glass formed by two lenses of same kind of glass, with the transparent liquid element between—e.g., double convex lens, then water or HCl glycerine, then double concave or convexo-concave, or plano-concave lens? Any information will much oblige.—CURIOUS.

[96890.]—**Lahmeyer Dynamo.**—To MR. AVERY.—I have made a dynamo according to instructions given by you in the ENGLISH MECHANIC of May 7, 1897, with a four-pole armature. When driven at 3,000 revolutions it just gives current enough to deflect a galvanometer needle when put in circuit. I have tested the F.M. and A. insulations, and find them all right. The F.M.'s were magnetised by two bichromate cells. Is that enough, or should more cells be used? Is the quantity of wire right: 4oz. No. 20 on A., and 5oz. No. 20 on each pole-piece? I shall feel obliged if you will let me know the probable cause of its failure.—J. F. SEERVAI.

[96891.]—**Sun Views by Projection.**—Proctor, in his "Half-hours," recommends the use of a circular piece of glass ruled in quotations of $^1{}_{200}$in. apart, to form a network of lines across the image of the sun. What should be the cost of this (approximately)? Is there any other contrivance which would do as well, or better? Proctor says that a Huyghenian eyepiece should be used. Another book I have says that the Ramsden is employed. Are both forms suitable, or is there a mistake somewhere? If I use an ordinary diagonal to throw the image of the sun on a screen, in what way will the image be inverted? By using a diagonal I shall be able to screen myself from the sun, which otherwise is extremely difficult in this country.—E. G. R., Masulipatam.

[96892.]—**Harrison - Cox - Walker Telephone Instrument.**—Would anyone kindly give a diagram showing the internal and external connections of these instruments?—W. H.

[96893.]—**Gains and Losses.**—A limited company shows an annual profit of £1,520. Its (erroneous) trial monthly balance-sheets show that it has made £3,630. These trial monthly balance-sheets, although wrong as to actual amounts, are correct as to ratio, and show a *loss* as follows:—January, £670; February, £10; March, £750; April, £810 = £2,250. And they show a *gain* amounting to:—May, £1,310; June, £1,650; July, £900; August, £160; September, £610; October, £390; November, £90; and December, £770—in all, £5,880. How can you determine the actual gains and losses of each month, taking the ratio of the erroneous monthly balance-sheets as a basis to work upon?—E. P. P.

[96894.]—**Crickets.**—Having recently moved into a new house, we find it is infested with crickets. Could any of your correspondents give us a remedy to get rid of them? We have tried several powders, but they have not answered.—Cricket.

[96895.]—**To "Monty."**—Thanks for reply. What pressure per square inch is best in firing tube lamp? Will it work well if tank is below lamp, if the pressure is sufficient? Would a porcelain, platinum, or nickel tube be best? Do you consider that, taking into account the weight, complication, and cost of electrical ignition, it is to be preferred to the firing-tube and lamp? I have drawings of Pennington motor of about four years ago, to which you referred, and find that the petrol is fed into the air-pipe by a needle-valve, as you said. I should not think that this would be quite satisfactory, but should like to hear your opinion as to whether a vaporiser which thoroughly mixed the air with the vapour, and being heated, say, by the waste heat of the lamp, would not be quite as efficient and more simple than the carburettor described by "The Writer of the Articles."—Investigator.

[96896.]—**Drawing an Eccentric Ellipse.**—I wish to draw an ellipse as exactly as possible, having a major axis of about 20in., and a minor axis of about 3½in. This is a rather extreme eccentricity, and makes it a matter of some difficulty to draw this ellipse exactly. The foci are so very near the vertices that the most exact measurement I could make of it would perhaps give a serious error in finding points of the curve. The common method of finding the curve by means of a taut thread and two pins does not give trustworthy results, owing to the stretching of the thread at some parts, and fine wire is little better. Perhaps some of your readers may be able to advise me as to the best method of drawing an eccentric ellipse exactly, or what precautions should be taken in either of the two methods I have mentioned to secure accuracy? I use, of course, logarithmic paper.—B. B. M.

[96897.]—**Slade Micrometer.**—Can any reader suggest a handy way of illuminating a Slade micrometer, fitted on an ordinary 4in. equatorial refractor, German pattern, equatorial head, as usually made?—Fleur-de-Lys.

[96898.]—**Nickel-Plating.**—What is the best way of reducing the solution when it has become very acid, owing to the anodes failing to replace the equivalent of the deposited nickel? After neutralising with ammonia there is a precipitate, ammonium sulphate presumably. Will the addition of nickel sulphate—the single salt—set it right by combining with the matter in suspension, and forming the double sulphate? Any practical information will oblige.—E. A. W., Rhyl.

[96899.]—**Tides.** — Will some nautical reader, or perhaps "F.R.A.S.," kindly explain the following point to me? In the Admiralty tide-tables a list of ports in all parts of the world is given, with their respective times of "high water, full and change of the moon," from which the establishments of the ports are deduced. The expression "Time of high water, full and change of the moon" leads one to suppose that, at any given place, high water occurs at the same time both at full moon and new moon, and also that at each full moon and each new moon high water still occurs at a fixed time; but the moon does not become full or new at the same hour each lunation, nor does full moon occur at the same hour as new moon in a particular lunation. How, then, can high water occur at a fixed hour?—Fleur-de-Lys.

[96900.] — **Grammaphone.** — Will Mr. Bennett kindly inform me where to look for the fault in my grammaphone? It screeches every now and then, and the sound is not perfect. Is the diaphragm to be as thin as you can get it? Could any reader tell me how to drive my grammaphone with a weight running down a distance of 3ft.? I find that it requires to go round about 200 times to run a record down.—A. Walford.

[96901.]—**Wimshurst.**—To Mr. Bottone.—To make 18in. by $^1/_{16}$in. ebonite discs more rigid, and to dispense with washers between the two plates (which are now ⅜in. apart), I propose to fasten on outside of discs, with tire cement, two well-varnished wood discs, say, ⅛in. thick (or other material you may suggest). Will you please advise as to the wisdom of the idea, and also the largest diam. allowed without in the least reducing the efficiency of the machine?—Wm. Milnes.

[96902.]—**Gas Explosions.**—If you try to light the jet of a hydrogen bottle before all the air is expelled, an explosion occurs. If you light an ordinary gas-jet into which air has leaked, you get a blue flame, but there is no explosion in the pipe leading to the burner. Why is there this difference?—L. L. L.

[96903.] - **Double Contact Relay.**—Will someone please tell me how to manage this? I want to close two distinct electric bell circuits with one relay. In theory it appears simple; not so in practice, because if the two connections are made to back of relay, and the other connections to contact-pillar, if both batteries are not exactly equal the storage has a tendency to short circuit itself through the other when contact is closed.—Parallel Arc.

[96904.]—**Ashes or Cinder Sifter.**—Can anyone tell me some simple plan of "riddling" these without being a nuisance to the neighbours, and smothering myself with dust? There is a galvanised-iron arrangement patented that answers well, but it is too expensive. I have an idea of a sack-bag to fit the riddle and another to cover it. Will someone please put this into a practical form? Any suggestion will oblige.—Hard Up.

[96905.] - **Negatives of Diagrams.**—Will someone give me hints upon taking photographic negatives of diagrams drawn in black upon white paper? I fail to get sufficient contrast between the lines and the ground of the negative, with the result that while the diagram prints out, some light gets through the body of the negative as well, and what should be the white ground of the print becomes discoloured. My method has been to fasten the diagram to the wall opposite to the window, so as to secure a good light, and then to photograph it.—A. P.

[96906.]—**Arc Lamp.**—Will some electrical reader kindly explain—1. Whether a hand-feeding arc lamp can be got to burn steadily without spluttering? 2. Why some carbons have a soft core in their centre? 3. What is the best diameter for + and − carbons for lantern use, having special regard to steadiness? I have recently been experimenting with a Ross-Hepworth arc lamp, with the intention of using it for illuminating cinematograph pictures, but have not been able, so far, to get it nearly steady enough for my purpose. I have been using it with 13 amps. 60 volts. I got a very good quality of light, the only objection being the spluttering. Is this the fault of my inexperience, or what?—Lanternist.

[96907.]—**Wireless Telegraphy.**—To Mr. Bottone.—1. I have made a coherer on Marconi's plan with filings in a glass-tube in circuit with a relay and a Leclanché cell. The relay has a soft-iron core, horseshoe shape, wound with 2oz. of No. 30 s.c. wire. The armature is soldered to a thin strip of brass cut from a cartridge-case, and adjusted with two brass screws, which make a connection with a similar cell, an electric bell, and the decoherer. At the transmitter end I have a ½in. coil, three brass balls arranged thus—o O o, connected with a vertical wire 8ft. high. With this I can ring the bell in any part of the house; but when rung the bell will not stop until disconnected from the cell, notwithstanding the vigorous working of the coherer, as the slight sparking of the relay and the bell appear to excite the coherer afresh. How can I prevent this? 2. The vertical wire of the coherer is only 24in. high, as I wish the bell to be portable. Would a strip of metal arranged horizontally like wings be more effective? And would the addition of another ball, thus—o O O o, increase the power and range of the electric vibrations? The length of the vertical wire at the transmitter end is limited to the height of the room, and the effect of the discharge is not always sufficient to ring the bell on first pressing the push. Is this due to want of sensitiveness in the coherer and relay, or to the shortness of the vertical wires?—G. M. S.

[96908.]—**To Mr. J. Dormer.**—Will you be kind enough to answer the following questions? (1) Whether I can take antiquarian photo. prints by electric light in an ordinary flat printing frame? If so, how many are lamps shall I require, and what candle power? (2) Recipe for ferro-prussiate printing paper. (3) Whether I can put sensitised solutions on parchment without it crinkling up. The reason I ask No. 1 is because I have a flat frame and want to save buying a special cylinder, if I can do without.—W. J. A.

[96909.]—**Gilding.**—Will any of "ours" tell me how to gild the edges of a few books? I want to do them myself if possible.—Gilder.

[96910.]—**Belt Lacing.**—Will some reader tell me how the leather is prepared that is used for belt lacing? If it is not a trade secret a full description will oblige.—Oudeni.

[96911.]—**Accumulators.**—Will any of our readers please say in what respects (apart altogether from the expense of forming) the "pasted" plates are better or worse than the Planté method.—L. W.

[96912.]—**Pasting Accumulator Plates.**—Will some electrician kindly tell me if there is any chemical that may be mixed with the red-lead paste so as to make it harder or less liable to fall off when in use? Also, how may spongy lead be made satisfactorily, as I have tried making it from lead acetate, precipitating it with zinc, but it crumbled and became hard when pressed into the grid? It is also a rather expensive way when a lot of plates are to be pasted. And how can I make porous lead plates like those made by the Crompton-Howell Company, as their way of casting a large block and sawing it into plates is impossible for an amateur?—P. A. S.

[96913.]—**Workshop Lamps.** — All things considered, what is the best lamp for a workshop where plenty of artificial light is required, by burning paraffin-oil—duplex, round wick, or the patent lamp requiring no chimney and wound up with a key? What class of reflectors are the most suitable, giving back the greatest amount of reflected light? Can I increase the reflection by a block-tin reflector round top of chimney, or shall I require a white enamel one? In fact, I want all the light possible to be obtained from such lamps, and as they are so varied and numerous on the market, it is hard to choose.—Jasmine.

[96914.]—**Astronomical.**—Would any reader kindly show me how to find (in mean solar time) how long a star which rises exactly in the east remains above the horizon?—Novice.

[96915.]—**Comets.**—What is the origin of this statement? Astronomers say that in the solar system there are at least 17,000,000 comets of all sizes. Why "at least," and who are the astronomers?—D. B.

[96916.]—**Isle of Man Steamers.**—Thanks for "Red Admiral's" reply to my query in last week's edition. There is one thing not mentioned, the speed of the two steamers *Mona's Queen* and *Peveril*. He gives the *Tynwald*. If unable to give it, perhaps he could give the *Duchess of Devonshire*, of Barrow. That boat left same time as *Mona's Queen*, and kept almost level with us, so if he could give some particulars of this boat will oblige. Or could he give the distance in miles from Peel to Belfast, Douglas to Fleetwood, and Douglas to Ardrossan? Time taken 4 hours, 3½ hours, and 7 hours respectively.—Alexander.

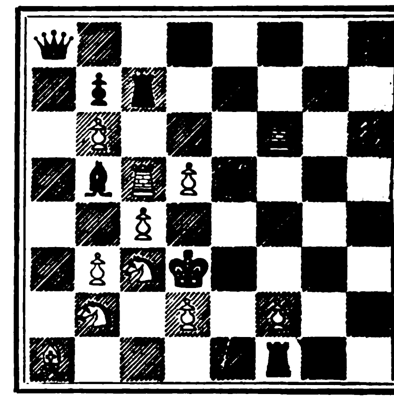
[96917.]—**Faint Stars.**—Among several correspondents to the "E.M." in 1876, re faint stars between ε 1 and ε 2 Lyræ, Mr. R. A. Proctor, in No. 597, p. 640, sends a chart of the stars observed by Mr. Bassnett in the "clear air of Western America," with a 6¼ refractor, by Fitz, of New York, of "singular excellence." The chart contains about 100 minute stars! Isn't there some mistake? If a correspondent of less weight than our revered "R. A. P." had spoken it, and apparently thought so much of the chart and of the observer's trustworthiness, I would not have mentioned it. Mr. Proctor, too, mentions somewhere of Vega's 36 companions (in his "Half-hours," I believe), observed at Harvard. Isn't there some mistake here, too?—A. Ashby, Croydon.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1697.—By A. F. Mackenzie.

Black. [7 pieces.



White. [13 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Oct. 30.*)

Solution of Problem No. 1695.—By C. A. Gilberg.

Key-move, B-K sq.

NOTICES TO CORRESPONDENTS.

Problem No. 1695.—Correct solution has been received from Joseph Elster, F. B. L. (Devonport), Rev. Dr. Quilter, Richard Inwards, A. Tapman, J. E. Gore (we noticed the coincidence too late), G. W. U., F. B. (Oldham), T. Clark, Quizoo, T. Jones, W. Walton.

F. Chipperfield.—Only solution of No. 1694 as published last week.

Whin-Hurst.—May he win a V.C.!

The North Bessemer Tunnel on the Pittsburgh, Bessemer, and Lake Erie Railroad is nearly 1,000 yards long, of horseshoe section, 23½ft. high, and 26ft. wide. The excavation was carried on from the ends and two intermediate shafts, and consisted first in driving a top heading of from 19ft. to 21ft. bottom width, and 8ft. high at the centre. This heading was followed by two benches, the first or upper bench being loaded by means of chutes into side dump-cars. The lower bench was blasted loose, and loaded into grading-cars by steam shovels.

To Preserve Fish Glue for Process Work.—Herr Gaedicke recommends the following method in the *Photographisches Wochenblatt*. Clear the whites of some fresh hens' eggs and beat them to froth. Let them settle for twelve hours, and pour off the clear fluid. The following stock solution should then be made up:—Albumen 7c.c., fish glue 7c.c., distilled water 14c.c., carbolic acid (five per cent.) 1c.c. After well mixing, filter the solution thrice through cotton-wool. The solution will become perfectly clear if it is allowed to stand for some weeks; but this is unnecessary, as the particles which produce the cloudiness are so fine that they may be disregarded. A 10 per cent. solution of ammonium bichromate should also be prepared. Both solutions are stable. For use mix four parts of fish-glue solution with one or two parts of bichromate solution, and then add ammonia drop by drop until the fluid is of a greenish straw colour. The sensitised solution should be mixed fresh each day, and the unused portion thrown away. This method will be found conducive to regularity and certainty of results.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, OCTOBER 27, 1899.

INLAYING.—III.

APART from the commonly-known woods, such as pine and its varieties, as red, yellow, white, American, and that beautiful class known as Swiss—all of which, by the way, come very acceptable as grounds to work upon—we have the choice of the more expensive, such as mahogany, birch, oak, walnut, and Hungarian ash—woods that are light-brown tint is employed, coloured woods show up well, without any adjunct whatever. Oak is seldom used; mahogany is the general medium as much in years past as at the present day. Most of our work will be in mahogany, so need not comment further here.

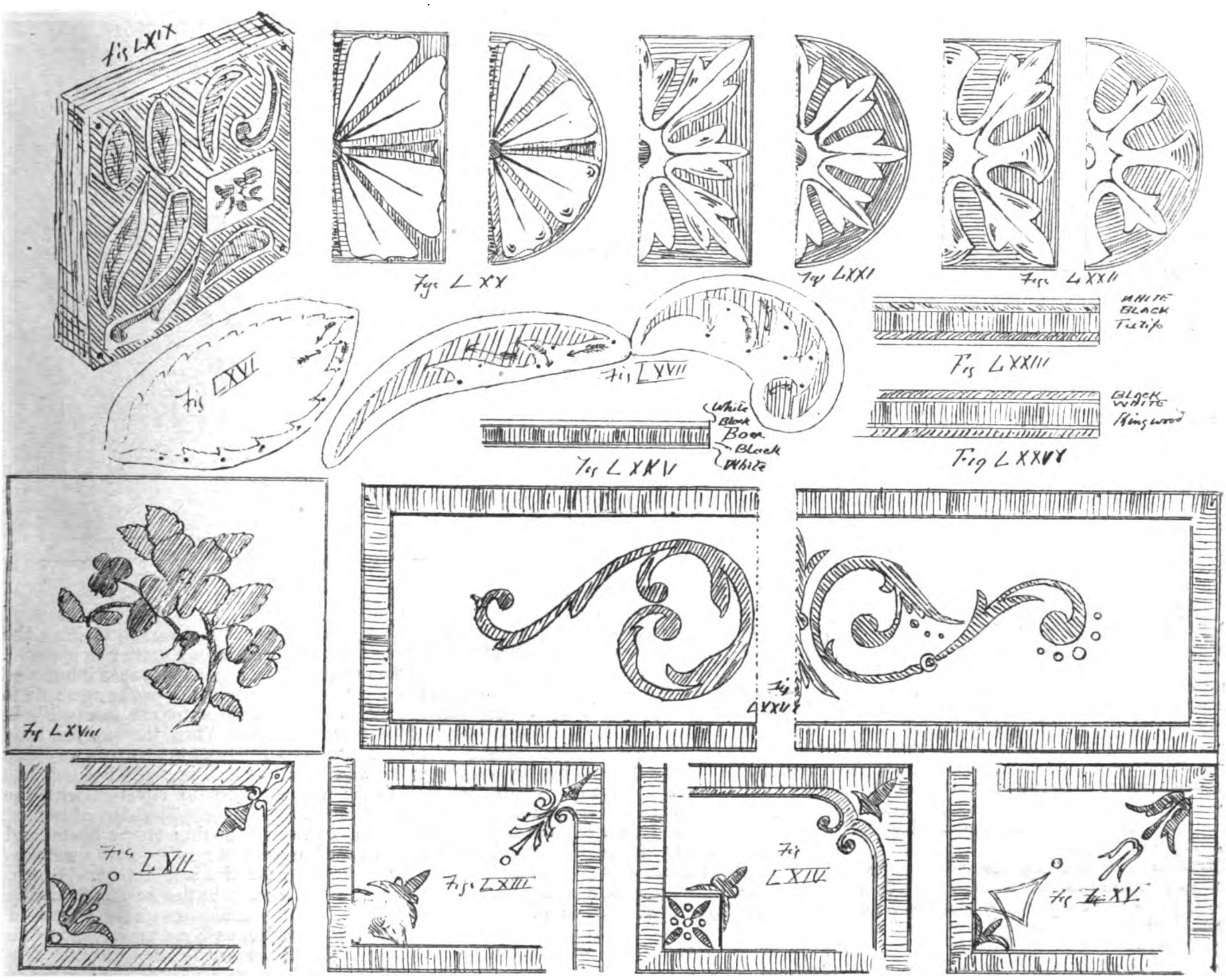
Kingwood, from its rich dark browns, reds, and yellows, is also an excellent banding, and when used in widths up to 3in. show up grandly. Coromandel forms an excellent medium for silver ornament, its dense brown red and straight figure lending well to ornamentation when in small panels or friezes.

Other woods again can only be employed in direct conjunction with those of greater or lesser contrast; as, for instance, Amboyna much sought after, and in general use for a better class of work. Though possessed of a certain amount of colour and figure, they are not so beautiful as the rarer kinds, known as rosewood (a misnomer), or, more properly speaking, polysandra, and tulip wood, which has another name, "Bois de Rose." The former is a fine medium for white ornament, and is also used for flowers, though we must candidly confess there are many pieces of cutting of this sort that should not have been recognised, some flowers almost merging into the ground. Good contrast can always be got with little trouble, if a panel is formed of another colour ground, and then superimposed, so to speak, on the greater, or rosewood, ground. Either of the above woods looks well as a banding, both wide and narrow, and give effect and relief that cannot well be described on paper. Walnut is largely used for both flower and ornament, and if the burr or Turkish walnut of a medium with neat flowers, will bear a satinwood or black banding, or both together if of narrow dimensions, or, if with boxwood ornament, cut in has a pleasing effect, and can either carry a border or not. Boxwood, by the way, is not used for panels and such portions, but is invariably used either as stringing or cut, as above stated.

A choice variety of rarer woods can be got with such as acacia, hawthorn, snakewood, partridge, pear, apple, and quince; for flowering ornament, green and violet ebony, and pomegranate in narrow bands look well with coloured ornament cut in. Amaranth, a rich purple which darkens when exposed to light, looks rich if cut as an ornament, and let into a satinwood or Hungarian ash ground. Coral and sandal look well as little ornaments superimposed on dark grounds. There are many more; but we think the above quite sufficient, for even the most fastidious cutter.

The principal wood used in dyeing is holly. From its whiteness and even texture it is largely in demand for white ornaments and coloured flowers. It is, in fact, the marquetry cutters' typical wood, not only for reasons above stated, but because it holds up well under the saw, whether cut across or with the grain, and takes the different dyes admirably. Plain grain sycamore and chestnut are both white or nearly so, but are not used to any extent, therefore call for little comment.

The different colours and tints in request are gained by steeping the veneers in a boiling solution for a given time, or pouring the hot liquid on the veneers, which lie in troughs or other receptacle, and letting them soak, sometimes for days together.



For small pieces of veneer, an ordinary frying-pan and an inner dish, well glazed (a pie-dish will do), and of such size as will leave a space all round ½in. less than the pan, will be about the size. The pan will require a thick layer, ½in. or so, of silver-sand, in which the dish with the required dye is laid. The pan with the sand will be required to shade our work when cut, so need not be cast aside. We use the sand wet to dye with, and dry when shading. The different tints or tones of colour are gained by a shorter or prolonged immersion. Hot liquids with the articles therein take less time, as a rule.

As blackwood plays an important part, and is largely used, the method of dyeing will be treated first. A two-solution dye is needed to gain the best results, although those who are able to purchase the French stain that is in the market will avoid much trouble. For those who cannot, the following

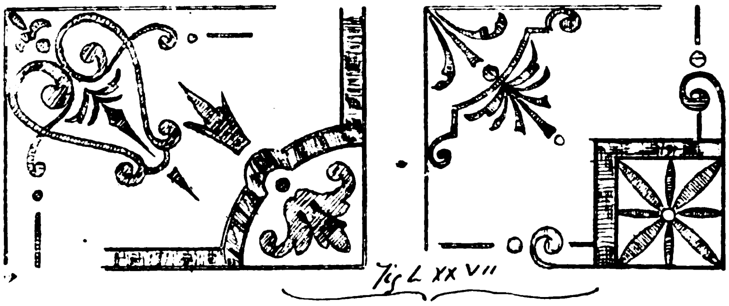


Fig LXXVII

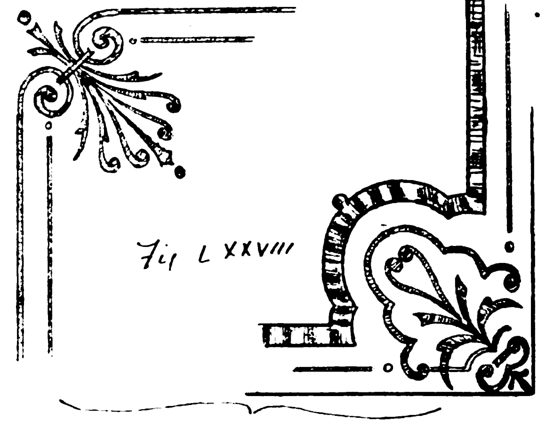


Fig LXXVIII

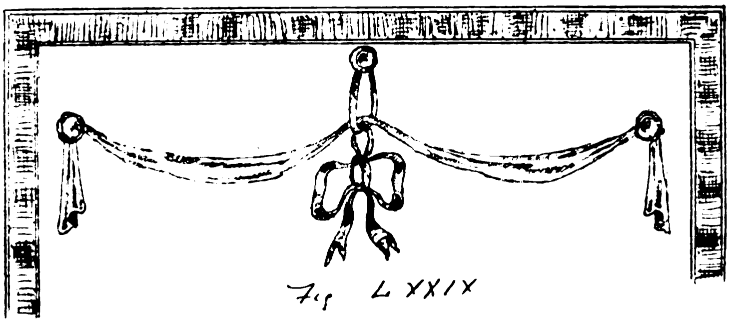


Fig LXXIX

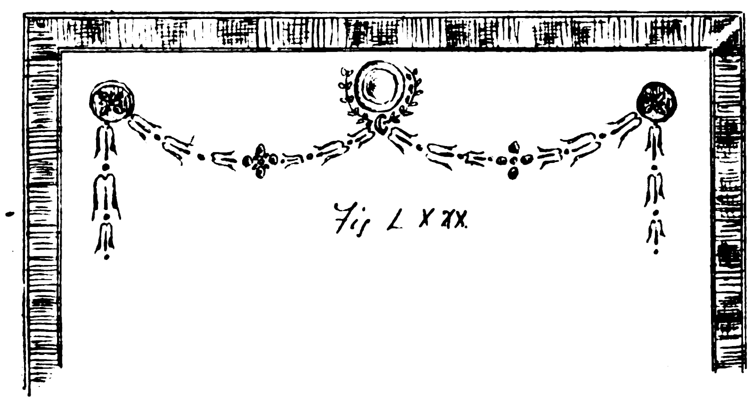


Fig LXXX

Fig LXXXI

is reliable:—To ¼lb. of logwood chips are added three pints of water, some walnut peelings, and half a pint of vinegar; the whole to be made quite hot in using. The second solution is simply ½oz. green copperas dissolved in a pint of water, also made hot. The process is to immerse in the first liquid or decoction until thoroughly permeated; when partially dry, the wood can then be immersed in the second until the desired depth of black is gained. Test it by cutting a piece off.

Let us here caution the manipulator to keep all veneers as flat as possible; that is easily done by pressure. When the veneers are half-dry, they should be retained under pressure until thoroughly dry. Changing the position by bringing the centre pieces to the top and bottom will improve matters. It is a difficult job to cut six or eight thicknesses of veneer if they are buckled or uneven, irrespective of breaking saws innumerable. A hot solution of nitrate of silver will blacken if the veneers are exposed to the light or sun's rays for a short time. The persulphate or acetate of iron can be used in lieu of the copperas solution.

Reds and scarlets are gained—the former with cochineal, the latter with scarlet lac dye, or some pieces of scarlet cloth boiled in with the veneers, adding a little chloride of sodium or common salt. Chloride of tin and Brazil-wood chips, or a strong solution of logwood ditto, will give good reds.

Sulphate of indigo is in general use for blues, and the addition of potash will give any tone from light to very deep. A saturated solution of verdigris, or the chloride of tin above mentioned in solution as the preliminary dyeing, after immersing the veneers in hot fustic liquor. With this recipe any tint can be gained at will.

A violet tone is got by using the tin mordant. Afterwards lay the veneers in a hot solution of logwood.

Yellows are got by means of turmeric and saffron, with a little picric acid. (The latter is poisonous.)

The above are the principal solutions in use; but much may be done by resorting to the natural coloured woods where applicable, although the process of dyeing is simplicity itself. It is far better to purchase the veneers ready for use if possible, and that applies to the narrow strips or stringing, as above mentioned. Yet we shall in future chapters explain the method of making-up bands, narrow borders, stringing, &c. Handle your veneers with wood forceps or tongs; if cuts or bruises are prevalent, the above solutions will not tend to mend matters.

For ivory work much of the above may be used; but let us here say, cut your articles, or, rather, ornaments first from the natural ivory and then dye them. Artificial ivory must be purchased already stained, as we know of no method of doing it (it being a patent). Soda tends to darken mahogany; potash also darkens—especially is that so with oak.

Preparing the Wood for Cutting.

If only one or two veneers are chosen, then a backing of some sort, preferably the waste pieces of pine used to make small boxes are excellent, and not costly. Some fine wire nails will be required, called "veneer pins." They can be purchased at any veneer merchant's. A given quantity of veneers are cut of an even size—say, for convenience sake, about 6in. square. When the veneers are pinned together at the four corners, the pounced design is glued on the uppermost veneer. Thin glue is best for this reason: in cutting we must keep the work as free from sticky matter as possible. Some cutters used greased paper interposed between the veneers. We prefer as a rule to apply a little beeswax to the saw while in the act of cutting. When the saw has been thrust to its limits from the cutter, we apply the wax, which is held in the left hand, and of such a size as not to interfere with the handling of the veneer. The saw, of course, cannot be turned, having only a lateral and downward movement; consequently we must turn the work for the saw to cut. A little practice will soon gain the knack of turning to a nicety, the guide answering a twofold purpose: it enables us to cut square, and takes the weight off the wrist of the cutter.

The first four examples that are given at Figs. 62, 63, 64, and 65 should be sufficient to enable the cutter to overcome some of the obstacles that may appear difficult in future designs. Assuming, then, the earlier and simple examples have been tried, upon reference to the rough sketch in perspective of our work, it will be seen to have a few round dots marked. That is a guide to a system that must be adhered to throughout the cutting examples, and is explained to suffice for all. All work must be started from as near the centre of its bulk as possible, and *worked outwards*. For that reason we bring into service the handy little tool the Archimedean drill, and drill a hole through the entire thickness and at the spots, as dotted. Were we to start cutting our ornament from the outer edges, it is just possible the veneer at that part cut would foul the jaws of the donkey, and break up. To avoid that, we ever endeavour to keep the outer portion intact.

Again, the more surface there is to be grasped in the jaws, the better the holding;

Fig LXXXII

Fig LXXXIII

Fig LXXXIV

Fig LXXXV

whereas, if we commenced at the edge, more than half our work would be cut away.

The other reasons will be self-evident as we proceed in our work. It must not be inferred that as we sketch our panel, corner, or whatever it may be, so it is cut. Not so. For economy's sake we subdivide it, and glue the leaf upon the green veneers, the bud upon the red, or whatever colour is needed—in short, our little blocks of 6in. square are mostly of the one colour, but can be of two or three shades. The same applies to the flower blocks. The design as cut in paper form must be as close to the dots (the pouncing) as the scissors will permit.

Fig. 57 indicates the travel of the saw as the arrows point. To cut a sharp angle as at A, it is necessary to draw the saw back gently. Cut a little space away as at B, which will enable one to make the back of the saw take the place of the teeth. In that way we shall be able to retain sharp and definite serrations at the bottom, as shown at Fig. 57. It then remains to cut outwards. By turning the saw completely round, a hole will be made sufficient to commence the second downward cut, and so on until the whole side has been cut. To return the saw to our starting-point—as, for instance, in a leaf—a little of the waste can be cut away to give freedom, finally meeting the two cuts at the base of the leaf. As dexterity in the use of the saw is gained, so can the operation be varied; but in no wise should a slender piece of work be cut on one side entirely. Endeavour to cut from both sides, leaving the greater bulk, which is the strongest, till last. One of the most difficult pieces of work we have to contend with is an ornament, flower, or leaf in *cross* grain. To get the point intact, the weakest support should be cut away first. It may happen that there is little perceivable difference; in that case it is advisable to cut on both sides a little at a time, and that very gently, until substance remains to stand the strain of the saw. Reference to Fig. 67 will assist us in our meaning. In work of more complicated a nature, a duplicate-formed design will be needed to assemble the cutting upon, for reasons previously stated. A duplicate design is got by taking a rubbing with heelball.

Having blocks ready with the designs glued on, and the holes drilled, the saw is released in the front clamp and guided through one of the drilled holes, with the design facing the cutter. Spring the frame together, and clamp the saw tight. The frame is best taken out of the sockets, and by turning the frame completely over, resting on our left side, it should not be a difficult matter to slip it through the hole and pinch up without breaking the saw.

Do not hack your work; endeavour to thrust the saw through its entire cutting length; but in turning, and on very delicate portions, due care must be exercised, otherwise broken work or broken saws will follow.

We must not overlook this fact: that we shall require as many pounced designs as we have different coloured woods. For instance, a given design, as at Fig. 68, contains two reds, two greens, one blue, and one white. If our blocks of veneers contain two or more shades of a given colour, then one paper-pouncing of each will suffice. The two flowers should be got from one block, the five leaves from one block, the two little centres of white from one block, and the bud, if not of the colour desired in the flower block, must be cut from a separate block of lighter tints. If a vase is required, one block only will be needed. The cutting of the design will require a slight modification where it is intended the saw cut or kerf should show a division, then the pouncing need not be cut up; but where the jointing is desired close, separation is necessary to enable one to cut half the dots (pounced) away, so that when brought together a close joint is attained.

Fig. 68 shows how a ground-work design is glued on to cut away so as to leave room for the different pieces that are cut separately. Fig. 69 gives the nailed-up block of veneers, and shows the manner of utilising our blocks to the best advantage. Figs. 70, 71, 72 are practical illustrations of adapting the square design to a circular, or *vice versâ*. Figs. 73, 74, 75 show how narrow banding is glued up for small quantities. The cutting-gauge has to take the place of the circular saw. The best method is to cut from cross-grained woods, of such selection as pleases the reader, and to unite them on a piece of paper by gluing the paper with thin glue, and working up the amount that may be required. Whether it is only two breadths or twenty, the process applies to all. A thin lath is nailed down on the paper as a guide, the paper being still tacky. The first line or string is put close up to the lath, the other lines and landings are worked up until the amount required is made up. Where the widths are supposed to separate, do not put any glue, but the other jointings may as well be glued. It remains, when dry, to separate each width with a thin knife. It may be found, in working up wider bands than a ½in., necessary to apply a few weights or heavy piece of flat wood, to keep them flat. The bandings can be let in before veneering. In that case, they are assembled in conjunction with the marquetry cutting, and held together here and there with a few veneer pins, allowing them to stand up when the work is complete. A piece of paper is glued and laid on bodily, forcing adhesion of the paper to the veneers with a stiff shoe-brush. If it is found necessary to apply weights or a piece of heavy wood, the veneer

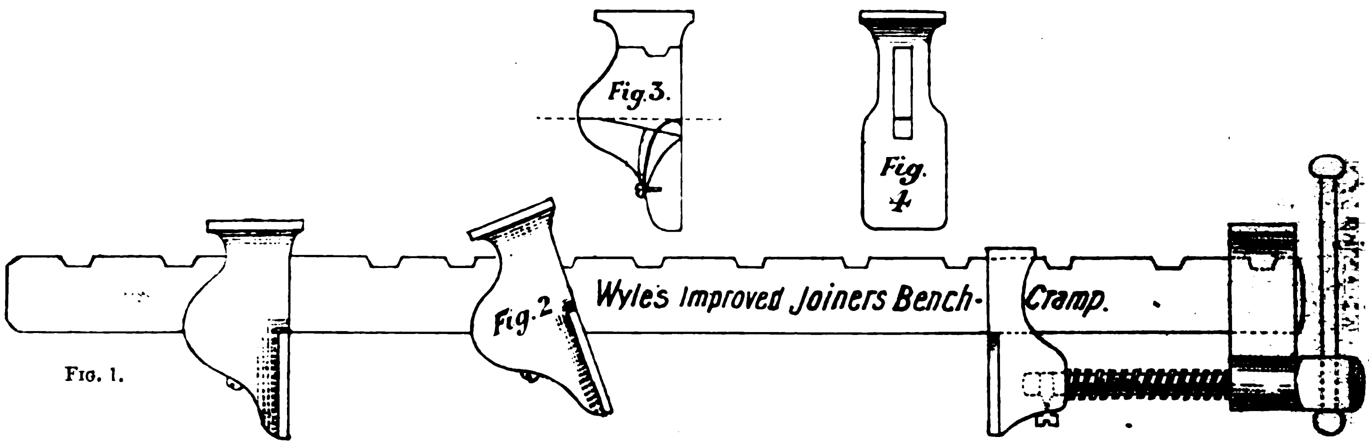


Fig. 1.

pins should be gently prised up; but in no case should they be bent over on a piece of delicate work. A heavy piece of wood, that is flat, should prove efficient without warming, but if the air is cold, and unavoidable delay has chilled the glue, then warming the wood first will be of service.

Fig. 76 shows the half-lengths of two simple little friezes, and can be cut with the banding, or simply a broad line; or the cutting can be simply in a ground only. It is suggested to cut them in box or holly, as an object-lesson, and as progress is gained, they can be altered to suit the taste at will, if cut as above in holly and let into a walnut ground have a graceful appearance. As a light little ornament on a bookcase frieze, or even on a door or drawer front, their uses are many, and they will well repay careful cutting.

Fig. 77 shows four corners, requiring just a trifle more care and patience than previous examples.

Fig. 78 shows some still more difficult, and can be utilised for doors, panels, or wide drawers' fronts, and, if cut in holly and let into a walnut ground, will give satisfaction. A better effect is gained by cutting the ornament in boxwood, let into a rosewood ground; but due care is necessary in cutting, as boxwood is more brittle than holly.

Figs. 79, 80, and 81 are panel tops. The latter is a very effective panel, and should be enlarged four to eight times, and may be in two colours only for the first trial, viz:—The flowers and buds in red, and the leaves and stem in greens, but is intended mainly as an example of judicious display and graceful development.

Fig. 82 is a more difficult lesson in twisted leaves, and may be cut in any waste, not being intended for use. Further designs will give the twist in conjunction with flowers, &c..

Fig. 83 is a bolder design. Figs. 84 and 85 show a coarse specimen of flower-cutting, and an example of buckled or bulged leaves.

IMPROVED JOINER'S BENCH OR SASH CRAMP.

THIS Cramp is a very useful one, and well worth the attention of builders' toolmakers. Fig. 1 shows the shoe in position, Fig. 2 shows the shoe at liberty to slide to any part of bar. Fig. 3 is half of shoe. The thick curved line indicates spring which holds shoe in position on bar. Fig. 4 is a front elevation of shoe. The advantages of this cramp are that the edge of the bar does not in any way damage the work. The shoe when in position (Fig. 1) is perfectly rigid and square to the work. There is no loose pin to fall out or wedge to slip. As will be seen by illustration, it will stand firm on its back on the bench. Fig. 4 is a front elevation of shoe. This invention is to be disposed of by the patentee, Mr. J. A. Wyles, 3, North Fields Cottages, Stamford, Lincolnshire.

THE deepest-running stream in the world is said to be the Niagara River, under the Suspension Bridge.

MILLWRIGHT'S WORK.—XIV.

TO set end brackets like those in Fig. 44, p. 52, a plumb-line is set in relation to others on the line of the shaft, by centres, and sighted along. This gives the horizontal position. For the vertical position a parallel strip is used from the faces of the brackets, or from the bottom seating of the bearings. When the vertical centre and the height are thus fixed, a templet (Fig. 83) is used to set out the bolt holes in the wall, and the work proceeds as in previous cases.

Parallel lines of shafting are laid out either by marking them with chalk lines on the ground, and plumbing by them, or by working from one shaft already fixed, using a gauge which measures the exact distance between the shafts; or if the shafts are parallel, but not in line, a cord may be extended from one already fixed, and measurement taken from the cord to the shaft adjacent.

Pulleys are set in line by means of a cord strained from the edges of the fellow. In case the pulleys should be badly hung, which, of course, should not be the case, the shaft may be turned a quarter round and tried again. There are two excellent tests of the mutual fitting of a shaft and its bearings. The first is the turning of the shaft by hand, when the good fitting or otherwise is indicated by the degree of freedom with which it can be revolved completely and in

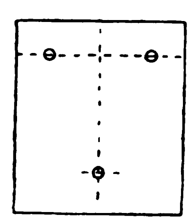


Fig. 83.

different positions of rotation. The other is seen in the results of lubrication. If a bearing is being cut away by its shaft, the waste lubricant is coloured and thickened more or less deeply by the abraded metal or alloy. If it is not, the lubricant remains clear for an indefinite time, so clear that it can be used repeatedly.

The erection of shafting has been much simplified and cheapened by the use of swivel bearings. When bearings can be adjusted in place, there is less necessity for the care in setting the pedestal bracket, hangers, &c., described in the last article. It is extremely difficult and tedious to fix up these to beams, walls, and pillars by the aid afforded by straining lines, straight-edges, levels, and strips. These are all open to errors, slight in themselves, and relatively to the nature of the aids and appliances used, but of considerable magnitude in relation to the linear truth of shafting. It must be clear to anyone that there is a vast difference between fixing a bearing true by its foot to a beam, wall, or pillar with bolts, and adjusting a swivelling bearing in its foot, or surrounding framing. Apart from the awkward character of the work in many locations, it is not possible to obtain so great exactitude in the first case as in the second. A number of little liabilities to error creep in, all more or less cumulative. Even the final tightening-up of bolts will draw the work out of truth to an extent greater than is really permissible in the correct alignment of shafts. So that men will not infrequently spend as much time in making minute adjustments, without anything to show for their work, as would suffice to erect and finish a line of adjustable bearings. And then there is the possibility that similar adjustments will have to be performed again within a year or two.

In erecting rigid bearings adjustments have to be made in vertical and horizontal directions, and

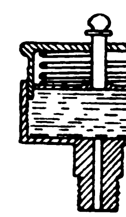


Fig. 84.

it is the combination of these which wastes so much trouble and time. When one is got right, the other is often found to be wrong, and the work has to be gone over again.

One method of erecting shafting takes advantage of the use of a water-trough, laid down in place of the levelled blocks alluded to in the last article. The Webster Manufacturing Co., of Chicago, have improved on this by the employment of a hydrostatic level. It consists of two tubes set vertically on feet, connected with a length of hose, and fitted with stopcocks. The tubes are divided into inches and parts of the inch, and will indicate to 3¼in. variation in height. Within that limit the level of the water in the tubes will give truly horizontal positions anywhere up to 25ft. apart.

In a bearing of great length, and well fitted, there is practically no wear, and a most minute expenditure of oil. With short and rigid bearings an enormous quantity of oil is wasted without much to show for it. It becomes literally squeezed out, leaving the metallic surfaces in contact and liable to abrasion.

There are two principal methods of lubrication adopted—the fluid and the solid. In the first, the oil is either poured or fed into the bearing, and allowed to run into waste cups or trays below, to be thrown away or filtered and used

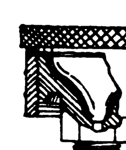


Fig. 85.

again; or it is used on the self-oiling principle, being carried over the bearing constantly with chains, as illustrated in a previous article. In the second method, solid lubricant is employed, being pressed down by a small piston or cap. Each method has its advocates; each has given excellent results.

The needle lubricators for oil have the disadvantage that they feed without intermission. They are, however, vastly more economical than the older crude methods of hand oiling. The

present tendency seems in favour of solid lubricants, used in Stauffer's and Reisert's and similar vessels, in which the supply is constant without waste. The cover is generally screwed down by hand at intervals of a few days, or it is loaded with a shot or with a spring.

Two or three types of lubricators for solid lubricant are shown in the figures. In one, Fig. 84, gentle pressure is exercised by a coiled spring over a piston, and the cap is screwed down as the lubricant diminishes in quantity. In Fig. 85, pressure is exercised only by the screw-down cap. In Fig. 86, the type by Trier Brothers, a tell-tale indicates the diminution of the lubricant. A cylinder standing over the screw-cap incloses a piston A, actuated by a weak spring. A rod B attached to the piston passes through the top, and shows

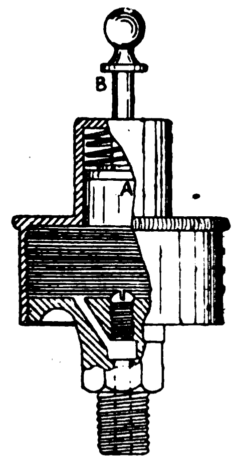


Fig. 86.

by its descent the working of the lubricator. By reason of the difference in the diameters of the piston and of the reservoir, the former descends more rapidly than the lubricant sinks. When it has reached the limit of its movement, the turning of the cap raises it anew to the top.

The Reisert lubricator, by the same firm, is a very good type. It consists of a glass reservoir, slightly conical in form, in which works a soft leather piston which is attached to a hollow stem. The piston is weighted with shot or washers. The conical form of the reservoir permits of equal pressure on the lubricant, whether the latter is full or only partly so.

There are many varieties in the Stauffer type of lubricator besides those shown. Conditions vary so much that one type would not cover all the cases that arise in practice. A great advantage of these is, that the flow being due to exercise of pressure, position is of no consequence. They can be stuck above or below bearings, or horizontally, or diagonally, and will be efficient in either case—saving much of the trouble which attends the fitting of oil lubricators in any but vertical positions. They save time spent in oiling, since a turn of the cap about once a week suffices in ordinary shafting. J. H.

ASTRONOMICAL NOTES FOR NOVEMBER, 1899.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 43 40·49 a.m.	14 25 54	14 27 40	14 42 13·52
6	11 43 44 10 ,,	14 45 40	16 0 47	15 1 56·30
11	11 44 8·28 ,,	15 5 47	17 27 12	15 21 39·09
16	11 44 53·16 ,,	15 26 15	18 46 4	15 41 21·85
21	11 45 58·86 ,,	15 47 4	19 56 37	16 1 4·65
26	11 47 24·89 ,,	16 8 12	20 58 5	16 20 47·43

The method of finding the Sidereal Time at Local Mean Noon at any other station is described on p. 454 of Vol. LXVIII.

As the period of Sunspot Minimum has now definitely arrived, the sun has lost all interest to the observer possessed of any ordinary telescope. The last minimum, it will be recollected, occurred in 1889·6, so that 10·1 years only have elapsed since; the period of 11·11 years of certain textbooks having thus broken down entirely.

The Moon.

New Moon....	Nov. 3	......	10h. 26·7m. a.m.
First Quarter..	,, 10	......	1h. 35·0m. p.m.
Full Moon....	,, 17	......	10h. 18·4m. a.m.
Last Quarter..	,, 25	......	6h. 34·6m. ,,
Perigee	,, 12	......	0h. 18·0m. p.m.
Apogee	,, 25	......	2h. 0·0m. a.m.

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	
	Days.	h. m.	°	Sun.
1	27·70	10 6·6 a.m.	70·0 E.	S.
6	3·06	2 26·8 p.m.	46·8 W.	R.
11	8·06	6 58·6 ,,	16·3 E.	R.
16	13·06	11 18·2 ,,	79·4 E.	R.
21	18·06	2 55·4 a.m.	50·1 W.	S.
26	23·06	6 35·7 ,,	12·6 E.	S.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

The Moon will be in Conjunction with

——	Day of Month.	Hour.	Planet.
Jupiter	4	3 a.m.	3° 39′ N.
Venus	4	1 p.m.	2 24 ,,
Mars	4	Midnight.	1 15 ,,
Mercury	5	1 a.m.	0 39 S.
Saturn	6	Noon.	1 1 N.

At noon, on the 1st, the Moon is in Virgo. She enters

——	Day of Month.	Hour.
		h. m.
Libra..................	3	3 0 a.m.
Scorpio	4	8 0 p.m.
Ophiuchus	5	9 0 a.m.
Sagittarius	6	8 0 p.m.
Capricornus	9	6 0 a.m.
Aquarius	9	10 0 p.m.
Pisces	12	11 0 a.m.
Aries..................	15	1 0 p.m.
Taurus	17	7 0 a.m.
Gemini	19	Midnight.
Cancer	22	5 0 a.m.
Leo	23	Midnight.
Sextans................	24	11 0 p.m.
Leo	25	Midnight.
Virgo	27	4 0 a.m.
Libra..................	30	11 0 ,,

Mercury

is an Evening Star, attaining his greatest elongation east of the sun (22° 18′) at 4 p.m. on the 16th. His very great and increasing south declination, though, will seriously interfere with his observation in these latitudes, and he will be wholly invisible to the naked eye. His angular equatorial diameter increases from 5·2″ on the 1st to 9·2″ by the last day of the month.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 38·0	21 32·1	0 55·6 p.m.
6	16 6·9	23 20·4	1 4·8 ,,
11	16 34·5	24 37·9	1 12·7 ,,
16	16 59·2	25 20·6	1 17·7 ,,
21	17 17·9	25 23·9	1 16·6 ,,
26	17 25·2	24 42·8	1 4·2 ,,

It will be seen from the above ephemeris that, starting from a point in Libra, Mercury will cross the northern spike of Scorpio, and be found in Ophiuchus during the remainder of the month. He will be pretty close to the 2·5 mag. star δ Scorpii on the 4th, and pass some 2° to the north of Antares on the 9th, but will approach no other conspicuous star. He will be in conjunction with Mars (1° 48′ south of that planet) at 7 a.m. on the 4th, with Uranus at midnight on the 8th (Mercury 2° 37′ south), with Venus at 11 a.m. on the 26th (0° 43′ south of her), and again with Mars at 9 p.m. on the 30th, Mercury being 0° 23′ N. of him.

Venus

is an Evening Star, too, and just as badly placed for the observer as Mercury, whose path in the sky she more or less follows. Her gibbous little disc subtends an angle of only 10″ at the beginning of November, increasing imperceptibly to 10·6″ by the end of it.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	15 14·0	17 46·4	0 31·7 p.m.
6	15 39·4	19 30·9	0 37·3 ,,
11	16 5·3	21 2·1	0 43·5 ,,
16	16 31·6	22 18·4	0 50·1 ,,
21	16 58·5	23 18·4	0 57·2 ,,
26	17 25·6	24 1·2	1 4·6 ,,

As in the case of Mercury, Venus thus starts in Libra, crosses the spike of Scorpio somewhat to the north of the path of the former planet, and is at the end of the month in the confines of Ophiuchus and Sagittarius. She passes some 2° N. of δ Scorpio on the 9th, but this is her nearest approach to any moderately bright star. She will be in conjunction with Uranus (0° 24′ south of him) at 5h. p.m. on the 14th; with Mars at noon on the the 16th (0° 11′ North of him); and with Saturn at 9h. p.m. on the 27th; but in neither case will the phenomenon be, in any legitimate

Occultations of (and near approaches to) Fixed Stars by the Moon, and an Occultation of Neptune, visible at Greenwich.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
9	τ^2 Capricorni	5·3	†7 49 p.m.	N.N.W.	334	311				
12	κ Piscium	5·0	11 11 ,,	Dark	136	104	11 29 p.m.	Bright	170	137
17	τ^2 Arietis	5·2	†6 52 a.m.	N.	355	319				
17	65 Arietis	5 6	7 31 ,,	N.	355	322				
17	A^1 Tauri	4·5	10 21 p.m.	Bright	54	83	11 29 ,,	Dark	283	296
17	A^2 Tauri	6·5	10 36 ,,	Bright	76	102	11 52 ,,	Dark	262	269
18	B.A.C. 1289	6·2	3 10 a.m.	Bright	23	345	3 39 a.m.	Dark	333	294
18	56 Tauri	5·4	†6 30 ,,	S.	181	140				
19	Neptune		6 10 p.m.	Bright	95	129	7 1 p.m.	Dark	261	299
20	B.A.C. 1970	6·5	4 20 a.m.	Bright	29	356	4 41 a.m.	Dark	355	320
21	f Geminorum	5·2	†8 3 p.m.	S. by W.	188	223				
22	B.A.C. 2649	6·3	7 10 a.m.	Bright	183	145	7 33 ,,	Dark	223	184
26	55 Leonis	6·0	2 11 ,,	Bright	108	144	3 21 ,,	Dark	306	337

† Near approaches. A description of the above table will be found on p. 455 of Vol. LXVIII.

sense, observable. Her conjunction with Mercury on the 26th has been spoken of above.

The night sky continues, so far as the planets are concerned, to be a perfect blank, for

Mars

is, of course, invisible.

Jupiter

comes into Conjunction with the Sun at 8h. a.m. on the 13th; as does

Uranus

on the 30th, at 4 p.m.; while

Saturn

rises so late and sets so soon as to be unobservable.

Neptune,

however, is now coming into view again, and is sufficiently high above the horizon before midnight for the resumption of our ephemeris of him. It is needless to reiterate here that a powerful telescope is needed to show his planetary character.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 46·0	22 7·1	3 5·2 a.m.
6	5 45·6	22 6·8	2 45·2 ,,
11	5 45·2	22 6·6	2 25·1 ,,
16	5 44·7	22 6·3	2 4·9 ,,
21	5 44·2	22 6·0	1 44·8 ,,
26	5 43·7	22 5·8	1 24·6 ,,

This short retrograde arc is described in Taurus, to the north of Orion.

Minima of the Variable Star Algol.

Day of Month.	——
	h. m.
14	4 54 a.m.
17	1 43 ,,
19	10 32 p.m.
22	7 21 ,,

And on other occasions, when daylight will render the phenomenon invisible.

Shooting Stars

Of all the meteoric showers that occur during the year, there is no more important one than that of the Leonids which appears annually from about the 13th to the 16th of November. Many of our readers must be familiar with the account of the tremendous display of these bodies in the year 1833, as witnessed in Canada and the United States, when many of the labouring classes, and notably the negro slaves, believed that the last day had arrived; and more must remember the astonishing spectacle witnessed in 1866, when the sky seemed really to be snowing fire. We have spoken of the annual display of these meteors, which travel round the sun in an orbit identical with that of Tempel's little Comet I., 1866 (a fact first established by Schiaparelli); but it is necessary to add that, although practically filling this orbit, the aggregation of the component meteors is very far from being uniform throughout it. In fact, while sparsely scattered over a considerable part, they are thickly clustered in one portion of it, which has been called "the gem of the ring," and as the period of revolution of the entire stream is approximately 33 years, it is only after that interval that our earth plunges into the thick of the stream, and such astonishing displays occur. We had them in 1833 and in 1866, and quite obviously must expect one this year. We have spoken of them above as the Leonids, a name they derive from their apparent radiant point at the apex of a triangle whereof γ and ζ Leonis form the extremities of the base, and we would here reiterate our annual caution to the observer that it is useless to commence his watch very long before Leo rises, which is not much before midnight. The early morning of November 15 is that on which the grand display is to be anticipated this month. Space imposes a limit upon any more detailed account of this phenomenon here; but everyone interested in it should most certainly provide himself with Mr. Denning's excellent little pamphlet "The Great Meteor Shower of November," published by Taylor and Francis, for a small sum. This, however, is not the only apparition of shooting stars of importance to be looked for in November, as persistent watch may well be kept for a night or two before and up to the 27th of November for a display of the Andromedes, which appear to emanate from a point to the north-west of that beautiful star γ Andromedæ. That they are in some way connected with the lost and disintegrated comet of Biela appears extremely probable; in fact, some writers assert categorically that we are simply plunging into what remains of that body, whenever the Andromedes appear. Without expressing any opinion on this, we may yet urge the student to maintain a watch on the part of the sky we have indicated from the 23rd to the 27th inclusive. Minor displays from different radiants are predicted for the nights of 1st, 2nd, 7th, 10-12th, 16th to 28th, 20th, and 30th.

Greenwich Mean Time of Southing of Twenty-two of the Principal Fixed Stars on the Night of November 1st, 1899.

Star.	Magnitude.	Souths.
		h. m. s.
α Cygni........	1·5	5 54 49·78 p.m.
ζ Cygni	3·5	6 25 24·50 ,,
β Aquarii......	3·1	6 42 58·63 ,,
ε Pegasi	2·4	6 55 55·30 ,,
α Aquarii	3·2	7 17 14·93 ,,
η Pegasi	3·1	7 54 48·47 ,,
Fomalhaut	1·3	8 8 34·91 ,,
Markab	2·6	8 16 12·85 ,,
γ Piscium........	3·8	8 28 23·00 ,,
α Andromedæ ..	2·1	9 19 29·17 ,,
γ Pegasi	3·0	9 24 20·35 ,,
α Cassiopeiæ ..	2·2 to 2·8	9 51 1·62 ,,
β Andromedæ ..	2·2	10 20 14·37 ,,
Polaris	2·2	10 39 37·76 ,,
β Arietis	2·8	11 5 5·85 ,,
γ¹ Andromedæ ..	2·2	11 13 43·50 ,,
α Arietis	2·1	11 17 29·11 ,,
γ² Ceti	3·0	11 53 57·97 ,,
α Ceti	2·7	*12 12 50·87 a.m.
Algol	2·2 to 3·7	*12 17 27·16 ,,
α Persei	1·9	*12 32 56·19 ,,
η Tauri	3·0	*12 57 13·00 ,,

* Early morning of the 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the above list on any other night in November, as also that of determining the local instant of its transit over the meridian of any other station, will be found on p. 456 of Vol. LXVIII. It must, however, be noted that, as there stated, these rules given are not rigidly accurate as applied to Polaris, nor, in fact, to any close circumpolar star, though in practice they will doubtless be found abundantly so for the regulation of the best ordinary clock or watch.

USES OF ALUMINIUM.*

THE principal uses of aluminium are too many to be enumerated. The properties of the metal are so akin to those of copper and brass that, broadly speaking, aluminium or one of its light alloys should to a large extent replace both copper and tin and also nickel or German silver. Such a change would be followed by various advantages to all concerned. Not only would there be a considerable reduction in the weight of the articles, but they would not tarnish or turn black on exposure to air. The cost should be the same, if not actually lower, inasmuch as, bulk for bulk, aluminium is already cheaper than copper or tin; and its price will continue to fall as the demand increases. One field, however, remains which copper is bound to maintain as its own—namely, the construction of isolated electrical conductors. Experiments have already been made on a large scale with bare conductors of aluminium for telephones, with perfectly satisfactory results, its conductivity, weight for weight, being double that of copper. But when the mains have to be insulated, copper is absolutely unapproachable, on account of its greater conductivity, volume for volume, which is 165 per cent. of that of aluminium.

Besides the advantages set forth above, aluminium is not poisonous, and is pre-eminently adapted for the manufacture of cooking utensils. A steady demand for aluminium is springing up in various kinds of printing processes, as well as in lithography. The metal appears to answer admirably for the construction of rollers used in calico printing; and when its surface is properly prepared, it is also capable of replacing the ordinary lithographic stone. It can easily be imagined that, instead of having cumbrous and heavy stones, which can be printed only on special slow-running "litho" machines, it is far better and cheaper to use thin sheets of a metal which can be bent into a circular form and printed on rotary presses. Bicycles, electric-light fittings, chains, bridles, stirrups, surgical instruments, sextants, and other scientific apparatus, keys, cigar-cases, pen and pencil-holders, toilet articles, plates and dishes, spoons, forks, frames, nameplates, door furniture, hat and coat-pegs, boot-trees, fire-engine fittings, business and visiting cards, and photographic cameras are a few of the things that are being daily made in aluminium by various firms. For motor-cars there should be a large field for aluminium. A further demand for the metal will be brought by its introduction into the military services. All parts of the soldier's equipment have practically been made already in aluminium, such as mess-tins, water bottles, buttons, helmets, parts of rifles, cartridge-cases, fittings for guns, tents, horseshoes, portable bridges, &c., and it is well known that Continental armies, notably the German army, are employing aluminium on a large scale.

The use of aluminium in shipbuilding is growing rapidly, on account of the almost inestimable advantage of its great saving in weight. Four or five years ago a small canoe was made on the Thames of two sheets of aluminium, stamped and riveted together. In 1892 Messrs. Escher, Wyss, and Co., of Zürich, constructed a small launch entirely of aluminium, driven by a naphtha motor, and in the following year they built for Mr. Nobel another larger vessel which has been in use ever since, and is now on one of the Swedish lakes. During 1894 and 1895 the author had a similar vessel on the Thames, between Windsor and Maidenhead. A much more ambitious attempt was made by Messrs. Yarrow in 1894. By request of the French Government they built of aluminium the whole of a second-class torpedo-boat, 60ft. long by 9ft. 3in. beam. This boat weighed in full working order, but exclusive of armament, only 9½ tons, and attained, during a run of two hours, carrying a load of three tons and with engines indicating about 300H.P., a mean speed of 20¼ knots—an advance of 3¼ knots over all previous records.

Several yachts were also constructed at the same time, but they do not seem to have been a real and permanent success, owing probably to the adoption of an unsuitable alloy. As pure aluminium was not strong enough alone, it was thought better to use an alloy containing about 6 per cent. of copper in the construction of some of these boats. This alloy possesses a tensile strength of 14 tons per square inch; but, as already stated, this material is absolutely untrustworthy in sea water, owing to the rapid corrosive action set up between its two ingredients. Moreover, although nobody would dream of employing any other metal than copper for plating sea-going vessels unless it were afterwards painted, aluminium has always been used bare, which the author considers a mistake. If the aluminium had been protected from direct contact with the water, it would have lasted much better.

Unfortunately, this comparative failure has materially discouraged the adoption of aluminium in shipbuilding, and although it is now well recognised that the pure metal, and several of its alloys which do not contain copper, stand the action of salt water better than iron or steel, some time is likely to elapse before these premature tests are forgotten. Eventually, however, when further experiments have been carried out, there is no reason why a suitable alloy should not be adopted which, when properly used and protected from direct contact with sea water, would resist corrosion as effectually as the majority of materials now employed in shipbuilding. These remarks refer only to the keel and other parts of the vessel below water, and chiefly to such craft as are to navigate the open seas.

* By E. Ristori, in *Cassier's Magazine*.

ELECTRIC LIGHTING FROM CAR AXLES.

THE system of lighting railroad cars by electric current generated from the axle, which has been developed by the National Electric Car Lighting Company of New York, has made use of a belt connecting the axle to the generator, and while it has proved to be possible to make this work satisfactorily when camel's-hair belts were used, the elimination of the uncertainty of the life of the belt was seen to be desirable, and this company has recently improved and simplified its apparatus by substituting direct frictional contact between a fibre roller on the end of the generator shaft and a pulley mounted on the axle. The belted connection required a countershaft between the pulley and the generator, the triangular connection of which, together with spring mountings in the countershaft bearings, provided for the vertical motion between the generator and the axle. The slack was adjusted by tightening the springs of the countershaft bearings. The average life of a belt with this arrangement was not above 15,000 miles, and the

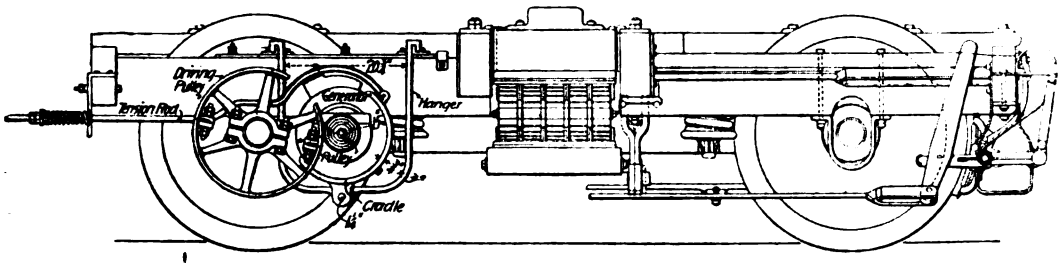


Fig. 1.—Truck with Generator for Axle Lighting: Atchison, Topeka, and Santa Fé Ry.

arrangement shown by the accompanying engravings insures a life of at least 35,000 miles for the transmitting pulley, which, we are told, is a statement based on experience.

The engravings illustrate the new method of mounting the generator and the construction of the fibre roller or pulley. The generator is carried under the frame of the truck, to which it is hung in slings and carried on a hinged support at the bottom, as shown in the elevation. A tension rod urged towards the left by a spring draws the roller to the driving pulley with a pressure which is adjustable. It will be seen at a glance that the vertical motions of the generator with reference to the axle are fully provided for in a very simple manner. In the detail drawing of the driven pulley or roller the method of substituting a new fibre filler for one which may have become worn is seen to be easy. It is stated that this improvement is giving excellent results on the Atchison, Topeka, and Santa Fé, where it has been for some time in service. This road has this lighting system in use on about a hundred cars, and it is understood that it is to be extended.

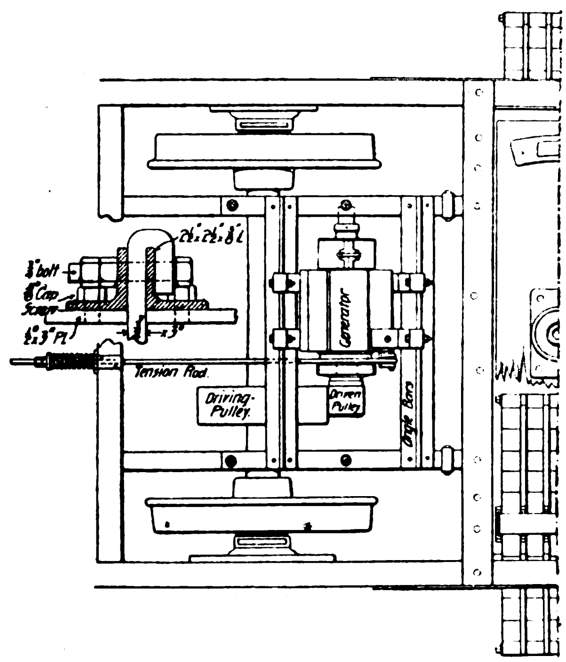


Fig. 2.—Plan of Truck, showing Generating Apparatus.

In addition to a material reduction in the number of parts, the new arrangement renders the generator more accessible and the lubricating problem is greatly simplified. In connection with lubrication, another improvement has been made, whereby the oil is carried in a tank containing about 2½gal., which is connected to the lubricating devices by a sight feed, and the valve regulating the supply of oil is controlled by a solenoid, which is operated by the electric current in such a way as to cut off the supply of lubricant when the generator stops. By the use of these devices cars make trips of 3,000 miles without requiring any attention to the lubricating apparatus. Experiments are now being made to insure a uniform viscosity of oil in summer and winter. The improved method of driving the generators was designed by Mr. Morris Moskowitz, chief electrician of the company, and the improvements in lubrication were devised by Mr. George K. Wheeler, superintendent of the company.

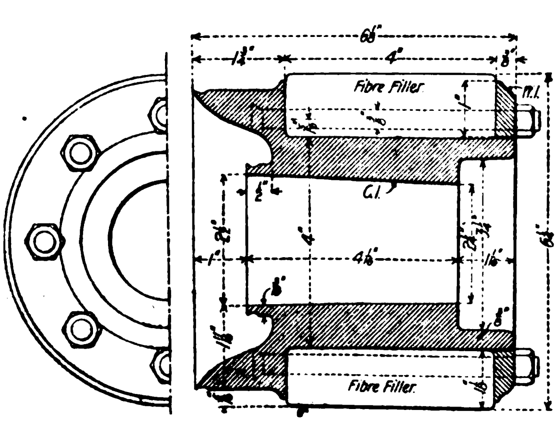


Fig. 3.—Driven Pulley—Showing Method of Holding the Fibre Filler.

The Electric Axle Light and Power Company has recently assumed control of the National Electric Car Lighting Company, the new company being incorporated under the laws of New Jersey with an authorised capital of 25,000,000dols. The introduction of the axle light is to be pushed, and it is understood that the company is also experimenting with a system of car refrigeration, in which the power will be taken from the axles in the same way as it is now taken for electric lighting.—*American Engineer and Railroad Journal.*

ENGINEERING FORMULÆ.

In the spring of this year Mr. Brysson Cunningham read a paper on "Engineering Formulæ" before the Liverpool Engineering Society, and a useful discussion followed. The *Engineer*, commenting on the subject of the paper, says:—It was suggested that the paper was more suitable for students than for grown-up engineers, and then proceeds—"We all go on day after day doing certain things; and we do them on Wednesday simply because we have done them on Tuesday, without asking any questinns, or hearing the suggestion that it might be advantageous to make a change. We use formulæ and make allowances, and postulate conditions, not because this is the best way to arrive at a good bridge, or the discharge of a water main, but because it is the way we have always done it. Mr. Cunningham's paper was intended to wake us up, and this he very effectively does by pulling the house down about our ears. He told his hearers that formulæ were not the special gifts of Providence that some people seem to suppose, and he went on to demolish a number of those in daily use in a fashion leading to the belief that if he only had time he would smash "Molesworth" from cover to cover. It must be submitted that his statements were wholly irrefutable. Nothing worth mentioning was said at the meeting in the defence of formulæ, unless it was the statement of one gentleman, that he had used one concerning a weir in Molesworth, and the result was entirely satisfactory; or the remarks of another, that "what struck him more than anything else was the agreement of results calculated from formulæ under conditions often different to those from which the formulæ were constructed," which, after all, is a very poor compliment to the formulæ.

The substance of the whole matter is that engineers use formulæ, because these represent, or are supposed to represent, the results of experience. The defects of the formulæ are that the author may not have rightly understood the results of his experience, or that that experience was too narrow, or that a false analogy has been drawn between the formula and the new case to which it is being applied. Another feature of most formulæ is the presence of constants, and Mr. Cunningham showed that in important instances there is no agreement whatever between the constants proposed by different authorities. It is not necessary to quote any examples. They will suggest themselves, no doubt, to most of our readers. It will be enough to name hydraulic formulæ, and those relating to wind pressure, and to the strength of columns. This lack of agreement testifies to our ignorance. If we knew all about everything we should have no difficulty in preparing formulæ which would invariably agree, and always be right. As the world goes every formula must be regarded as a bit of information which has to be taken for what it is worth. Thus to cite an example. The formula given by Seaton for proportioning screw-propellers is useful in that it gives us some kind of data on which to start designing a propeller. But it would be foolishness to suppose that by using it we shall of necessity get the best propeller possible for any particular ship. "Formulæ," said Mr. Cunningham, "were primarily intended to be a means of saving time. To solve every problem from first principles would involve an amount of labour which might be more usefully expended in other directions." This is only partly true. Scores of formulæ exist, and are in use simply because there are no first principles to go on. A formula is the condensed essence of an experience. Fairbairn's formulæ for the strength of beams, for example, were all based on an elaborate series of experiments. The shortcomings of formulæ are due in the main to the limited range of the experiments on which they are based. We may test a hundred cast-iron bars transversely and get a certain result. Then comes the hundred-and-first bar, which is very much stronger or very much weaker, and our whole average is upset. It is the characteristic

defect of averages that they can be ruined by big exceptions. When we use a formula for the calculation of the strength of a girder, we assume that it will represent the average within a little. It has often been urged that formulæ need to be used with intelligence. The truth is obvious; the means of applying it obscure. The only intelligence which can be brought to bear appears to be that engineering instinct, which divides the capable man from his fellows, and which is really responsible for the greater part of the best constructive work past and present.

But the use of formulæ is reconcilable with very good practice, because of the beneficent action of the factor of safety. The late Ross Winans, locomotive builder, is said to have told his pupils, "Boys, when you have to make a thing strong, mind that you make it d——d strong." That is the clue to half the success which has been attained in engineering. It is a curious fact that the more accurate a formula is, the less likely is it to be right. If a calculation works out to more than two places of decimals, we may be certain that the results will not be borne out in practice. It is the knowledge of this and kindred truths that has endowed us with the factor of safety. It is noteworthy that this is quite arbitrary. For some unknown reason it is usually taken to mean six to one. The engineer calls in the aid of the specialist calculator, and works out the designs for a great bridge with infinite care and thought, and reams of paper, and when they have arrived at a result, they say, "Ah, ah! that is good! Now, we will put in just six times as much steel as the calculation says will be enough." Why six times? And what is the utility of calculating stresses to five or more places of decimals, if the calculations give us after all no more than a rough approximation to what the bridge will carry with safety? There is incompatibility between the differential calculus and the factor of safety. The higher mathematics seem to be stultified by a brutal insistence that they are not more than fractionally right in the reply they give to our questions. After all, the factor of safety is nothing more than the manifestation of that splendid mixture of ignorance corrected by common sense which has practically solved most of the great engineering problems of the world. The most refined calculations cannot tell us what a bridge really will carry, because there are so many "it's" in the conditions. But they they are competent to keep us safe, provided we allow a large margin. That is the true function of formulæ. They are of use, provided we do not trust them too far. If a man selling pig iron possessed no weight but one which he knew to be somewhere about one-sixth of a ton, he would find his advantage in giving six times its weight as a ton rather than in guessing at the number of pigs which represented twenty hundredweights. It seems a pity, however, that so little is known, or can be known, about this factor of safety. It is of very great importance. In bridge work, for example, the larger the factor of safety the heavier the bridge. A structure with a factor of but three to one might, anomalous as it sounds, be in all respects a better bridge than one with a factor of six. It is probable that large numbers of bridges now exist which are very much stronger than they need be. Anyone looking at the wonderful Boyne Viaduct, for example, must feel that if it is right a great many other bridges are wrong.

Notwithstanding Mr. Cunningham's criticism, the world will go on using formulæ. They are beyond all question extremely serviceable. Whether quite in the right way is another question. Even those who do not understand them, and employ them empirically, just as they do "Bradshaw," may resort to their use without much chance of going far wrong if they will allow a sufficient margin for contingencies. If we calculate that a particular cutting will stand at two to one—Mr. Cunningham was peculiarly severe on earthwork formulæ—we shall probably be safe if we make the slopes four to one. After all, this seems to be what is meant by the intelligent use of formulæ.

TURNING PISTON-RINGS.*

THE turning and facing-up of piston-rings is a job that needs care, or the expense account of the rings will be as bad-looking as the rings themselves. If a job is turned out of the lathe bad, it is a bad job all through. It has to be doctored here and there, and perhaps finds its place in the scrap pile. We cannot, either, say that it is always the poor mechanic that turns out the poor job, for mishaps will occur sometimes with the best of men; but then it is usually caused by matters beyond his control. His machine may need repairs, a matter that he has often reported, but nothing has come out of it, and this one bad job may cost more than to have repaired the tool many times over. There are a great many companies that say it does not pay to use a machine that is either out of date or badly in need of repair, even though the repair might put the tool in shape to do that particular job just as well as a new one, and though, if the repairs had been kept up when required, the tool would have been good for many years. The danger in this direction is that when a concern adopts this line, a great many tools will be taken out and replaced when the difference in cost will not meet the difference in saving. If it costs 2dol. to turn out a piece of work on a machine that is worth 600dol., and it is replaced by one that costs 3,000dol., and the piece may then be produced for 3 per cent. less, the wear and tear of the new tool may more than offset the saving. There are cases where a large amount of money has been used in the purchase of machinery and plant, and where the result has been very wide of what has been expected. Money put into tools

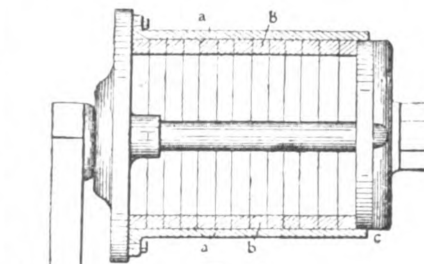


Fig. 1

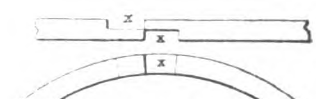


Fig. 2

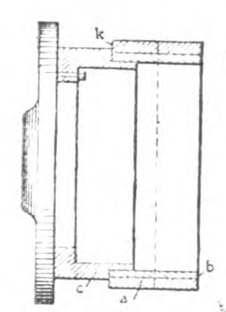


Fig. 3

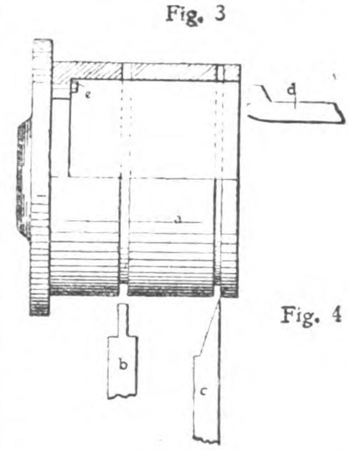


Fig. 4

that are producers, if the tools can be kept at work, is well spent; but when the dollars are put into brick and mortar, care must be used, or the amount so invested will not show at the end of the year. There are other concerns who have made the mistake of thinking that because they had a great amount of floor space they could set machines as far apart as they chose. But when the time came for increase of plant they must go to the expense either of digging out old foundations and putting in new, so as to close up the tools, or of adding new buildings.

Now, in the matter of piston-rings, we might say we will put in a new machine, specially designed, drawings and patterns made, and only one of them built, at great cost, that will take care of these rings all right. But the money might be used to a greater advantage in an increase of the number of regular tools, and some special attachments devised for this job.

The piston-ring that is used very extensively of late years is a single ring turned about $\frac{3}{16}$in. to the foot larger than the bore of the cylinder, sprung together after cutting, and filed to fit the bore. To do this by hand is expensive, and there is danger of spoiling the ring by filing too much, and having the ends stand open in the cylinder. To get over this hand-filing I devised the arrangement shown in Fig. 1. A special face-plate was finished up, with a good, strong bolt screwed into the centre of it, with a plate *c* turned true on the outer end of the bolt and fitted into the ring or sleeve *a*. After cutting the rings, as shown at *x x x*, Fig. 2, we placed a number of them inside of this sleeve, springing them together, and after drawing the plate *c* hard against the rings we could remove the sleeve *a*, and take a light cut over the lot at very slight cost. The bore of the sleeve should be just enough larger than the cylinder bore to allow this cut to be taken. The amount required to be cut out of the ring at *x x x* is about three times the amount that the ring is larger than the bore of the cylinder; or, to be exact, multiply the difference between the bore of the cylinder and the diameter of the ring by 3·1416.

In Fig. 4 is shown the method of preparing the rings for Fig. 1. In the first place we take the ring or sleeve from the foundry, and face the edge where it is bolted against the face-plate, so that the casting may be without spring. It is a bad practice to catch the casting in a chuck to finish the rings, as the chuck jaws will distort the sleeve casting, and when the rings are cut off they will be out of round. To have a still better job, after the rough cuts, inside and out, have been run over the sleeve *a*, it should be loosened and allowed to take its natural shape, after which we tighten up the bolts *e* and proceed. We first cut down the groove with the square-nose tool *b* to within about $\frac{1}{32}$in. of going through. Then with a good sharp side tool *c* take a finish cut inside, and also with the opposite side tool finish the outside. Now we put in a boring-tool *d*, and cut away the stock inside, and the ring will drop off.

Fig. 3 shows the method of finishing up the old-style three-ring packing, one inside and two out. After cutting them off from the sleeve, as at Fig. 4, we drive them together, and by using the short end of the sleeve *c*, Fig. 3, as a mandrel, we may take a cut over the outside and face up the outer edge. In turning this mandrel care should be used in squaring the edge *k*, so that the rings may run true at this point, and not require facing.

* By H. S. Brown, in the *American Machinist*.

THE DUKE OF ARGYLL ON FLYING MACHINES.

THE Duke of Argyll, commenting on Major Baden-Powell's letter in the *Times* on the "aërial ship" now being prepared in Germany, says:—One objection to the probability of its success strikes me very greatly, and that objection is that it is constructed on a principle directly the reverse of that on which nature solves the problem when she has to deal with it. This ship is constructed entirely on the principle of buoyancy. The whole ship is to be lighter than the air it will displace. This is the principle of all balloons, and Major Powell very correctly refers to it as "a buoyant balloon such as this." Now, nothing can be more certain than that no flying animal is constructed on this principle. Every one of them is constructed on the opposite principle of weight lifted and guided by mechanical energy. There is not a flying animal in the world, from the smallest midge to the largest bird like the condor, which is not always heavier than the air in which we stupidly describe it as "floating." If you wound the organs of mechanical energy every flying animal falls like a stone. I do not think that man can overcome the natural laws that condemn all buoyant bodies to an inertia that makes them useless. They must go with the medium in which they float. They cannot resist it, seeing that they have no fulcrum to act upon. My own belief has long been that if we ever are to navigate the air it must be on the mechanical principles which nature has adopted in her glorious and exquisite mechanism of avian flight.

The letter of Major Baden-Powell referred to by the Duke of Argyll reads:—Having lately had the opportunity of inspecting the vast contrivance now being "made in Germany" which is expected shortly to plough its way through the realms of the air even as the Atlantic liner glides over the waters, I may perhaps be allowed once more to call attention to the great importance of the advent of such an innovation. Through the kindness of General Count Zeppelin, I was allowed to visit the "dockyard" wherein this wonderful ship is being constructed, and was immensely impressed on entering the great wooden building erected on a floating raft to see what appeared to be the slender skeleton of some huge vessel, as big as one of our most powerful battleships, but of such delicate material as rather to suggest a stupendous birdcage. This, made entirely of aluminium, is the framework on which the outer skin is to be stretched. Inside a number of large balloons will be placed. Underneath are the gallery and the cars, all of aluminium, and here are the engines with which to drive the vessel, it is hoped,

at the rate of 22 miles an hour through the air. The total lifting capacity will be about ten tons, which should enable the vessel to carry sufficient stores and ballast to remain in the air for some days. All this may sound like some dream, but it is stern reality. It is said that altogether something like £70,000 has been spent upon it, and a commission including many of the leading scientific experts in Germany have approved the plans. In a few weeks' time all should be ready for a start, and though accidents and delays may, of course, happen in connection with such a novel undertaking, much is expected from this event, since such an amount of money and skill has never before been expended on such an enterprise, and all the calculations have been so accurately made, every contingency so carefully considered, each possibility of failure so cautiously guarded against, that we can but hope that success will follow. A buoyant balloon such as this, it may be pointed out, has the great advantage over a purely mechanical flying-machine (such as that of Maxim or Langley) of being able to rise with certainty off the ground, and of preserving its balance when suspended in mid-air. We have just recently had an unfortunate instance of the extreme difficulty of preserving this balance even in a small flying-machine (I myself having been a witness of this most regrettable event). In the case of a machine lighter than the displaced air these uncertainties are done away with, and the whole question becomes one of speed. Twenty-two miles an hour is perhaps no great rate as compared to that of the winds which have to be surmounted, but it is sufficient to accomplish a great deal. Given a practical airship, and improvements are bound to follow. And what then? Notwithstanding what peace conferences may decide, wars in the future will without doubt be decided in the air. The plateaus of the Pamirs, the defiles of the North-West Frontier, the swamps of the Upper Nile—even Mafeking and the tablelands of the Transvaal—will become as accessible as New York. The exploration of the North and South Poles—but I will no further speculate. Those wishing for visions of the future can refer to Jules Verne. Those that desire technical details of this latest scheme to utilise the highway of the air may find them in the *Aëronautical Journal* for this month. I will here only direct attention to what we may call the political aspect of the question, in the hope that we in England may not be long in following in the lead of our energetic cousins in making a bold and unsparing attempt to conquer this element, which has hitherto baffled our ingenuity.

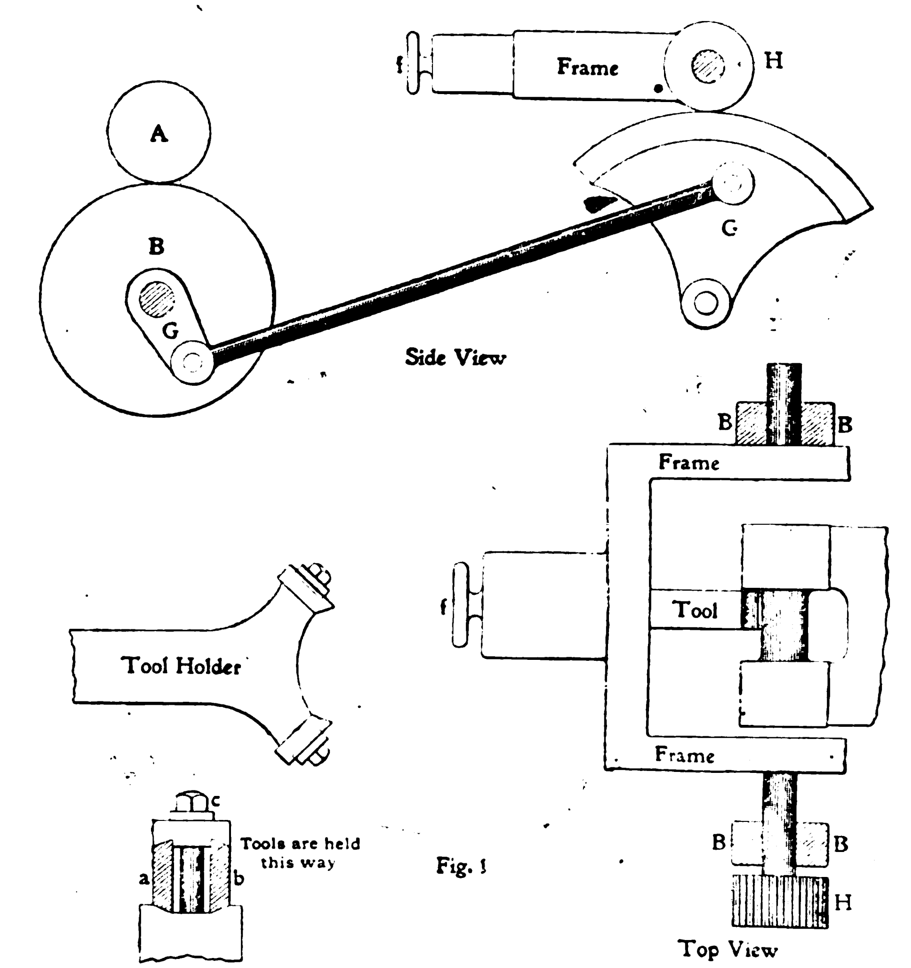


Fig. 1

TURNING SOLID CROSS-HEAD PINS.

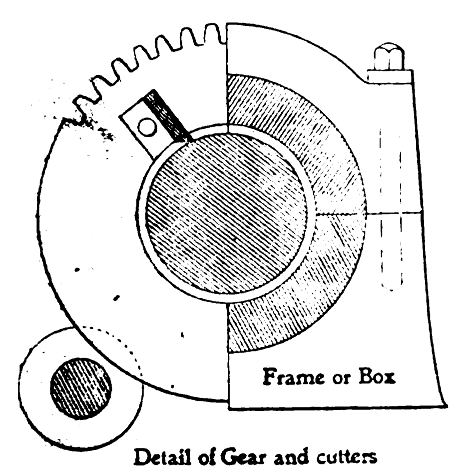
As solid cross-head pins are being used to considerable extent in some localities, it may be interesting to see how they are turned in some shops, and it must be admitted they have some advantages as well as disadvantages, when compared with the loose pin.

There are several methods used in various shops, from the hand machine to the special tools shown in outline here, not forgetting the cross-head lathe attachment which has been patented from time to time, and which usually turns the cross-head in about two-thirds of a revolution and back again. This arrangement either uses two tools—one back and one front—or shifts the cross-head so as to complete the turning. This idea was probably the foundation of the machine shown in Fig. 1, which was found in the Manchester Locomotive Works recently. The sketches shown give an idea as to its method of working, but are, of course, only an outline and not all in correct proportions, but the idea is there.

In this the cross-head is fastened solidly to the machine in a vertical position, so that the centre of the cross-head pin is in line with the main shaft, as shown in the top view.

Taking the side view of the machine, A is the main driving pinion, which drives the gear B, also crank C, which is fastened to same shaft. This is connected by the rod shown to the segment G, which gives motion to gear H, shown in both views. This turns gear H and carries the frame with it about two-thirds of a revolution, so that the tools in the tool-holder (shown in small sketch) cover the entire surface at each complete sweep. The frame is fed along by a rachet feed, similar to a planer, and moves in the bearings, as shown. The gear H is wide face to allow for this. It would seem better to feed the cross-head; but there may have been difficulties in the way of design which were not apparent at a hasty glance. The tool-holder and method of holding tools are shown, so that little more need be said, the tools being fed in, of course, by the hand-wheel shown at back of frame.

The machine at the Rhode Island Locomotive Works is built on the lines of some of the hand and portable power machines which have been used at various times for the last fifty years, and though only a sketch is shown, the working will be clear (Fig. 2). The top view shows the gears, or rather gear *a b*, for it is one gear, with about a third of its face turned down in the centre for a bearing in the frame or box shown in the detail. This is driven by the double-face pinion *c d*, which in turn derives its motion from the pulleys shown through gear *e* and pinion *f*. This view also shows the crosshead in place.—*Locomotive Engineering*, N.Y.



Detail of Gear and cutters

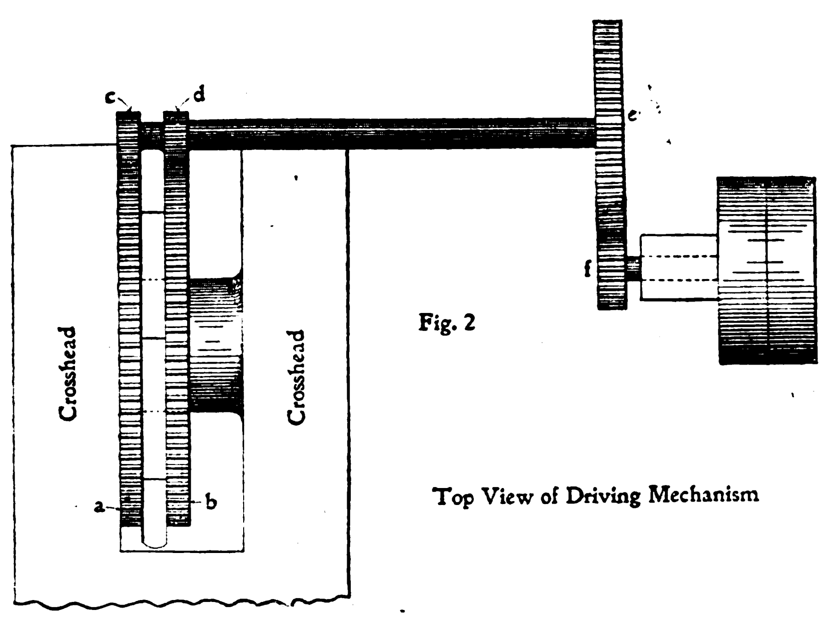


Fig. 2

Top View of Driving Mechanism

THE HARVEIAN ORATION.

THE Harveian Oration was delivered at the Royal College of Physicians by Dr. George Vivian Poore, F.R.C.P. After alluding to the benefactors of the past year, Dr. Poore reminded his audience that they met upon St. Luke's Day, and after comparing the high state of medical knowledge and education in the first century with its almost total eclipse in the Dark and Middle Ages, he arrived at the conclusion that the "beloved Physician," the companion of St. Paul, had probably a more extended and more scientific grasp of medicine than the immediate predecessors of Vesalius and Harvey. But if science in the Middle Ages stood still,

The Handicrafts Progressed,

and found ultimate expression in buildings marvellous for their engineering skill and matchless beauty, which enshrined all that the most cunning hands, impelled by artistic imagination and devotional enthusiasm, could produce. Science can never know what it owes to the handicrafts. Not only has it been largely recruited from their ranks, but it is obvious that science cannot progress without the craftsman to furnish it with instruments of precision. Chemistry could not exist without the glassblowery; astronomy and microscopy owe their very existence to the optician; while medicine and physiology have advanced *pari passu* with the power of recording and measuring. All branches of science must unite in doing homage to the printer who made the Renaissance possible. Further, it should not be forgotten that the Middle Ages were not without their high ideals, and that the Mediæval priests were indefatigable in preaching charity. Many of our asylums and hospitals owe their existence to the exhortations and piety of ecclesiastics. To take only one example, let us not forget that St. Bartholomew's Hospital owes its existence to a Mediæval prebend of St. Paul's, and that Rahere, by providing a place in which our Harvey subsequently observed disease, must be allowed to have some share in Harvey's great discovery. Dr. Poore said Harvey was a born naturalist. He could not help observing. He was in this respect like Aristotle or Pliny, Nehemiah Grew, White of Selborne, John Hunter, and Charles Darwin. In the pursuit of natural knowledge never tired, because "the labour we delight in physics pain." He seems to have risen superior to the political violence of the time, and to have felt that the establishment of the

Facts of Nature

was of more importance than the ephemeral questions by which professional politicians seek ascendency. No man can successfully interrogate nature unless he his constitutionally honest, and it is not, therefore, surprising that Harvey should have earned the entire confidence of the King and Lord Arundel. It must be admitted that, considering the rancour of the times, he suffered singularly little at the hands of the Parliamentary party. His papers appear to have been destroyed by a mob which visited Whitehall, but no harsh treatment was ever meted out to Harvey by Cromwell or his subordinates. This fact is probably due not only to the guileless simplicity of Harvey's character, but to the sanity of the reformers. Cromwell could recognise a wise man when he met one, and, although he knew the uses of fanaticism, he was not one to tolerate the mastery of a mob. One cannot but contrast the safety of Harvey with the fate of Lavoisier, who, one hundred and fifty years later, was hurried to execution with the cry that "The Republic has no need of *savants*." Dr. Poore exhorted his brethren to search out the secrets of nature by way of experiment. If knowledge is to advance investigation, is a necessity. Not only is it true that, as Aristotle pointed out, the greatest pleasure in life is contemplation, but the philosophic mind is never dull, and the joys of the successful investigator are probably the greatest which this world has to give. The modern investigator, who by infinite pains turns a disease from a word into a fact, and who, by careful isolation, cultivation, and inoculation, draws back the veil of mystery, and points the way towards the prevention and cure of a pestilence, surely experiences an unsullied joy such as the victorious general, the idolised plutocrat, the lucky gambler, and the adroitest of Parliamentary hands have no knowledge of. The

Soul is Invulnerable.

The well-stored mind soars above the whips and scorns of time. When, after a period of civil strife, unequalled in the history of this country, Ent sought out Harvey in 1650, and asked, "If all were well with him," "How can it be?" was Harvey's reply, "when the Commonwealth is full of distractions, and I myself am still in the open sea. And truly," he continued, "did I not find a solace in my studies, and a balm for my spirit in the memory of my observations of former years, I should feel very little desire for longer life. But so it has been, that this life of obscurity, this vacation from public business, which causes tedium and disgust to so many, has proved a sovereign remedy to me." Here we have from Harvey's own lips precious testimony to the content which is to be found in searching out the secrets of nature. "Happy is the man that findeth wisdom; her ways are ways of pleasantness, and all her paths are peace." Nature is omnipresent, and the study of her affords the best discipline for the mind, for she only yields her secrets to the man of truthful spirit who works with patience. The great advance of the latter half of this century has been the discovery of microscopic parasites in the blood and tissues. It is but fifty years since Davaine demonstrated the Bacillus anthracis in the blood, and the facts of a similar order since accumulated have bewildered us by their number and variety. To take only one example:—We have attained to a certain knowledge of the physical cause of the plague, which in times past has numbered its victims by millions. This disease has been isolated and cultivated. It has been sent half round the world in a tube, and has been reinoculated in animals. Some of these animals accidently transmitted the disease to their keeper, who, in turn, infected his medical attendant and nurses. The disease manifested all its ancient virulence, but a knowledge of the cause enabled the plague to be stayed. The much-honoured and lamented victims of Vienna have demonstrated to the world at large how the pestilence which walketh in darkness has been illuminated by the full light of science. We are full of hope as to the good which will follow on the discovery of the malaria parasites in the blood, and their transference by means of mosquitoes. There can be no doubt that the rational and methodical observation of disease, assisted by experiment, has had an enormous influence for good on manners and morals. It is to the leaders of medicine that we owe the recognition of the fact that conduct which we once regarded as sin, calling for cruel and revengeful punishments, is in reality disease, which must indeed be controlled with firmness, but firmness tempered with mercy rather than vengeance. There can be no doubt that one of the causes which has led to the decrease of our prison population and the increase of our asylum population has been the gradual appreciation by the educated public that much disorderly conduct is, in reality, disease. We are more ready now than heretofore to "forgive those that trespass against us." There can be no doubt that our increased power of recognising the early stages of brain disease, a power which we largely owe to those who have sought out the

Secrets of Nature

by way of experiment, has made for mercy. The average man regards medicine as merely the art of curing disease, and judges of its progress by the degree to which it enables him to enjoy life, often in defiance of common sense and morality. The higher aim of medicine, however, is to point out man's true relationship to his surroundings in this world. Our relationship to our fellow men, the lower animals, vegetation, the atmosphere, sunlight, water, and earth can only be determined by the study of "the things which are," and by searching out the secrets of Nature by every means which human ingenuity can devise. There have always been two schools of thought in regard to scientific inquiry. One school, fearful lest inquiry into proximate causes should lessen our reverence for the ultimate cause, protests that "all is vanity," and "he that increaseth knowledge increaseth sorrow"; while the other school finds in wisdom "an effulgence from everlasting light and an unspotted mirror of the working of God." It is quite impossible not to admit that our increased knowledge of the laws which regulate the visible universe has increased our living faith and added to the glory of God, while it has made it more difficult for men to make gods after their own image, and use them for their own purposes.

Modern Medicine

is teaching us that much bodily suffering is due to man's wilful neglect of the beneficent laws of nature. That diseases are due to ignorance and disregard of law, and are not "sent" as scourges by a petulant and capricious Deity, is clearly a doctrine which in no way dims the glory of God. After alluding to the opposition which science occasionally has met with at the hands of fanatical and emotional persons, Dr. Poore concluded:—In this country we have always wisely recognised the uses of opposition. The stability of our political organisation has been largely due to the fact that the party in power is subjected to the ruthless criticism of the Opposition—"the toad ugly and venomous" which "wears yet a precious jewel in its head." So it has been in medicine, where scientific advance has been checked not only by the criticism of the learned, but occasionally by the clamour of the prejudiced and ignorant. We have seemed at times to lag behind our neighbours, but our advance, if occasionally slow, has generally been sure. The party of scientific advance is necessarily always a small one, and it is possible that the relatively ignorant may cause some temporary discomfort to the learned few. But this is the extent of their power. The true spirit of inquiry, like the divine afflatus of the poet, is not subject to human control, and the laws of Nature are more permanent than Acts of Parliament.

MOUNTANTS AND MOUNTING.

IT may seem almost an act of supererogation to many to devote an article to the above simple subject, yet amongst the most frequent queries we have to reply to in the answers column are those relating to mountants and mounting. Scarcely a week passes without our being asked by one correspondent or another how to mount photographs without the mounts cockling, or how to mount them on the leaves of an album without the same thing occurring. Now, there is no question that a cockled mount is a very unsightly thing, whether it is framed or unframed; also, that an album with its leaves so buckled that the book will not close flat is very ugly. The avoidance of these evils, without the aid of a rolling press large enough to take the mounts is, however, no easy matter to overcome; and even with that aid at command, unless certain precautions are taken in the first instance, it is sometimes difficult.

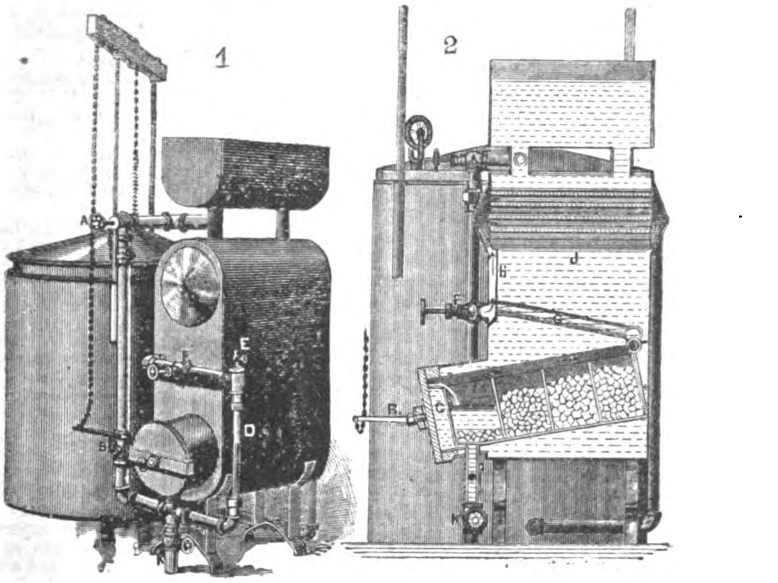
In the case of the prints having to be mounted in an album, the rolling of the pictures is, of course, out of the question, unless, indeed, the album is first taken to pieces, and that is really the proper course to pursue when the best result is imperative. A bookbinder will, however, take the album to pieces and rebind it, after the prints have been mounted and rolled, for a very small sum, and it is somewhat surprising that this is not more often done than it is. We shall here assume, however, that this cannot be done, and see how the best results are to be secured without it.

In the first place, it will be well to consider what it is that brings about the cockling, so that, when that is fully recognised, the conditions for its avoidance, or at least reducing it to a minimum, will be better understood. When paper, whether in the form of a print or a mount, is moistened with water, however slightly, it has a tendency to expand, and it contracts again as it dries. Hence, when an aqueous mountant is applied to the back of a print, it expands, and, if much water is present, greatly. If, while in this expanded state, it be put upon the mount, it is larger than it was when dry; then, as it dries, it contracts again, and in doing so draws the mount with it, and so produces buckling. This is not all, for the moisture in the print also causes the centre of the mount to expand, and thus further increases the evil.

Now, a little consideration will show that the drier the print and the mount can be kept during the operation the less will be the expansion, and, consequently, the less will be the cockling. Conversely, the wetter the print is made the more will the difficulty be increased. Many photographers are in the habit of having their prints mounted wet. Now, it will be obvious that this condition, whatever mountant be used, is fatal in the avoidance of cockling with thin mounts without rolling, because the pictures are put on the mounts in their most expanded condition. Even after rolling they often cannot be made perfectly flat if the mounts are very thin.

After what has been said, it will be seen that, if the print be dry and the mountant contain no water, there would be no cockling. Have we such a mountant? Yes; in a solution of indiarubber in benzole. When that is employed, the pictures and the mounts remain perfectly flat. This mountant, unfortunately, however, is not at all satisfactory, as it is found, after a time, that the rubber is liable to perish—becomes resinised—and the picture peels off. Alcoholic solutions of different resins would cause no expansion of the paper, but, in practice, they have not been satisfactory for mounting purposes; therefore we have to rely upon aqueous mountants. There are ways, however, in which these may be utilised in what may be termed almost a dry state.

Some years ago Mr. A. Cowan published a dry method of mounting. It was this: the back of the print was coated with starch paste and allowed to dry; the surface of the mount was then slightly moistened with a damp sponge, and the two passed through a rolling press, when perfect adhesion was secured. Here is another method we saw in use in a large Continental publishing house, where the pictures were issued on plate-paper mounts with India tint and titled. The method was this: the back of the print was coated with a thin solution of gelatine, dried, and then trimmed; the India paper was slightly damped between blotting-paper. Next a copper-plate, with the title engraved upon it, was heated and inked in, after the usual manner of copper-plate printing. It was then placed on the bed of the copper-plate press, the print put upon it, then the damp India paper, and on that the plate paper, after its surface had been brushed, as is usual with printing on India paper; the whole was then passed through the press. The damp India paper caused



the gelatine to adhere to it, and it adhered to the plate paper by virtue of the brushing it had received. In this way the mounting, titling, and plate-marking are done in a single operation. These mounted prints were as flat as if they were copper-plate prints instead of mounted photographs.

As, however, the above methods are not applicable to mounting photographs in albums, other means must be adopted, and, from what has been said, it will be manifest that the object must be to reduce the water in the mountant to the smallest possible quantity, and, at the same time, to get the print into position on the mount before the paper has time to expand to any great extent. The great thing to be avoided is the expansion of the paper. It will be obvious, for this reason, that if, say, starch-paste be used, a thick solution, thinly and quickly applied, will cause less expansion than will a thin solution applied thickly. Starch, however, is not to be recommended for our present purpose, because, however thickly the paste be made, it must necessarily contain a large proportion of water.—*British Journal of Photography.*

AN AUTOMATIC ACETYLENE GENERATOR.

THE improved acetylene apparatus, which we illustrate in perspective and in section, consists essentially of two parts—a gasometer and a generator connected by pipes. The gasometer comprises the usual water-sealed bell rising and falling in a tank. The generator comprises a case located alongside of the gasometer and provided with a superposed tank, from which water is supplied to the carbide-chamber. This carbide-chamber, C (Fig. 2), consists of an inclined cylinder inserted in the lower portion of the case, and projecting outwardly for a short distance. The cylinder contains a drawer divided into a number of carbide compartments. The drawer being inclined, it follows that when the carbide is all decomposed the compartments will all be filled with water, and, consequently, little gas will be lost when the chamber is opened to be cleaned. From the upper end of the carbide-chamber a pipe G extends to the cooler, and thence to the gasometer. Water is conducted to the carbide by means of a pipe connected with the lowermost chamber. The carbide-chamber receives its supply of water from the superposed tank through the medium of a pipe having a valve, A, the seat of which is provided with a small by-pass, through which the water can always flow, so as to prevent the possibility of an inrush of water through the feeding-pipe, and, hence, an over-production of gas. Between this valve and the generator a controlling-valve B is inserted, by means of which the flow of water can be entirely cut off. The valve B is automatically operated by means of a lever connected by a chain with the gasometer-bell. When the bell has reached its lowermost position, the chain is pulled, the lever raised, and the valve B opened to admit water to the generator. The water-pipe, provided with the valves A and B, is connected with the generating-chamber by means of a four-way fitting, with which is also connected a valved drain-pipe K. The fitting is provided with a by-pass pipe extending upwards, and connecting with a T-valve, F, controlling the pipe C leading to the carbide-chamber. The by-pass is fitted with a water-gauge D showing the level of the water in the carbide-chamber, and is provided with a vent-valve E. When the carbide-chamber is filled with water and the valve F is closed, the by-pass allows the water to run off for the renewal of the carbide. The valve F also controls the passage H leading to the cooler L, consisting of pipes, the ends of which are covered by caps. The gas flows through the passage H between the first cap and the side of the case, thence to the space between the opposite cap and side of the case down through a pipe into the gasometer. The inventor of the apparatus is Leonard F. Rose, of New London, Iowa.—*Scientific American.*

SCIENTIFIC SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.

THE 371st ordinary meeting of this Club was held on Friday, Oct. 20, at 20, Hanover-square, Dr. John Tatham, M.A., F.R.C.P., president, in the chair. After the usual formal business, Mr. R. T Lewis presented a series of preparations of cattle ticks he had mounted from material sent by Mr. C. J. Pound, of New South Wales, and on which he made a communication at the April meeting. Mr. Curties exhibited a number of photo-micrographs of low-power objects with the Kromscope. Messrs. Watson exhibited their new educational or school microscope, with a well-made coarse, but no fine, adjustment, and their "Holoscopic" eyepieces with an adjustment to render them either under or over-corrected for use with achromatic or apochromatic objectives. Mr. Nelson was afraid that in inexperienced hands, at least, these eyepieces would introduced greater aberrations than those they were intended to correct, as it was a difficult and delicate matter to adjust an eyepiece to varying objectives.

Mr. Nelson made some remarks on a series of Reichert's microscopes shown in the room, with improvements in the fine and other adjustments. Also a new form of double-rack coarse movement, which he had devised to obviate loss of time or backlash in focussing, fitted for him by Messrs. Watson to one of their student's microscopes, and a fine adjustment to the substage of the same instrument. In reply to a question by the President, Mr. Nelson said he considered this latter adjustment almost indispensable when immersion condensers of high aperture were employed.

Mr. J. G. Waller read a paper on "An Undescribed British Sponge of the Genus Raphiodesma Bowerbank," illustrated by figures and drawings on the board.

Votes of thanks were passed for these several exhibits and communications, and the proceedings terminated. The next meeting will be held on Friday, Nov. 17.

A VEIN of coal has been discovered 1½ mile from Bessemer, Alabama. It is 7ft. thick, and is said to be of good quality.

THE "London University Guide," issued by the Univ. Corr. Coll. Press, is a very useful work for students, as it not only gives them all the information they need for matriculating or graduating at the London University, but furnishes lists of books which will help candidates in their studies. The work is published at Burlington House, Cambridge, and at 32, Red Lion-square, London, W.C. A copy of this work should be in all the schools where science classes are held, and in all public libraries, especially as those who have any right to ask for it can, we believe, have it gratis.

SCIENTIFIC NEWS.

IT appears that the special committee of the Russian Astronomical Society appointed to revise the Julian Calendar and bring it into agreement with the Gregorian have been unable to accomplish the task, owing to the difficulty (impossibility, it is said) of reconciling the dates of the religious festivals as they are given in the two calendars. The committee have, however, decided to recommend that the dates according to the old and new style should be indicated on public and private documents. That is to say, the matter remains as it was.

The American *Nautical Almanac* for 1902 contains some alterations in the details, notably in the constants assigned for precession, nutation, aberration, and mean obliquity of the ecliptic; but these, pending an agreement amongst astronomers, are merely temporary. The three partial eclipses of the sun will be invisible at Washington, but one of the two total eclipses of the moon will be visible in America. The "Ephemeris" has been published under the editorship of Prof. Harkness.

Those who would like to have a history of Greenwich Observatory, with portraits of the Astronomers-Royal from the time of Flamsteed, will find their desire satisfied in the October number of the *Observatory*. The article is by Mr. H. P. Hollis, B.A., F.R.A.S., one of the editors, who has succeeded in obtaining a portrait of Pond, the predecessor of Airy.

The *Journal* of the British Astronomical Association (Oct. 18) contains the report of the council, the revenue account, and the balance-sheet for the past year, some reports from branches and the meteoric section, and a number of interesting notes on astronomical subjects gathered from various sources. There are also several letters which will attract attention. Members who wish to take part in the photographic observation of the November meteors are requested to send (without delay) their names, with full particulars of their photographic equipment, to the Director of the Section, Mr. R. Wilding, F.R.A.S., Swillbrook House, Bartle, near Preston, Lancs.

The death is announced of Mr. James Carpenter, F.R.A.S. (1867), of Lewisham, in his sixtieth year. He was formerly on the staff at Greenwich, and was joint author with the late Mr. Nasmyth, of "The Moon, considered as a Planet, a World, and a Satellite."

The Council of the London Mathematical Society have selected the president (Lord Kelvin), the vice-presidents, and the secretaries to serve in the same capacity on the council during the ensuing session. Prof. W. Burnside, Mr. H. M. Macdonald, and Mr. E. T. Whittaker have been nominated to fill the vacancies on the council. At the annual meeting, which will be held on Nov. 9, the De Morgan Medal will be presented to the sixth medallist, Prof. Burnside. The council have sanctioned the issue by the secretaries of an index to the first thirty volumes of the *Proceedings*. This index will be drawn up on the lines of the similar index to the first fifty volumes of the *Mathematische Annalen*. They have also authorised Mr. Tucker to draw up a list of all the members elected since the foundation of the society in 1865.

It is stated that a circular has been issued to all Catholic missionaries by the Sacred Congregation of the Propagation of the Faith, urging them to use such opportunities as the locality of their mission work affords for the collection of natural history specimens, to be given to scientific societies and institutions. The intention is not only to interest and encourage such missionaries as are keen naturalists, but also to remove the reproach that the Church does not look with favour upon science, and especially biological science.

Mr. P. L. Sclater, F.R.S., the secretary of the Zoological Society, is at Cape Town, where his son is director of the South African Museum. Mr. Sclater is, says the *Chronicle*, anxious to bring back examples of the Gemsbok antelope, which is not represented in the Regent's Park Gardens. The species is found in Namaqualand and Bechuanaland, but is rare.

At a recent meeting of the Paris Academy of Sciences, M. Tsvett presented a memoir on the reversible liquefaction of albuminoids. The solution of those bodies is assisted by some acids, alkalies, and salts; and M. Tsvett has found

that some organic bodies also possesses the liquefying power to a remarkable extent—e.g., resorcinol, phenol, pyrocatechol, chloral hydrate. He finds that a solution of gelatine treated with an 80 per cent. aqueous solution of resorcinol forms two liquid layers, the upper of which is a solution of gelatine in aqueous resorcinol, and the lower a solution of aqueous resorcinol in gelatine, the solubilities varying with the concentration of the resorcinol and the temperature.

It has been decided by the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland that the societies should hold conjointly, under the management of the board, an annual examination in the science and practice of agriculture at a convenient centre. Candidates who may pass the examination and obtain a certain percentage of maximum number of marks will receive a diploma, and those who obtain a higher percentage of marks the diploma with honours, a gold medal being awarded to the best candidate on the honours list. The examination will be divided into two parts, to be taken, as a rule, in two successive years. The scheme now only awaits the formal approval of the councils of the two societies before being publicly issued, and it is contemplated that the first examination will be held in the month of May, 1900.

The council of the Royal Photographic Society have decided to hold a series of monthly meetings at which lantern lectures will be given. The first Tuesday in the month is the day selected, and the lectures will be delivered from Nov. to April, the first being given on Nov. 7. The second Traill Taylor memorial lecture will be delivered on Nov. 14, at the rooms of the Royal Photographic Society by Major-General Waterhouse, who will take for a subject "The Teachings of the Daguerreotype."

The third International Congress of Photography will be held in Paris July 23-28, 1900. Those who desire to be present are requested to communicate with the secretary, M. S. Pictor, Rue Lincoln 9, Paris.

Prof. Watts, of Mason University College, lecturing at the Midland Institute Scientific Society on "Coral Reefs," said that Darwin's theory was that the reefs had grown round islands which had subsided; Murray's theory supposed the level of the ocean bed to remain stationary while the reefs grew outwards like fairy rings on their own débris. Instances of rings formed, according to both methods, were quoted, and the arguments, on the whole, were considered by the lecturer to show that subsidence was the main mechanism in the majority of cases. Darwin had suggested that a millionaire might enable the problem to be solved by arranging for a boring through a coral island. The Royal Society, with the co-operation of the Admiralty and the Government of New South Wales, have adopted that method of investigation. A boring to a depth of about 1,100ft. had been carried out on the island of Funafuti in the South Pacific, while the Admiralty had surveyed the island and sounded the ocean round its shores. The result had been to give a clearer picture than had ever been obtained before; but sufficient details had not been made known yet to justify an absolute conclusion. Summing up, Prof. Watts said that if the subsidence theory were correct, the fact that the reefs were spread over a large area of the Pacific and Indian Oceans would indicate that large areas of land—vast continents, indeed—must have disappeared, and that the subsidence must have been going on for an enormous length of time.

A patent has been obtained in the United States by Mr. C. T. E. Zimmerman, of Cumberland, Wisconsin, for an improved pendulum escapement. An ordinary clock does not keep correct time because of the varying tension of the spring, but the invention is designed to overcome that by a peculiar construction and arrangement of the parts of an escapement, so combined with the pendulum and an escapement-wheel that the pendulum is not actuated by the escapement-wheel and the variable power of the mainspring, but by an intermediate weight set into action by the escapement-wheel and falling with a constant force to actuate the pendulum uniformly.

A locomotive driven by a rotary engine forms the subject of a patent granted to Mr. A. Given, of Ellensburg, Washington, U.S.A. It is stated that the locomotive is "considerably simplified," since the usual cylinders and parts thereon depending are dispensed with. It is safe to say that when this locomotive is built and put to actual work its performances will be watched by every locomotive engineer in the world.

An International Congress will meet at Paris on July 19, and will sit for three days, to discuss subjects connected with naval architecture—not necessarily connected with warships. Lord Hopetoun, Sir W. White, and Dr. Elgar are on the committee, and those who desire to take part in the discussions should communicate with M. Borja de Mozota, Place de la Bourse 8, Paris, and those who wish to read papers with M. Hauser, the secretary, Rue Meissonier 4, Paris.

According to M. Henri Coupin, in a memoir presented to the Paris Academy of Sciences, the vitality of seeds is affected, when under the influence of anæsthetics, by the hygrometric condition. If the seeds are dry, they are unaffected, so far as their vitality is concerned, by atmospheres saturated with chloroform or ether; but if the seeds are moist, the presence of even a small quantity of ether in the atmosphere surrounding them is sufficient to destroy their vitality.

The old question about the poisonous effects of yew on cattle and horses has cropped up again. Mr. G. R. Ryder gives a case of a carthorse, four years-old, supposed to be poisoned by yew, because in the stomach shoots of yew were found. The time of year is this month, and these are the statements:—"All the organs were healthy—no trace of any poison was to be found—but in the stomach there were from 12 to 20 shoots of yew, about 3in. long apiece, unchewed, lying on the surface of the stomach. No one connected with the place was aware that there was any yew tree accessible from the field; but, after minute research, there was found to be one stunted specimen of an Irish yew under a beech tree, almost merged in other little shrubs, and from this it was evident some shoots had been recently torn off. The nearest could not have been less than from 2ft. to 3ft. distant on the inside of the fence, and the horse could only reach them by straining his neck over the iron fence, which had a barbed wire running along the top bar, and tearing them off, for they bore signs of being torn rather than bitten off, and were so undamaged in the stomach that some of them were afterwards fitted to the branch from which they were taken. The horse seems to have died within 10 or 15 minutes of the first shoot having been eaten. It seems extraordinary that the virus of the undigested shoot should have been so powerful as to destroy vitality so completely and in so short a time. I may add that calves and horses and a donkey have been in the field throughout the summer with absolute impunity." It is well known that there is a deep-rooted belief in the poisonous character of the yew, especially the young shoots; but some hold it is the leaves, particularly the dead leaves, that are poisonous. The subject is one that might well occupy the attention of experts, for it is not proven that the yew has any deleterious properties.

The continuous brakes return laid before Parliament for the half-year ended December 31 last shows that the number of vehicles fitted with brakes complying with some, or all, of the conditions laid down in the requirements of the Board of Trade amounted, at that date, to 95 per cent. of the number in use, and that the number of vehicles fitted only with pipes and connections amounted to 4 per cent.

Iodine in Articles of Diet.—Iodine has not hitherto been presumed to be present in any important quantity in alimentary materials; but according to recent researches which have opened up a very delicate process for the detection and estimation of iodine, this element occurs certainly in the flesh of fish and shell-fish in not a negligible quantity. It is true that traces of iodine have been found in cod-liver oil, which with other elements such as bromine and phosphorus probably exert a slight specific action, and possibly a favourable influence, on the absorption of the oil, thus contributing in some measure to its tonic effects. The flesh of fish is peculiarly nutritive, though less satisfying, and perhaps less stimulating, than ordinary kinds of meat. It is able to be digested more easily and rapidly than is animal flesh, and on these considerations affords a useful food for invalids. But (says the *Lancet*) most fishes contain iodine, and thus the occurrence of this element may be a factor of importance in the suitability of a fish diet for invalids.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no moe than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

VEGA AND ε LYRÆ—REDUCING INTENSITY OF LIGHT—COLOUR OF RIGEL, &c.

[42948.]—LET me thank Mr. Espin for his information and diagrams of α and ε Lyræ. Being in Dublin last week, I took the opportunity of visiting Dunsink once more, with the special object of having another look at Vega, and a few more stars in which I am interested, with the South equatorial. The night was a lovely one, and the air fairly steady; but not a trace of the second companion to Vega could be seen. There must have been something wrong with my observations last time. The star, or ghost of a star, was distinctly visible then—not only to me, but also to my brother, who was with me. I also paid special attention to ε Lyræ, and could see not only those stars figured by Mr. Espin, but also one or two more extremely faint points of light in the group. May I say also, in reply to another correspondent who inquires about the visibility of the companion to Vega in a 3⅞in. or 4in. Gregorian, that on the evening of Wednesday, Oct. 11, observing from the window of a house in the suburbs of Dublin, about 9.30 p.m., I saw the companion distinctly with a 2¾in. Tulley refractor, power 66.

I thank Mr. Stielow for his much too flattering remarks regarding my humble self. My experience *re* visibility of faint companions to bright stars is slightly misrepresented in the way he puts it. I should not recommend low, but *moderately* low, powers for such objects. Thus, of the eyepieces of my telescope, 86 shows the companion to Vega best, 40 next best. I can always see it easily with 86; not quite so well with 40. It is often difficult with 150, or anything higher. This cannot be owing to different thicknesses of lenses, as my 86 power has the thickest lenses of the whole set. It is a great thing to be theoretically correct, and I am duly grateful to "H." for his criticisms on my various proposed devices for reducing the intensity of the sun's light and heat for telescopic purposes. But what I wanted to get at was not theoretical correctness, but a practical working device which would be safe, cheap, and would not materially impair definition. This I think would be attained by placing a piece of coloured glass in the inside end of the draw-tube about 10in. within the solar focus of the object-glass. With the purpose of ascertaining how much such a device would affect definition, I cut out a circular piece of ordinary good plate-glass, and fixed it in the draw-tube of my 4in. telescope, and then tried the instrument on some stellar test-objects. Result: a slight loss of light, and a slight lengthening of the focus (about $\frac{1}{10}$in.) Effect on definition almost *nil*. Star discs still sharp and round; perhaps a trace of scattered light round bright ones. π Aquilæ still separated, nearly as sharply as before. For the purposes of nine amateur observers out of ten, this amount of disturbance of definition, in solar observations, would be quite immaterial.

"H." suggests that the coloured glass would need to be figured to certain curves which should be calculated by mathematical process. It does not require much mathematics after all. The curves required to give least possible disturbance of rays from the object-glass would evidently be spherical curves, having their common centre at the solar focus of the o.g. Thus, if the dark-glass were to be 10in. within the solar focus and ⅛in. thick, it should be a meniscus having its convex surface of 10in. radius, and its concave surface 9⅞in. radius. Then all rays from the o.g. would be perfectly normal to both surfaces, and would suffer no change whatever, neither refraction nor dispersion, in passing through the glass, save only reduction in intensity.

Such a lens need be only about 1in. in diameter and could not cost many shillings. Of course, I agree with Mr. Calver that a solar diagonal is the proper thing; but a diagonal costs about thirty shillings, while my device would not cost five, and would be good enough for those who only want to see, not to observe with minute accuracy. "H." also recommended a perforated stop as improving

the view of double stars. I have already recorded my effects as applied to solar work: it was not encouraging. But, as "H" advocated its use on stars so strongly, I thought I would try it. I used a piece of perforated zinc, dead-blacked, and mounted in the dew-cap, about ½in. in front of the object-glass. I pointed the instrument to Vega, and looked through the eyepiece with great expectations. The result was magnificent, but it was not astronomy. In the centre of the field shone a feeble ghost of Vega; surrounding it were six brilliant diffraction spectra arranged in radial streaks of colour: outside of these, again, were multitudes—millions, it seemed—of similar spectra, fading away through infinite gradations of faintness, to the extreme edge of the field of view. I turned the telescope to γ Delphini; same result, only doubled. I shall not make "H." my guide, philosopher, and friend in matters astronomical any more.

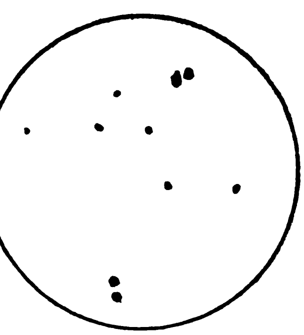
What different eyes we all must have as regards colour perception (see letter 42841)! To me Rigel, Sirius, Vega, Altair, and α Cygni are all alike, blue-white, the colour of an arc lamp. I should think the spectroscope would be the court of final appeal on this point. Have not these five stars spectra practically identical—i.e., hydrogen lines strong, all other lines faint or absent? That is, they differ little from a continuous spectrum like that of the electric light.

Wm. F. A. Ellison.

Monkwearmouth, Oct. 18.

EPSILON LYRÆ.

[42949.]—I beg to send you copy of the sketch of this group by the late Major T. A. Skelton (letter 42873, p. 208), as seen in his 15in. With reflector,



power 240, Sept. 8, 1891. The sketch appeared in Vol. LIV. p. 349, where it is mentioned he thought it probable that a higher power eyepiece on a very fine night would have shown him additional stars.

W. M. P.

CRATER NEAR TIMOCHARIS.

[42950.]—"R. P." (letter 42839) apparently seeks information about what Elger describes as "a bright little crater on the N.W. connected with the foot of the glacis," and it is drawn as such in his map. In Vol. XXIII., *Ast. Register*, Elger describes it as a crater, or rather crater-cone, on N.W. near the foot of the wall, adding, "Mädler and Neison omit it."

"F.R.A.S." seems to have seen Timocharis *a* and *b*, which are very much more distant. These are figured by Neison, but I cannot find them in Elger's map; while the crater close to the wall is not given by Neison, nor have I seen it.

The suggestion as to incorrect orientation is probably the true explanation of "R. P.'s" difficulty.

E. D.

61 CYGNI—LIGHTNING.

[42951.]—Can "F.R.A.S." or any other of your astronomical contributors inform me whether the star which he refers to as *a*, in his letter in your issue of Oct. 20, has been used as a comparison star in any previous determination of the parallax of 61 Cygni? It is evident that its use for such a purpose by an astronomer who was unaware of its peculiarities, might derange his figures altogether.

I can hardly believe in a very faint star with small proper motion possessing the large parallax ascribed to this star by Dr. Schur. It seems to me much more likely that its proper motion is disturbed by a large invisible companion—which occurred long ago to Sirius and more recently to Procyon. The description of a small orbit in a period not differing much from a year might under certain conditions be easily mistaken for a large parallax, provided that the companion star was invisible.

The meteorology referred to in my letter (42933) was that of Kaenitz, of which an English translation was published many years ago. The author investigated the cases of heat-lightning which he noticed, and found that the date always corresponded with (so-called) forked lightning at considerable distances—sometimes I think 300 miles.

W. H. S. Monck.

BABBAGE'S CALCULATING MACHINE.

[42952.]—I have a copy of the "Vestiges of Natural History of Creation," published in 1844, and, as your readers know, this book contains an account of the above machine. The import of this book contains, as I understand it, this remarkable feature—that there is a natural classification of the animal creation, the typical—i.e., the main, or principal family; the sub-typical, or first and next offspring of that family, consisting of the beasts and birds of prey. The police, so to speak, to keep the excessive breeding of the first down; the natatorial—i.e., the aquatic, the sub-aquatic, such as sharks; the suctorial and the rasorial. Now, this deduction is apparently made to be the working out of a natural law, which is exemplified even in mathematics and logarithms. In order to prove this the author, Hugh Miller, instanced Babbage's Calculating Machine, and mentions the fact that in the revolutions of the wheels, to use his own words, "True to the vast induction which has been made, the next succeeding term will be one hundred million and one (viz., 100,000,001); but the next number, presented by the rim of wheel, instead of being one hundred million and two (100,000,002), is one hundred million, ten thousand and two (100,010,002). The law which seemed at first to govern this series failed at the one hundred million and second term; *x x s* being, in fact, the series of *tri*-angular numbers 1, 4, 6, 10, 15, 21, 28, &c.

$$1 = 1$$
$$1 + 2 = 3$$
$$1 + 2 + 3 = 6$$
$$1 + 2 + 3 + 4 = 10$$

&c., each multiplied by 10,000. In the "Vestiges" there is no illustration given of machines. In your issue of the 13th inst. there is, and it must have been of the greatest possible interest to your scientific readers to peruse the description of the same.

It often happens that, however great the human intellect may be in dealing with such matters, some simple feature is missed, which becomes at once apparent to another mind, which has not been so wrapped up in particular detail.

Without being dogmatic, it appears to me that there is a view to be taken of Babbage's calculating machine which is an intelligible explanation of the action of his machine, which Mr. Babbage admitted that he himself did not understand, because he jumped to the conclusion that there was some mysterious law in the succession of numbers, without suspecting that the cause was in the imperfect construction of his machine.

It is, as you say, a great pity that the Government did not afford the inventor the necessary means to have completed his investigations and machinery, because we are face to face with the fact that it misled Hugh Miller into fancying that the deductions he drew therefrom in the animated world were correct. "The Vestiges of Creation" was the stepping-stone in Hugh Miller's mind to the "Testimony of the Rocks."

Now, both works are full of the defective reasoning of the generation in which they were written, and the false conclusions, the dissolving views extraordinary of the exploded ideas of the Pentateuch, misled the author into supposing that he had made a discovery beyond which nothing could be discovered, and, eager to anticipate its truth, he *blew his silly brains out*.

The moment I saw your illustration of the mysterious world-famous machine I said: There is the cause of its mysterious action in producing the term 100,010,002 instead of 100,000,002, in having three columns of wheels instead of four, and in the number of barrels of numbers—the machine in short being triangularly constructed, the progression of numbers can only go on to a given point, at which point it must skip numbers in accordance with triangular, or odd, law, instead of progressing in an even manner, which it would have done had the columns been even and the barrels containing the numbers and the cogs of the wheels even also. As far as I can see, it cannot possibly be otherwise, because reason is against it.

The inference is that Hugh Miller supposed that after a species of animal—that is, the typical, had propagated a given number, it followed that some mysterious law of numbers leaped out of the regular routine and produced a beast or bird of prey.

Now, when you begin an argument the first thing to be sure of is whether both sides agree upon the meaning of the terms which they use, otherwise it is arguing on false premisses. In the instance before us it is not a question whether Babbage's or Hugh Miller's deductions were right, but whether their first premisses were correct; because if they were not the superstructure which these authors or scientists raise, falls down.

I think I have pointed out sufficient to show that there is nothing in any such idea, and that beyond the salient features of the different orders of animated life there is no such classification of species possible in the sense suggested by Hugh Miller in his celebrated work of the "Vestiges."

A. Subscriber.

[42953.]—In your issue for Oct. 13, you give an account of Babbage's calculating machines sufficient to whet our appetites for a more detailed explanation accompanied with illustrations of the various parts and movements. Apart from illustrations, it is next to impossible to understand such complex machinery. Could you not provide us with a few articles on this subject? I am sure they would be very acceptable to many of your readers as well as to

An Old Subscriber.

AERIAL NAVIGATION.

[42954.]—Kindly allow me to assure "Aviator that in my letter of the 13th inst. I had not the remotest idea of attacking the late Mr. Pilcher, or, indeed, anyone else. My sole object in writing that letter was not to air any ideas of my own or to sneer at the incompetency of others (we are all incompetent on this subject, including "Aviator" himself), but to warn any man, no matter who he may be, that to experiment in the air with any kind of contrivance that has large flat surfaces contained in it—will be, and ever must be, extremely dangerous. This fact will be brought home to any man by a little study. I think even "Aviator" will own to this hard fact if he only takes the trouble to study well over the subject. Nothing can possibly be more dangerous than a machine in the air containing large unbroken flat surfaces. It will be at the mercy of the wind, and no power contained in the machine itself can ever make it safe, and as a matter of course the larger the flat surfaces contained in the machine the greater will be the danger. In fact, in a rough wind such a machine would be certain of destruction. Will "Aviator" or any other man be bold enough to deny this? "Aviator" takes upon himself the task of defending those who have never been attacked. This, I opine, may be a thinly-veiled excuse to deliver a thrust at my humble self. "Aviator," in letter 42941, says I make two other mistakes: first to sneer at the use of gas-bags for aërial navigation, and secondly by asserting that the perfect flying-machine can be produced only by himself. Now, allow me to point out that it is "Aviator" himself who has made the greatest mistake here. I never said gas could not be used for aërial navigation, but that a flying-machine which depended upon gas-bags for support in the air would not be a flying-machine, but a balloon. Secondly, if "Aviator" will kindly point out any passage in my letters to this journal or any other wherein I stated that the flying-machine which would safely fly the air could only be produced by myself, I will most willingly withdraw the assertion. I am not aware I ever made the statement; but I have said, and say it again here, that the practical flying-machine, wherever made, and whenever made, and by whomsoever made, will be—in fact, must be—made on the general lines, on the general principles, which I have chosen for the foundation of my own design. This I have stated many times; but this is not saying that the practical flying-machine can only be produced by myself. One word more. I don't quite understand "Aviator's" meaning when he remarks that competent men like Langley, Maxim, Lilienthal, and Pilcher direct their efforts not to fly, but to prove plane support by various devices. Competent, what in? Does "Aviator" mean these men are competent in inventing or making flying-machines, or competent in only trying to do so? If the latter, why exclude your humble servant, the writer? The fact is, there is no particular class of men that can claim any real knowledge on this subject. The man of science knows no more than it is open to any humble mechanic to know, and, for all anyone can tell, the unlearned may see that which the most learned man of science failed to recognise: It is the unlikely that sometimes happens? Thomas George Challis.

THE WIMSHURST FOR X-RAYS.

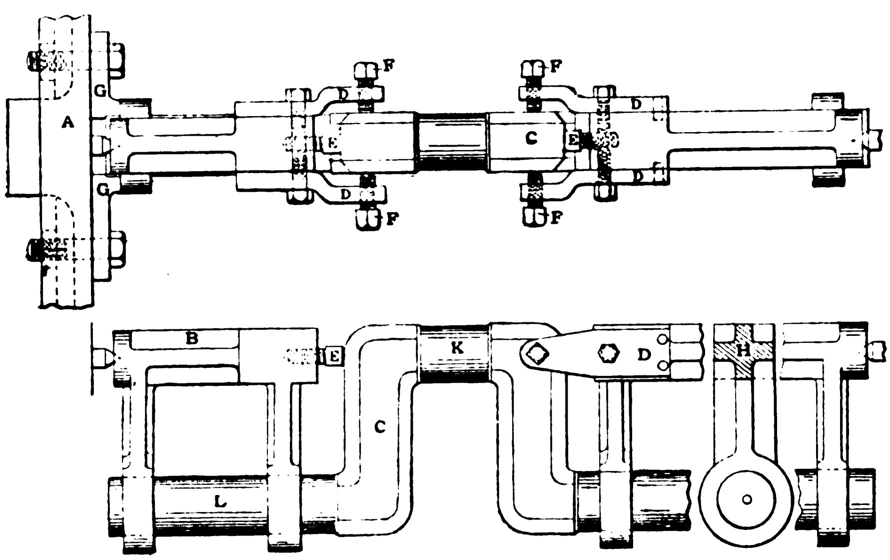
[42955.]—My attention has been directed to an article in the *Daily News* of Oct. 18, 1899, entitled, "The X-Rays in the War," in which credit is given to Mr. Pidgeon and to Major Beevor—to the former for inventing a new form of machine for generating electricity, and to the latter for the "first practical trial of the Wimshurst machine for the production of X-ray results." In justice to myself, I would point out that I was the first to practise and to advocate the use of the Wimshurst machine for this purpose. (See English Mechanic, April 3, 1896, reply 88031.) That I published in Jan. 7, 1897, a little work having for its scope full elucidation of the constructional modifications demanded by the application of the Wimshurst to this particular end, as also for the mode of using when constructed; and that in Jan. 3, 1898, I dedicated in my book "Radiography," a whole chapter to the construction and use of a specially devised form of Wimshurst adapted to this purpose; and, lastly, for the last three years I have manufactured and sent out from

my works several hundreds of these special X-ray Wimshursts to officers, medical men, and hospitals, and have succeeded in placing the Wimshurst in its proper position as being *facile princeps*, as compared to the coil, for X-ray purposes.

Wallington, Surrey. **S. Bottone.**

TURNING CRANKS.

[42956.]—As I have often seen inquiries in the "E. M." about methods of turning cranks, I send the following, which Mr. O. C. Crane contributed recently to the *American Machinist*:—The accompanying sketch shows a rig for turning cranks, used



with marked success on a number having a long throw in proportion to the size of the shaft. The castings B are bored to fit the straight turned part of shaft L, and centred for the lathe the same distance from the shaft centre as the required length of the crank, which, if they are properly set, insures the turning of the crank-wrist K parallel with the shaft. The straps D on the sides of casting B are for adjusting the side position of the crank by means of the set-screws F, thereby making the adjustment a very simple operation. The screws E are for resisting the pressure of the lathe centres. This combination makes the whole quite rigid for the turning of the wrist K. The time necessary for perfect adjustment with this arrangement is too insignificant to make any account of. The centre holes should be quite large, with three oil grooves cut in them to insure perfect lubrication. The casting B is square at D. The section of the arms is shown at H. A represents the face-plate of the lathe, with angles G, bolted on to lock and to drive the end of the shaft. The usual counterbalance, not shown, is bolted on the opposite side of the plate.

The tools for such turning have to be as stiff as possible, on account of the reach from the tool-post to the cutting point. The roughing tool has a single small round point, and feeds both ways, and is set to cut at or below the centre to prevent the digging-in, so liable to occur in such cases. The finishing tools should be square-ended, with a small round for the corners, one to feed right hand, and one left; these also set at or below the centre. By using soda water, a very fine finish can be made, without using file or emery-cloth.

This rig would not pay unless there were a considerable number to be made exactly alike. There are simple ways for centring arms clamped on the ends of a crank-shaft, when only one is to be turned, which the wide-awake mechanic will use without having to guess and try again.

Cincinnati, Ohio. **T. L. P.**

DODGES IN ARITHMETIC.

[42957.]—Referring to Mr. Schooling's article in last week's issue of your paper, it seems to me that he has omitted the simplest of all the methods of multiplying by 11. I mean by adding the original number to the same number multiplied by 10. Thus:—

763942 × 11
= 7639420
+ 763942
——— 8403362

Julian. V. Jameson.

St. Minver, Liss, Hants, Oct. 17.

MOTOR CARS.

[42958.]—As another reader waiting for the promised articles on a motor car, I would like to endorse the suggestion made in your last week's issue by E. H. Micklewood (letter 42940). If the castings and parts of the car and motor to be described could be obtained early, it would be possible to keep pace with the instructions, which I hope will not be long in making their appearance.

W. S. Miller.

MOTOR CYCLES.

[42959.]—Mr. E. H. Micklewood, in his letter (42940), exactly describes my position, and, I feel sure, that of many others.

Like him, I had made up my mind to start on a motor cycle; but I should much prefer to try the motor car, and I am sure if the writer of the articles could kindly arrange with a firm to supply the necessary parts at once, it would be a great boon to many, and would enable the work to be carried on as described in the "E.M.

R. M. G.

[42960.]—Referring to "Monty's" letter in a recent issue, your correspondent finds the bearings in the De Dion to be 9sq.in., and only 9·6sq.in. in the Components Dion motor, as fitted to "Ariel" and other cycles. He is incorrect in his measurements. The actual figures are as under:—

De Dion, 51 by 25mm. = 76mm.; diam., 20mm.; surface, 76 by 20mm. = 1,520mm. Components Dion, 39 by 31mm. = 70mm.; diam., 22·2mm.; surface, 70 by 22·2mm. = 1,554mm. Connecting rod: De Dion, 25·6mm.; diam., 16mm.; surface = 25·6 by 16mm. = 409·6mm. Components Dion, 26mm.; diam., 22·2mm.; surface, 26 by 22·2mm. = 577·2mm.

Your correspondent writes: "You will wonder how I am so familiar with internal economy of engine," and "though I am not in the motor-tricycle business," &c. "Monty" was in the employ of my firm, first as an engine-driver, and then in various capacities, ultimately finding his way in the early days into our motor department, where he was employed for some little time, eventually leaving—not of his own accord. He is now in the employ of a gentleman in this city who is engaged wholly in the motor business! I will content myself by asking your readers to compare and investigate for themselves the figures given above with the totally unreliable statements made in "Monty's" letter. I decline to continue further a correspondence with a former employé writing anonymously, especially as he does not confine himself to possible mechanical improvements, and, further, writes on a motor made 12 months ago, when we were admittedly new to the business.

Selly Oak, Birmingham. **Chas. Sangster.**

GARDEN CITY.

[42961.]—Mr. Steere and Mr. Howard both say, on p. 233, that enlargement beyond 32,000 inhabitants in one city is "eminently undesirable." That entirely alters the problem, and should rather be called "Garden Town." If mankind in future are to be scattered in towns of this moderate size, unenlargeable, the objections to more than 32,000 ought first to be stated and discussed.

However, Mr. Steere's next objection is that "parks are not visible" in my plan. Now, as I provide *six*, of unlimited size, all within half a mile of every dwelling, however large the city may grow, it is inconceivable how Mr. Howard's *one* of 145 acres can be preferred. All my dwellings are as near to factories, to gardens and allotments as any of his, and nearer the public buildings, which he put more than two furlongs from any other buildings. Railways might be carried round, more distant from the town hall, if they are pronounced "an annoyance." Howard's streets, all crossing at right angles, make every passage from house to house as wasteful of steps as in present cities. His blocks are of ten acres and more; mine less than five. The wide streets are sheer waste and delusive. The chief are 120ft., the width of Portland-place, Marylebone, which ought to have a central avenue of trees, if without railway or canal. But the grand fault is that, in contradiction to his term "Garden City," he really plans no gardens. Every dwelling has another to face it, while mine all look out on an opposite garden of more than half an acre. If the city were cut down to the infallible 32,000, mine alone, I contend, could be called *Garden* city. I would allow him the term *Crescent* city or *Circus* city. Anyone who has dwelt in Finsbury-circus, or Burton-crescent, knows how awkward the wedge-like rooms are.

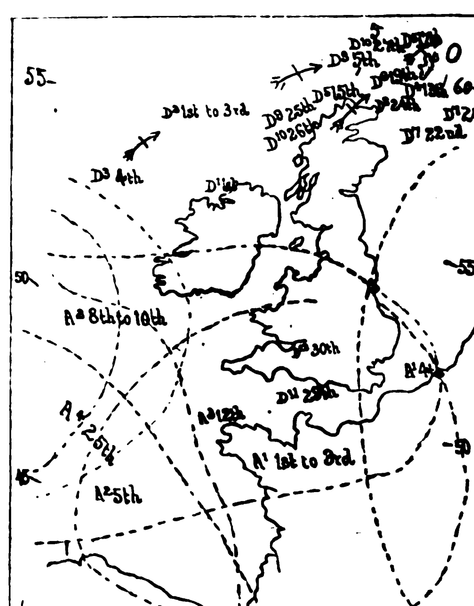
E. L. Garbett.

THE WEATHER OF THE BRITISH ISLES IN SEPTEMBER—REMARKABLE MOCK-SUN PHENOMENA.

[42962.]—

Date.	Cause.	Effect.
Sept. 1 to 3	Anticyclone to southward. Depression on the N.W.	Fine and warm, except in the N. and N.W.
4	High pressure to S.E., low-pressure area still N.W.	Fine everywhere, except in the N.W.
5	Anticyclone moving in from Atlantic.	Fine; very warm in central and south districts. Rain in extreme north.
6 and 7	Shallow depressions in the neighbourhood of the English Channel.	Heavy thunderstorms on the 6th in London, and on the South Coast. Fine, and very warm elsewhere.
8 to 12	Atlantic anticyclone.	Fine and warm as a whole.
12 to 14	Central anticyclone.	Fair generally.
15 to 26	A continuous series of depressions to N.	Persistent westerly winds of varying force, and unsettled weather.
27 to 29	Central depressions, crossing our islands from W. to E.	Unsettled, rainy weather throughout our entire area.
30	Deep depression over the Bristol Channel.	N.W. gale and much rain in the West of England.

Throughout the second half of the month a continued procession of low-pressure systems passed to the northward of our islands, gradually working



southward, and causing the very broken weather experienced towards the end of the month.

The rainfall during the heavy thunderstorm in London on the 6th amounted to the following values in the various districts of the Metropolis named:—Wandsworth Common, 1·09in.; Brixton,

1·00in.; Westminster, 0 90in.; Clapham Park, 0·53in.; Camden-square, 0·50in.; and Greenwich, 0·42in. We may add that at Bournemouth the fall was 1·49in.

On Oct. 11 a curious phenomenon occurred at about 1.30 p.m., and continued with variations for over an hour. The curious part of this "solar halo" was that it did not appear *as* a simple *circle* or semicircle, but as a series of ever-changing wavy lines, above which was an upright and inverted rainbow of brilliant colour. I should be pleased if any of your correspondents would say if this phenomenon is rare. D. W. Horner.

THE TELECTROSCOPE.

[42963.]—In opening this short note, I beg to wish Jan Szczepanik and his invention, the telectroscope, the best of success, and at the same time to make a few remarks on the same; also to mention an invention of my own. To begin with, the telectroscope is, on the whole, a simple instrument, and at the same time (according to an article "Seeing by Telegraph") it is ingenious. But the point is, Will it work? According to *Pearson's*, the experiments (private) so far made have been a success, the principles—i e., the blending of millions of points of light of different colours together—are well known in scientific circles. But here is the vital point: "Can those different points of light be dissected, transmitted, and then united or blended together again, and shown upon the screen sufficiently rapid as to form a similar picture as the one taken by the lens, and dissected by the prisms at the other end of the wires?" The first difficulty, if there be any difficulty at all; would be, I am inclined to think, in the fact that the selenium would not be sufficiently sensitive to register every dissected point of light, and at the same time to register them sufficiently rapid; and then, again, can those points of light be transmitted over the wires rapidly enough to be brought almost simultaneously upon the screen (I have my doubts); and if not, then the thing is a dead failure. We cannot overlook the fact of the rapidity with which the retina of our eyes are impressed by different points of light (and that almost simultaneously) which form the pictures that we see.

My invention, by the way, I have worked out without the slightest knowledge of what Jan Szczepanik was doing, and I did not know that he was the inventor of such a thing until I saw a short notice of the same in the "E. M." on the Monday of Oct. 16, 1899. However, though we have been working at a somewhat similar subject, yet we differ in many ways, as Szczepanik's invention is to show the object upon a screen, and mine is to take it down in black and white; and while his instrument will have to work at a great speed, mine will work much slower; but I will not say that my invention will be a success as yet. It is by criticising each other that we are better able to see where our faults lie. But Szczepanik is an inventor of no mean order.

The reader must bear in mind that my invention is not a telectroscope, and that I place it under another name, which I think is more appropriate.

Huddersfield. H. Mather.

PERPETUAL MOTION.

[42964]—Re letters 42938 and 42939, I beg to point out to "W. J. G. F.," and Webster Michelson, that I have not attempted "to obtain power from nothing"; but, as I before stated, I have tried to generate with a small amount of energy a greater amount than I first used. This may seem the same thing to many, but to my mind it is entirely different. For instance, the weight I represents the small amount of energy first used. In displacing the balanced weights C^1 and C^2 it generates power several times greater than itself. This I have proved by actual experiment. F. W. B.

MORE PERPETUAL MOTION.

[42965.]—Inclosed please find diagrams illustrating a machine designed to overcome the hitherto insuperable difficulties connected with the solving of the problem of perpetual motion.

The main object (as it must be with any machine designed for this purpose) I had in view was to generate with a small amount of energy a greater amount of power than I first used. This I have accomplished by balancing the weights c^1 and c^2 so that although the pendulum weight c^2 is sufficient to keep c^1 in the position described in Fig. 1, yet a very slight additional weight drives it down to the position assumed in Fig. 2. This additional weight is furnished by weight *i*. It will better aid you to understand the apparatus if I describe the actual working.

At the commencement the machine is as in Fig. 1. The weights c^1 and c^2 are, as I have stated, almost equally balanced, so that the weight *i* releasing itself from the spring *j* drives it down to position shown in Fig. 2. The access of power derived from the leverage exerted brings case *a* down as shown in Fig. 2.

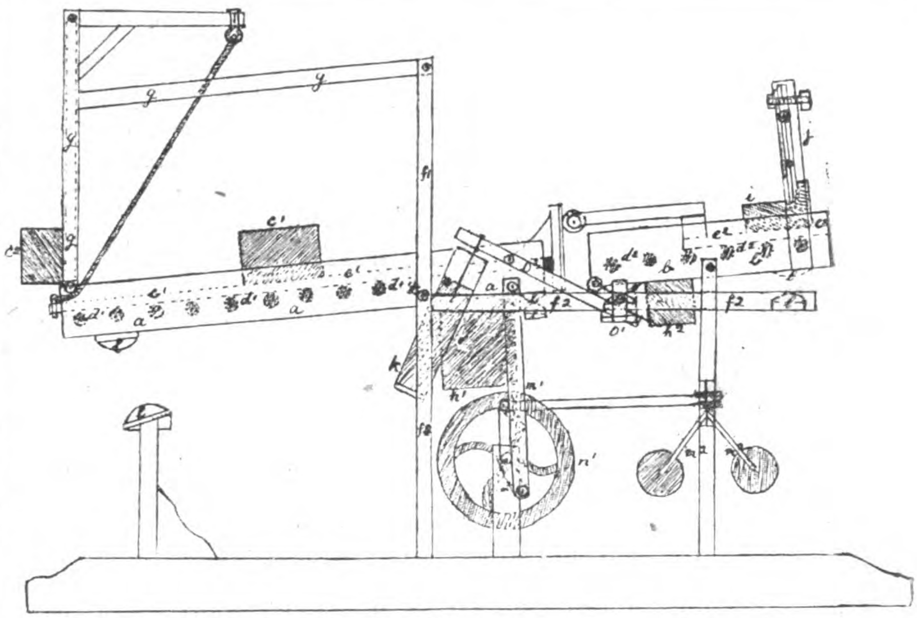


FIG. 1.

a, case; *b*, smaller ditto; c^1, lead weight; c^2, weight on pendulum counterbalancing c^1; d^1 and d^2, rollers; e^1 and e^2, pieces carrying weights c^1 and c^2 moving on rollers; f^1 and f^2 standards and support; *g*, supports for pendulum; h^1 weight counterbalancing, and slightly heavier than c^1 and c^2; h^2, weight counterbalancing, and slightly heavier than weight *i*; *j*, spring checking weight *i*; *k*, weight raising smaller case; *l*, pads; m^1 and m^2, crank-shafts; n^1 and n^2, flywheel and governors; o^1, shaft raising case *b*; o^2, catch holding o^1.

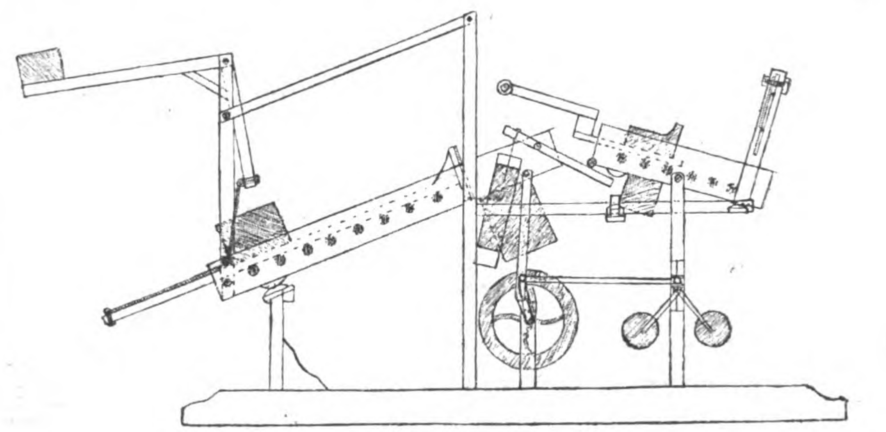


FIG. 2.

Case *a* being depressed, releases the shaft o^2 from the catch o^1 (shown in Figs. 3 and 4). The weight attached to shaft o^1 suffices to raise case *b*, as shown in Fig. 2. This takes the additional weight off c^1 and c^2. Fig. 2 shows the machine just at this

FIG. 3.

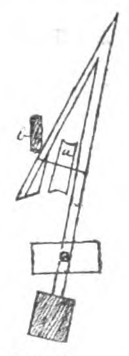


FIG. 4.

a, Grooved wheel; *b*, shaft; *c*, case; *d*, support; *e*, weight holding catch in position.

juncture before the pendulum weight c^2 has had time to drive back c^1 to its original position, and before weight *i* has run back to position shown in Fig. 1. This being done, the apparatus assumes its first position. The use of the spring *j* is to prevent weight *i* running down till case *b* is in its proper position, being adjusted by the screw, so that directly the case is at the right angle the force of the weight itself is sufficient to release it. The process, of course, would be continued *ad infinitum*.

From experiments I have carried out I have every reason to believe that the machine will attain the object for which it was designed, and I submit it to the criticism of your readers, hoping that they will be kind enough, through the medium of your valuable paper, to point out any defects they may notice either in its construction or the principle on which it is designed.

Stanley House, F. W. Baker.
Swiss-road, Weston-super-Mare.

LIQUID AIR AS A COMPANY LEVER.

[42966.]—In America, since the death of Keeley, great efforts have been made to boom liquid air, and all sorts of statements have been made as to its (prospective) capabilities—that is, in the prospectus of the company. Liquid air has its uses—only some have been found out as yet—but it will not do all that is claimed for it. Here is a very good exposure, which emanates from one company criticising the statements of another:—

"The refrigerating power of any substance is measured by its capacity of absorbing heat from the surrounding atmosphere and objects near at hand. And when we wish to express heat in terms of quantity we take as our standard what is known as the British thermal unit; that is to say, the amount of heat sufficient to raise the temperature of one pound of water by 1° Fahr. Now, it has been found by experiment that one pound of ice requires 144 heat-units in order to become completely melted. It is then in the form of one pound of water at 32°, and can absorb 18 additional units in rising to 50° Fahr. Consequently, when ice is used to cool the the interior of a refrigerator to 50° Fahr. it has a cooling power of 162 units per pound. In comparison with this let us see what cooling power is possessed by a pound of liquid air. The best scientific authorities are agreed that the heat absorbed in converting one pound of liquid air into ordinary gaseous air is 144 units; and the

product then has a temperature of about 312° below zero. A pound of gaseous air, however, takes very much less heat to raise it 1° than does a pound of water, the proportion being only 238 to 1,000. If, then, we desire to know how much heat a pound of air will absorb in rising from 312° below zero to 50° above, we have to multiply 362 by 0·238. This gives 86·156 units, which, added to 144, makes 230 as the entire cooling power of one pound of liquid air. Accordingly, one pound of liquid air, considered as a refrigerant, is theoretically equal to 230÷162, or 1·42lb. of ice. But as the loss by evaporation in moving and handling liquid air is very great compared with the analogous loss sustained by ice, we are bound to regard the two substances as being practically equal in refrigerating power, weight for weight. A pint of liquid air weighs somewhat less than a pound, and is thus not more effective than a pound of ice in cooling power. A tumblerful is the equivalent of about ½lb. of ice. Yet, the before quoted prospectus says it will maintain a temperature of zero in a refrigerator for twenty-hours!

"A house of moderate size contains about 1,000lb. of air. To reduce its temperature by 1° Fahr. requires the absorption of 238 heat units. A quart of liquid air is rather less than 2lb. in weight, and if used to reduce temperature to 60°. has a total theoretical cooling power of about 450 units. It, therefore, would not lower the temperature of a house full of air by even 2°, and if we consider that the air in a house is being continually changed, the effect of a single quart of liquid air gradually evaporated would be altogether inappreciable. Yet the precious prospectus tells us that 'a quart of it placed in the ventilating apparatus will keep the temperature of the whole house at 60° during the hottest summer day'!

"Heat, as everyone knows nowadays, is transformable into mechanical power. The force exerted by a steam-engine is derived from the heat in the furnace under the boiler. One heat unit if entirely converted into mechanical power will raise a weight of 772lb. through the space of a foot. Now, liquid air has no power in itself. It is merely a vehicle or mechanism by means of which heat may be converted into mechanical power, and its value in this respect is measured by the quantity of heat it can thus transform. It accomplishes the conversion by expanding against a piston in a cylinder, and a gallon of liquid air in thus expanding to 800gal. of gaseous air at ordinary atmospheric pressure and temperature, will develop a mechanical power of 1,500,000ft.-lb. One horse-power is 33,000ft.-lb. per minute. We see, therefore, that a gallon of liquid air is a mechanism by which we may exert a force of 1H.P. for 45 minutes, if we have a corresponding supply of heat available. We must find some way of warming the air, so as to gasify it and raise it to atmospheric temperature, and we must also supply it with a quantity of heat equivalent to 1,500,000ft.-lb. of work. In a steam-engine it is not the steam itself that does the work. The steam is a mere carrier for the heat generated in the furnace. In like manner liquid air used for power purposes is a mere carrier of heat. It has, however, an advantage over steam. It does not necessarily require a special supply of heat. Owing to its low initial temperature, the vessel that contains it and the surrounding atmosphere, together with all contiguous bodies, are very hot by comparison, and thus serve as a costless furnace. But this furnace is of very slow operation; so slow, indeed, as to be unavailable for practical purposes. A thousand candles may perhaps be capable of generating as much heat as 100lb. of coal; but a steam engine driven by the flame of a single candle would not be of much use, even though the flame might be kept burning from year's end to year's end. Assume, however, that this difficulty does not stand in the way, and that by some ingenious method the atmospheric heat is transmitted with practical celerity to the liquid air. Five and one-half pints —i.e., a gallon after deduction of a tumblerful and a quart—of liquid air used in a motor with full theoretical 100 per cent. efficiency will only give us a force of 1H.P. exerted for thirty-one minutes, or, say, one-tenth of a horse-power for five hours. And yet we are told by the prospectus Munchausen that it 'will generate enough heat to do the cooking, run the electric lights, warm the water for the bath, and in winter heat the entire house by electric radiators'!"

There are, it appears, several companies prepared to do wonders with liquid air, if only the public will supply them with funds; but after some recent exposures, it can scarcely be expected that the American public will seek after perpetual motion to the extent of diving deeply into their pockets.

M. E. V.

LIGHT AND DARKNESS IN A NEBULA.

[42967.]—The "F.R.A.S." is quite mistaken about the Nebula in Andromeda, which he tells us in p. 184 appeared in 1884. I have asked Mr. W. H. Maw, who says, "The temporary star you refer to did not appear in 1884, but in 1885 (August). Its position was slightly preceding and very slightly south of the centre of the nucleus." This was what I remembered, when saying that if it rotated, every place thereon would have evenings and mornings, like our world in the first three periods described in Genesis. Of course we know not whether it rotates, like the majority of heavenly bodies, or whether it exists. I only profess to take the most probable position.

The days must have been understood originally to be long periods. The traditions of the Hindoos prove this. They believe in six before the Deluge, and that we are now in the seventh. The Hebrews were to rest a day after six of labour, because God rests after six of his great days, which the Hindoos call "Days of Brahma." Their account of seven men and their wives in the Ark is not the oldest, but plainly arose from the earlier story of the patriarch having but seven saints with him. The word for "saints" became masculine instead of epicene as at first, and then seven wives were added. The story of his building the Ark was lost, and then it was said to be miraculously provided for him. The approaching comet is described as a fish that at first was no longer than his finger; in three days it was doubled, the next day tripled, and so on till the seventh day, when its train extended a million leagues. In a latter edition these days are turned into years.

E. L. Garbett.

WHEN WERE YOU BORN?

[42968.]—In your last issue a contributor to your valuable paper called attention to a formula of his, showing that this question could be answered, and inviting other readers of "E M.," if they had any other like formulæ, and would be pleased if you could insert them; but his formulæ is scarcely correct after all. Put into form thus, born 2/2/54; age 45. Example:—

Day of month born	2
Multiply by	2
	4
Add	4
	8
Multiply	50
	400
Add No. of month	2
	402
Multiply	100
	40200
Subtract age − 1	44
	40156

And then tell you the remainder.

You then add	100
	40256
Then subtract	20002
	20254

He then says you were born 2/2/54, but it is really 20/2/54, as shown.

I think I can furnish him with about six easier solutions of same with a little over half the figures. The last but one is this. Example:—

Day of month	2
Multiply	1000
	2000
Add No. of month in hundreds	200
	2200
Subtract age + 1	46
	2154

These tell you remainder.

You then add	100
	2254

Which is 2/2/54, as above. Or this—

Day of month	2
Multiply by	1000
	2000
Add No. of month + 1 in hundreds	300
	2300
Subtract age + 1	46
	2/2/54

Which is identical with the above.

R. A. Lawson.

READJUSTING GREGORIANS.

[42969.]—My thanks are due to your distinguished contributor "H." for his full and careful directions for cleaning and adjusting the specula of my old Gregorian. By following his directions, I put the old instrument in excellent working order in about three-quarters of an hour. When I began, the specula were about of the same brilliancy as the end of an old tin can; but in less than fifteen minutes I had them as bright as a piece of new plate mirror, then about half an hour's work adjusting put the instrument in perfect order. I have not had an opportunity of giving it a thorough test yet; but from the trials I have made of it, I think it will prove a very good one for its size and power. I am both surprised and delighted to be able to get it in such good condition so easily.

But "H." is not right in his conjecture as to the proper position of the lenses of my "dialyte," which, by the way, he admits is not at all a certainty. I tried the position he mentions, as well as all other possible relative positions for the two lenses of the corrector, and found that for *these particular lenses* the positions I mentioned in 42842 was the only correct one, and gave excellent results as far as I was able to test it, while all the other positions, including the one mentioned by "H.," gave most miserable definitions, although I could easily correct it for colour. I should certainly write to Mr. Ingall if I knew his address; but "A Mr. Ingall, of London," is a trifle indefinite—to me at least.

This whole subject of the dialyte seems to be very uncertain, and I suppose the best way to find out the facts in the case is to build the telescope and try it. This I shall do as soon as I can spare the time, and will try to give you the result when finished. I am an experienced mechanic, and shall take great care to make all mountings perfect, so the results will depend upon the lenses.

I intend to so mount the lenses of the corrector that they can be separated to any desired amount up to, say, 1½in., while kept rigidly parallel to each other and to the object-glass.

The tube of telescope I shall make of sheet steel, which will insure rigidity, which must be very important in such an instrument.

If any reader can offer any further advice or suggestions I should be glad to hear from them. Again I thank "H." for his valuable and explicit directions regarding the Gregorian.

E. P. Clark.

245, West 18th-street, New York, U.S.A.

CLEANER FOR TOBACCO-PIPE BOWLS.

[42970.]—The sketch represents a little tool numerous readers of "Ours" doubtless feel the want of; it is only necessary to explain that the scraper is of pliant "trough-shaped" steel, so each arm has two cutting edges, and the free upper ends

contract when inserted into a pipe. A turn or two of the appliance "evenly" removes the scale, and without the risk of breaking the bowl as when a "rigid" tool is used.

161, Albion-road, N. A. Clarke.

SEEING BY WIRE.

[42971.]—There seems to be rather more fiction than fact in that paragraph on p. 230, quoted from *Pearson's*. Statements of that genus may suit readers of the American papers (in the backwoods); but in this country, thanks to the science classes, boys of twelve to fourteen, say, are grounded in principles, and ask awkward questions when you speak to them about the possibility of seeing round a corner by means of electricity. "Almost as far back as he can remember, Szczepanik had it in mind to invent a machine for seeing at a distance." Just so: he had it in mind; but has he succeeded in inventing that machine? I think not; but I do not say it is impossible—only that it is improbable. We are becoming quite "acclimatised," so to speak, to these yarns, mostly emanating from American sources; but it would be interesting to have at least a small portion of fact to go with the fiction, so as to have something to digest. Can anyone tell me whether anything whatever has been done towards seeing by wire, or by electricity? I think not, but I preserve an "open mind." These tales may do in a novel on the Jules Verne plan, but they "won't wash." You can telegraph writing and therefore drawings, as witness Cowper's writing telegraph, and more recently Elisha Gray's method, but are they useful as well as practical? The latest device of the kind is practical, but so far as I can learn it is not a practical success in the sense of being commercially useful. The "electroscope" may be

"beautifully simple in its underlying principle," but where is it—where can it be seen? The writer of the article quoted says, "when we see a man or a house, we really receive in the eye perhaps a million, perhaps ten million, distinct pictures of distinct points on the surface of that man or house." It would certainly be interesting to learn what that means. It will be noted that the "time" is not stated. Writers of fiction are apt to take hold of anything they see in the papers of a "startling" character; but we have not arrived at the stage of "seeing by wire." Why "wire," when we already have "wireless telegraphy," as it is called? The question I would ask is simply, Has that "peck of pepper" been found? S. R.

GILBERT'S NEW POWER MACHINE.

[42972.]—Would that the problem of perpetual motion were forsaken for ever. Mr. Gilbert says that he has overcome friction; in that case, why not get an ordinary wheel cast at the nearest foundry, fit it with his anti-friction idea, start it, and if frictional resistance by the air be got rid of, it will run on for ever; but neither Mr. Gilbert nor anyone else has overcome friction so far, because two surfaces can't be produced which are really smooth, for even the most microscopical protuberances on the one surface fit into hollows on the other, and consequently require some force to make them slide over one another. Now where is this force going to be got? In machine No. 1 there are six weights tending to lift eight besides working the lifting gear, so that it is evident that we need not look to the weights for this force, and so far as I can see they constitute the only peculiarities of an otherwise respectable wheel. Those holes look a bit out of place in the weights: if the weights are going to drive the thing, why weaken it by taking away its motive power? Mr. Gilbert says that the principle is there—about as much as in any other perpetual-motion machine. I do not know what Nos. 3 and 4 will be like; but they should be carefully secured with ropes while being built, in case they start of their own accord; failing which, you are as far from perpetual motion as ever; for if you have to start them, then the work put in = the work given out + lost work, so that you can never even get as much work out of the machine as you put into it, and friction in this case will be no negligible quantity, as Mr. Gilbert can prove by having a weight cast similar to those on No. 2, say, and screwing it in and out of a piece of iron and noting the effort required.

If would-be perpetual motion inventors would only take a few lessons in elementary applied mechanics, they would save themselves a lot of trouble, because they would see the futility of their ideas, and would grasp more fully what they in their ignorance were trying to do—namely, to create energy out of nothing. Knowing what we do of mechanics, those perpetual-motion fads, Keeley motors, and liquid-air motors constitute particularly nauseous reading, and cause one to sigh, and exclaim "So much more brainwork thrown away."

W. Ewart Gibson.

The First Iron Boat.—The county of Lancaster is entitled to the honour of having produced the first iron boat, which was made by John Wilkinson, at Cartmel, about 1750. John Wilkinson was in partnership with his father and brother, and they, having engaged in smelting the rich hematite ores then known as Furness iron, used the peat and turf of the district for fuel. To get a proper supply of this for the furnace, John Wilkinson designed a short canal which was cut through the turbary, and the iron boat was constructed. The country was then keen on canal enterprise, and Wilkinson constructed other iron boats for the purpose of this inland navigation. These iron boats caused great astonishment, and, according to a letter written by Wilkinson, the unbelievers in their capacity for swimming were 999 in 1,000. The boats were a nine days' wonder, and were then like Columbus's egg.

Casting Iron Columns.—At a meeting of the German Iron Founders' Association, Direktor Pusch made a communication as to the vertical casting of iron pipes and columns, and eventually the following conclusions were adopted:—1. The vertical casting of columns affords no greater guarantee of uniform thickness and sound metal than does horizontal casting; and a column moulded and cast horizontally with the same care is not inferior in quality to one cast vertically. 2. Uniformity of thickness secured by boring, and a compression test to double the maximum load, afford a sufficient guarantee of strength and quality. 3. The superiority of columns cast vertically cannot be admitted; but for producing pipes vertical casting is quite suitable, because they must be smooth inside and outside, with a uniform diameter, and there can be no support for the cores; while, during the vertical casting of plain pipes, the impurities in the cast iron rise to the top, and may without disadvantage form part of the runner.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96555.]—**Equation.**—"M.I.C.E." has evaded my remarks. I simply questioned the legitimacy of introducing certain integral assumptions into a problem. When, for example, we are asked to find x in $x^2 + 3x = 5$, we have no right to begin by making restrictions, such as "M.I.C.E." does—viz., that the sum of a rational and surd cannot be a whole number, and therefore x must be exact or the equation absurd. "M.I.C E." stated that there were only two values of x^2 which could divide 34,445¼ exactly—viz., ¼ and 2¼, and I pointed out that there were certainly twenty values which could do this. He now says that x cannot be a surd, that its extreme value is only a little over three, and a number of other things which have nothing to do with the subject or his method of solution. So far as we could know, x, y, z might have been surds without disturbing the conditions of the equation. Thus, if $x = \sqrt{\frac{2}{3}}$, $y = \sqrt{\frac{3}{2}}$, $z = \sqrt{6}$, then $x^2, y^2, z^2, xy, xz, yz$, are all rationals. Again, how can we be sure that one of the three unknowns is not negative? Of course, trials may convince us one way or the other; but this is not algebra. I admit, however, that the device employed by "M.I.C.E." is a useful suggestion, and may frequently lead to a quick solution of cubic and biquadratic equations when x is *not* a surd. I simply object to unlimited assumption as an algebraical process—nothing more. Suppose we have the following cubic to solve:—

$$x^3 - 18x^2 + 87x - 70 = 0.$$

Here the usual formula fails, and the trigonometrical method is laborious and clumsy. But, dividing by x, and making the assumption that x must be exact, we have—

$$x^2 + 87 = 18x + \frac{70}{x}$$

where x must be one or more of the factors of 70—viz., 1, 2, 5, 7, 10, 35. We see at once that 35 is too great, and that 1 and 10 satisfy the equation. We also find that 2 and 5 are too great for the left-hand branch, and that 7 exactly balances both. Hence x=1, 7, 10. Lastly, in the biquadratic—

$$x^4 - 25x^2 + 60x - 36 = 0.$$

Dividing by x^2 and assuming x to be exact, we have—

$$x^2 + \frac{60}{x} = \frac{36}{x^2} + 25.$$

But x^2 can only be 1, 4, 9, 36, and therefore x, 1, 2, 3, 6. The first three values satisfy the equation, and taking 6 negatively, we obtain a fourth—i.e., x = 1, 2, 3 − 6.

West Norwood. Henry T. Burgess.

[96555.]—**Equation**—(Correction).—See my reply, p. 234 (near the middle). In the equation $m = \frac{8}{3} n \pm \ldots$, the fraction $\frac{8}{3}$ should be $\frac{8}{5}$.

Bath. M.I.C.E.

[96633.]—**Green Water.**—I think Mr. J. Sinel is right in attributing the greenness to infusoria. The water not only turns green, but the surface becomes covered with myriads of minute bubbles, which go on increasing till in a few weeks the whole surface is covered with an inch of yellowish foam. Assuming it to be caused by Euglena viridis, is there any cure or prevention? The bath is 40ft. long, and contains over 9,000 gallons. The water is pumped from a well 37ft. deep in chalk, and is perfectly clear and drinkable when first pumped up. With a fair breeze the mill takes four days to fill the bath, and it begins immediately to get green.

Quex.

[96641.]—**Grinding-in Valves.**—If the valves have worn so very badly, it might be advisable to run over them with a dead-smooth file. The best "mud" for doing the fine grinding—that is, the grinding into the seat—is the stuff found in the grindstone trough. Very fine emery, such as is used for finishing telescope mirrors might do, but that is too valuable for other purposes, and ordinary emery, even if fine, should never be used for grinding metal surfaces to one another. Grindstone mud is the best stuff, and if a very close fit is required finish with jeweller's crocus or rouge. Mix the powders or "mud" with oil, and grind in with a circular motion, shifting from time to time.

M. T.

[96654.]—**Turret Clocks.**—The question asked is as to the best illustrated work on turret clocks, which is best answered by asking another question: Is there any illustrated work on turret clocks? The best work on such a subject that I know of is Lord Grimthorpe's (Sir E. Beckett's) "Clocks, Watches, and Bells," published by Crosby Lockwood and Son. All requisite information can be found in that. The Westminster clock commonly called Big Ben (which name refers to the bell) is a "turret" clock in a sense—possibly the best in the world.

S. R.

[96655.]—**Silvering Glass.**—Methods of silvering glass have been given many times, but as to a "perfectly opaque coating of silver on any polished glass surface" that is another matter. To be "perfectly opaque" the coat of silver would have to be rather thick. The querist will find the usual recipes in the back volumes, and in the manuals which treat on such subjects; but I expect he will have to experiment for some time before he obtains a "perfectly opaque" coating. Metops.

[96658.] — **Rheumatism.** — "Adams" asks (p. 188) what is meant by "kerosine oil," which may be spelt kerosene. It means, or should mean, the burning-oil obtained from petroleum after the lighter oils down to benzoline have been taken away by distillation, and the heavy oils removed by freezing or any approved method. It is the name used in America for the "safe" burning oil. I do not know what kerosene has to do with rheumatism; but possibly if the system is saturated with it the hydrocarbon will drive out the poison of the rheumatism. S. M.

[96668.] — **Mirror-Back Show-cards.** — This query is not quite definite; but if it means only how is bronze powder affixed to glass, that is easily done by making the glass perfectly clean, floating it with pure size or a clear varnish (Canada balsam if necessary), and then dusting on the powder. The bronze powder may be mixed with varnish and painted on, but the important point is that the glass must be quite clean—chemically clean. Essar.

[96719.]—**Gauging Cylindrical Tanks.**—As I read the query of "Chemicus," the tanks lie in a horizontal position, therefore the formula of "Regent's Park" is not applicable, as that applies to the vertical position. Perhaps "The Park" was a little misty just then. It is so sometimes at this season of the year. In all probability "Chemicus" will not get exactly what he wants; we rarely do. I think he will have to work out each wet inch separately. The transverse section of the fluid is, of course, a segment of a sphere, the area of which can be found by the help of the tables in Chambers's "Mathematical Tables" or Peddie's "Practical Measurer." The area being found and multiplied by the length, and then by "Regent's Park's" multipliers, would give the contents in gallons. The wet inches would, of course, correspond to the versed sine or rise of the arc. I think if "Chemicus" applied to a maker of slide-rules, he would get a rule probably made for the purpose—such as are used for gauging boilers. T. J. Lenny.

[96729.]—**Grindstone.**—I am much obliged to your correspondent "Regent's Park" for his suggestion as to a solution to my query; but it is not a solution. The problem should be capable of being dealt with in a useful form, which I feel sure "Regent's Park" or some other of your readers could devise. Grindstone.

[96759.]—**Bikes and Prams.**—What I want to know is where and when it was decided in a court of law that bicycles are carriages within the meaning of the Act. I fail to see how a cycle can be a "carriage" when it is not carrying anything, but is being merely wheeled on the path—to be removed as soon as possible. Please quote the case in which the point has been settled. I believe town councils, corporations, &c., can make by-laws within certain lines, and decide what shall be considered an "obstruction"; but if they can permit perambulators (which are certainly carriages) on the foot-path, they can also allow a bicycle to be wheeled on the path for the temporary convenience of the man who would prefer to ride it. I will promise not to use the word "bike" (which has come into universal use) when the makers of bicycles spell tire instead of tyre. Rota.

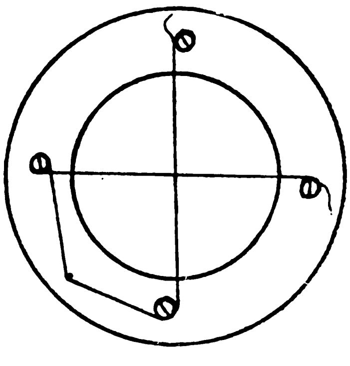
[96803.] — **Equatorial Adjustment.** — It appears to me as if the declination vernier is simply out of adjustment. Halve the difference between the two readings with the telescope E. and W. of the pillar, and set the vernier to this reading. Repeat the operation—using a star as nearly on the meridian as possible—until both read alike. The difference of reading indicated (three or four minutes) certainly appear a long way out—impossible in some instruments; but I have worked with an excellent equatorial of Wray's in which the vernier was a separate circle, which could be turned completely round on the declination axis.

H. Wadsworth.

[96808.]—**Dynamo Switchboard.**—Also practically the same in my little handbook "How to Manage the Dynamo," at pp. 36 to 39.—In replies over my name, 96830 and 96865, two errors occur. In the first, the power required to drive dynamo should be 48 to 50H.P.; and in the latter, in the last line but one, the word smaller should be substituted for "similar." S. Bottone.

[96810.]—**Finder.**—Mr. N. Maclachlan will find that a long piece of human hair (the finer the better) will make capital cross-lines for his finder. if applied in the following way:—Take the brass frame which carries the cross-lines, and drill and tap four holes in it, at opposite ends of two diameters accurately at right angles to each other.

In these holes insert four brass screws, which must fit friction tight. Twist the hair round the screws, having previously screwed them nearly home. When the cross is complete, screw the screws up tight; but not too tight, or the hair may cut. The hair should be twisted round the screws in such a way that when they are screwed home it may tighten, not loosen. With this arrangement it is easy to renew the lines at any time. If the querist lives in the country he may find it possible to use spider-web instead of hair. The elasticity of either the hair or web makes it possible to tighten up without breaking. The diagram will help to make



my directions clearer. It is a good plan to make a single hair form the entire cross, as there is less chance of its coming looce, and to do this it may be necessary to insert a small stud between two of the screws to keep that portion of the hair from crossing the field of view, as indicated in the figure; or the screws my be set further back from the edge of the aperture. W. F. A. Ellison.

[96837.]—**Phonograph.**—To give a full explanation of the difference between the Edison and Bettini reproducer would, I am afraid, take up too much space in this column. Briefly, it is this: In the recorders and reproducer of the phonograph and graphophone the style is attached to the centre of the glass diaphragm, whereas in the Bettini recorder and reproducer (in the case of a single diaphragm) it is attached by means of small arms on branches to various parts of its surface; but in the complex form, which consists of several diaphragms, the branches are attached to the centre of each diaphragm, so that each diaphragm will vibrate to some special characteristic in the sounds received. The Bettini improvements cover several forms of diaphragms, one or two of which have already appeared on the English market. In reply to your other question, there is practically no difference between the phonograph and graphophone records as now supplied. If by graphophone you mean the machines now being sold in this country under such names as phonograph-graphophone, Columbia phonograph, &c., though cheap, well-finished, and reliable machines, are not to compare with such machines as the genuine Edison and the better class of Edison-Bell phonographs. F. F.

[96837.]—**Phonograph.**—As "F. F." has not responded, I will endeavour to answer this query. The Bettini has a mellower, fuller, and more musical tone than the ordinary glass reproducer. This arises from three causes. 1. Its size. A big drum has a richer, mellower note than a small drum, and the Bettini has double the vibration area of the other. 2. The composition of the tympanum. If a metal plate be struck it emits a "singy" musical note, due to the number of overtones which it emits —a glass one on the contrary has a sharper and thinner tone with fewer overtones. My Bettini has apparently an aluminium diaphragm which I should think would be very much better replaced by a bellmetal or silver one. 3. The mechanism which forms the subject of Bettini's two patents, August 1889 and December 1892. When a stone is dropped into a still pond a circle is immediately formed, followed by another circle until the whole pond is covered by concentric circles. If a section of the pond could be obtained, the surface would be seen to consist of a regular series of troughs and crests like the waves of the sea—this being the way sound-waves are always projected. When in motion the diaphragm of the reproducer resembles the surface of the pond, and Bettini considered that he might utilise more than one wave; so I find mine has a sort of wire spider with nine legs fixed at different distances from the "body" which supports the sapphire stylus, thus utilising the whole vibratory surface. In addition it has a much larger area of tube to the horn projector. I presume by his second query, "C.E.O." means "Gramophone" which has a flat horizontal record. These are, I believe, made of celluloid, which is harder and has a more piercing tone than the wax ones of the phonograph; but the possessor cannot make his own records. Fred. Davis.

[96840.]—**Microscope.**—To "Optician."—My lenses are all convex. Micro Amateur.

[96848.]—**Failure of Dynamo.**—"Brewed Ginger" should look to his mode of connecting the lamps to the cables. Arrange the lamps in "parallel" instead of in "series," and then the failure will cease. In other words, instead of the lamps being connected all along the cables like beads on a string, they must be placed across the cables like the several rungs on a ladder. When this alteration has been effected, you may put back your 60-volt lamps, and your machine will then run fifteen or any less number of 16c.p. lamps, as it was originally intended to. Q. I. E.

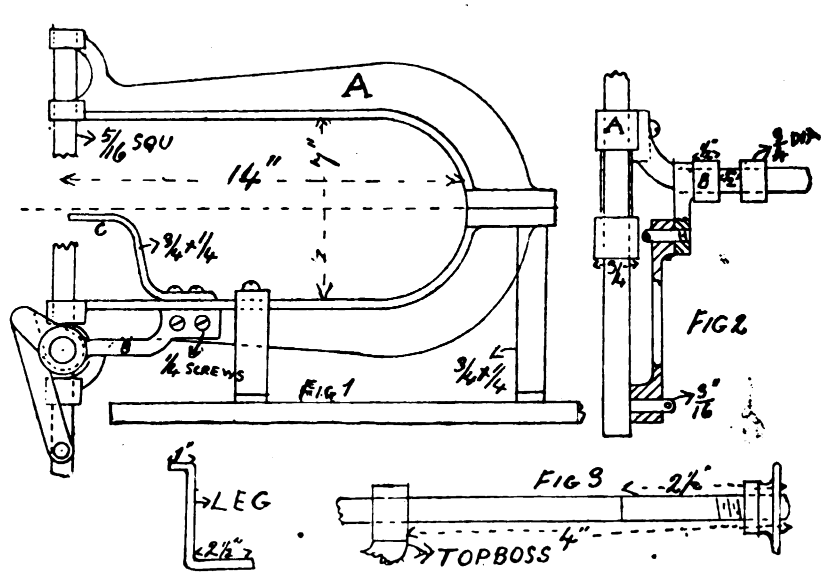
[96849.]—**Board of Trade Exam.**—Get afloat as engineer; you will have to serve about eighteen months at sea before allowed to sit for a second engineer's ticket. No certificate is required to commence with. Engineer.

[96849.]—**Board of Trade Exam.**—The Board of Trade regulations for a candidate for second-class certificate are: He must be twenty-one years of age, must have served an apprenticeship to an engineer for three years at least (no period of service in a drawing office can be allowed to count for more than six months' workshop time); he must have served one year at sea in the engine-room as an engineer on regular watch. "No Name's" best plan will be to try and get employment at a marine-engine works, or the repairing shops of a large steamship company (preferably the latter), for at least eighteen months; he will then have ample opportunity to persuade the owners or managers to give him a berth as junior engineer on one of the boats.
Niton, I.W. S. C.

[96859.]—**To "Monty."**—Ignition-lamp described is essentially a gravity-feed lamp, and is not intended to work with supply tank below or pressure in tank above ½lb. If tank was below, vaporising arrangement would have to be added similar to

frequently remedy by wiping points with piece fine emery-cloth, and perhaps slight adjustment of screw is all that is needed. The ignition plug, too, has been a fruitful source of worry, with cracks and loose stems through which high-tension current passes and is lost. A simple plug which is not a patent, having been used to my knowledge fifteen years ago, may be made from an old plug, centre china having been taken out and filled with mica washers, also top and bottom with mica ⅛in. thick, and whole screwed up solid by means of a centre bolt, which is tipped at bottom with platinum points. They are practically indestructible, and if a tight fit on centre bolt and screwed up hot, will give satisfaction in use. You can, if you like, fix platinum tube inside combustion chamber, and another outside for lamp. After engine has started lamp may be put out, and inside tube, becoming red-hot, will make engine self-firing, and it will keep running if not cut out too frequently or long at one time. The Daimler Co., who first introduced present tube system for oil motors, are now moving towards electric ignition on their latest cars. Monty.

[96862.]—**Fret-Saw Machine.**—I send a rough sketch of a machine I built some time ago. Its cost is under five shillings, and it cuts ⅜in. wood easily. "Terf-Was" should buy an old Singer sewing-machine of the kind that have two small mitre wheels in them. Mine cost me 1s. 6d. The parts to save for the fret-cutter are the flywheel with its spindle, the small crank underneath, and the largest of the screws. Then procure two casting, like A, Fig. 1, and bolt them together with ¼in. bolts (not shown), not forgetting to put a piece of leather in between, as that saves the trouble of filing up the joint-faces. Drill holes in the bosses where the bars work up and down, and file out square afterwards. A milled nut is fitted to the top bar, which bar is rounded and screwed for about 2¼in., as shown in



Actua, which consists simply in passing flame through a coil of tube through which oil is forced up. These lamps have sometimes 15lb. to 20lb. on them when forced. Why do you want to add vaporiser when you can buy petrol ready refined, which saves all paraphernalia, and also objectionable smell from heating heavy oil such as paraffin, which I presume you are thinking of doing? It is a far more difficult problem to produce a satisfactory heavy oil-engine for many reasons I can't give here —all tried so far are simply not in it with petrol. The Longuemare type of vaporiser as described for saturating air is one of the best going, though it has endless modifications. At risk of being tedious, I will again repeat warning: "Don't throttle your engine by making inlet and exhaust and all connections too small." Gauze box should have a diameter at least three times that of inlet pipe, as it retards vapour greatly. It is a great deal easier to choke high-speed petrol engines than most people are aware of. Platinum gives better results than anything else, though first cost is greater, present rate being about 34s. for a tube, half of which you will be allowed in changing for a new one. Platinum being thinner, heats us and fires much quicker, and lasts a very long time with care. There is a good imitation known as Hecnum metal, which may be bought for 7s. each. They seem to work well, though I have not given them lengthy trial on road. In spite of all drawbacks to electric ignition, it is infinitely superior to lamp, and some form of magneto will undoubtedly survive over troublesome batteries. The Dion form of contact-breaker is not certain when covered with oil on platinum points; hence faults sometimes, which user could

Fig. 3. When at its highest point, the top of the bar should be about 4in. above the top boss of machine. Slip a rather stiff spiral spring over bar, so that it rests on boss, and regulate stiffness by the nut on top. Make a full-sized drawing of machine before building it. A pattern must be made for the bracket B, Figs. 1 and 2. The worktable (now tilting) is screwed to the bent iron bracket C. Fig. 2 is an enlarged view of driving gear A, boss on frame B, bracket from pattern D, crank from old machine E, spindle from same, cut to length required. Driving-wheel from old machine goes on end of spindle E. Connecting-rod can be a little forging, or can be converted from rods about the sewing-machine. Cut a hole in bench for bottom bar to sink into. The back legs are held by two of the bolts, which hold the two halves of the machine together. This machine has a true vertical stroke, which is not the case with those that have two long arms to them. I have said nothing about the saw clamps on the ends of bars, as they can be copied from a hand-frame. In conclusion, if "Terf-Was" cares to advertise his address, I will lend him a pattern of A, Fig. 1, gratis. E. W. Fraser.

[96877.]—**Electric Light.**—The average consumption of units per hour for 16c.p. incandescents is ·056. For a 500c.p. arc on a 50v. circuit ·25 unit, and for a 1,000c.p. arc ·5 unit.
A. H. Avery, A.I.E.E.
Fulmen Works, Tunbridge Wells.

[96877.]—**Electric Light.**—Reckoning that a fairly efficient incandescent lamp takes 3½ watts to work it, then a 16c.p. will take 56 watts, or nearly one-eighteenth of a unit per hour. A 200c.p. will

take just about one unit. A 500c.p. arc lamp will take about one-third, and a 1,000c.p. about two-thirds of a unit. S. BOTTONE.

[96877.]—**Electric Light.**—The consumption in units per hour of a 16, 32, and 100c.p. incandescent lamps, and 500 and 1,000c.p. arcs, will be approximately $\frac{1}{16}$th, $\frac{1}{8}$th, and $\frac{1}{3}$rd of a unit, and $\frac{1}{6}$th and $\frac{1}{3}$rd of one unit respectively.

WEBSTER MICHELSON AND CO.,
Dudley. Electrical Engineers.

[96873.]—**Whole-Meal Bread.**—The reply of "Regent's Park" to the above query states: "Dissolve 1oz. of bicarbonate of soda in boiling water." He has apparently overlooked the fact that under these conditions the greater part of the bicarbonate $NaHCO_3$ would be converted to the sodium carbonate Na_2CO_3, the equation being, $2\ NaHCO_3 = NaCO_3 + CO_2 + H_2O$. On the decomposition of the bicarbonate by heat depends the aëration of soda cakes. It should be dissolved in cold water.

T. J. LENEY.

[96873.]—**Whole-Meal Bread.**—In making the above with yeast, there is a difficulty in getting sufficient porosity, as the yeast does not propagate so freely in wholemeal, owing, no doubt, to the white portion comprising the gluten and starch in which the yeast cells thrive being considerably separated, by reason of the presence of the bran. The remedy is to add a small portion of white flour, which will counteract this defect. Take, say, about one quartern of wholemeal and half a quartern of white. Use the pressed or German yeast—about 2oz. See that it is fresh. It should not crumble too readily. Dissolve this yeast in warm water that is of about the same temperature as the hand; add about a saltspoon of salt to the flour, and stir in the yeast water. Make the dough slack at first, and knead in more dry flour till of the right consistency. Have ready your baking-tins, grease them inside, and around the sides tie some paper. Put in each a piece of dough of a size sufficient to about one-third fill the tin. Place these somewhere near the fire, where they will be kept at about blood-heat, bearing in mind that yeast is a vegetable growth, and will easily be killed with too much heat. In about an hour it will have risen to nearly three times its bulk; then put in the oven, which should be brisk at first, and slower after. About one hour is the usual time of baking. The reason for having the oven brisk at first is that it will cause an expansion of the carbon dioxide set free by the yeast cells, and this tends towards greater porosity.

T. J. LENEY.

[96881.]—**Malting Wheat.**—H. Stopes on "Malt and Malting," of *Brewers' Journal* Office, London, E.C., gives difficulty of growing it with the acrospire outside the husk. Its excess of gluten and other nitrogenous constituents give much trouble. It is rarely made and little known. Differs in itself from barley, and is much more difficult to make. In 1834 wheat was cheaper than barley, and a considerable quantity made into malt. Owing to great difficulty of working up a flour without damage to the growing acrospire, many maltsters mixed wheat and barley together. At that time 13 bushels of barley produced same quantity of beer of standard gravity as 9 bushels of wheat, 10 of rye, or 10 of oats. J. E. Thausing and W. J. Braunt on Malt, and Low and Co., speaking of wheat malt:—It gives light colour better than barley, but more difficult because of its nakedness, and partly because in germinating the cotyledon appears on same point of grain shortly after radicle has made its appearance. The gaining of wort from wheat is difficult, on account of tenacious layer of grains. Wort is frequently cloudy, difficult to clarify, beer is said not to keep well—probably, as to latter, caused by the larger quantities of proteine substances dissolved in mashing. Mealy wheat better than glassy wheat for beer fabrication. As to rye, it appears to have same defects, as when the worts are cloudy mucous, does not clarify, has disagreeable, sharp taste—this sharpness caused by formation of butyric acid in rye mashes. Much the same processes as with barley.

REGENT'S PARK.

[96882.]—**Vinegar Plant.**—Vinegar by means of vinegar fungus:—In 1862 a new method of making, devised by Pasteur. Vinegar fungus (*Mycoderma aceti*) is agent, is first propagated and cultivated in fluid composed of water with two per cent. of alcohol, one per cent of vinegar, and a small quantity of the phosphate of potash, magnesia, and lime. The surface of fluid soon becomes covered with fungus, part of alcohol at same time acetified. When half of alcohol has become acetified, small quantities of wine and beer are added to fluid every day, and the process carried on until all alcohol has become oxidised. Vinegar then removed from containing vessel and fungus employed in manufacture of a second batch. Vinegar prepared thus is said to possess aroma of wine vinegar. Vessels are made of wood, and in form round or rectangular shallow tanks. The prepared liquid, contained in a vessel having an area of about $10\frac{3}{4}$ square feet, and a capacity of from 90 to 100 pints, yields about 9 to 10 pints of vinegar daily. Tanks are covered by lids, air admitted to contents through holes bored at end of vessel; whilst alcohol is conveyed to bottom of fluid through perforated guttapercha tubes—an arrangement which gets rid of the necessity of opening the lids. When alcohol alone is employed, Pasteur makes the addition to the fluid of about $\frac{1}{10000}$th of its weight of sulphate of ammonia and phosphate of potash and magnesia, as well as some vinegar. The above salts constitute the food of the fungus, and as they are contained in beer and wine, they are dispensed with when these fluids are employed instead of alcohol, and successful result can only be obtained by paying great attention to the healthy development and growth of the mycoderma at starting. REGENT'S PARK.

[96883.]—**Diamond.**—Unchanged by heating out of contact with air to 1,300° or 1,400°; but, placed between carbon poles of powerful battery, it glows brilliantly, swells up, splits, and after cooling the surface resembles coke from bituminous coal. Unchanged when heated to whiteness in water vapour. Strongly heated in a stream of O, diamond is completely burnt to CO_2, &c. (Watts's "Chemical Dictionary.") REGENT'S PARK.

[96887.]—**Clocks.**—Perhaps secretary of the Horological Society, Northampton-square, E.C., may have data. Have not seen it in Britten's works on clocks and watches. REGENT'S PARK.

[96890.]—**Lahmeyer Dynamo.**—TO MR. AVERY.—In the first place quadripolar armatures never give very good results. A tripolar, or, better still, cogged drum, would effect a vast improvement. Then, again, a finer gauge of wire is required on the armature; the querist does not mention what output he requires; but as a guide I may say that with a machine of these dimensions, I use 3oz. No. 24 on the armature, and 12oz. No. 22 on the fields, getting 15 volts 2 ampères at 2,800 revs.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96891.]—**Sun-Views by Projection.**—I have just obtained a Slade micrometer for this purpose, which I think will answer very well. But it will be advisable to stop down the o.g. or mirror, as too great heat might injure the photographic film. A ruled glass reticule will be somewhat expensive. I am using my Slade for direct vision, with my $8\frac{1}{2}$in. mirror largely stopped down. H. WADSWORTH.

[96894.]—**Crickets.**—Make a paste of some (one part) powdered chloride of lime and half a part of some fatty matter, and spread on pieces of bread to lay in or about infested places. Expect they will clear out. Or sprinkle a little quicklime near to cracks at which you expect they enter room. Laid down at night, it can be swept away in the morning; but keep the children from fingering chloride of lime. Or put chloride of lime and powdered tobacco in their holes. REGENT'S PARK.

[96899.]—**Tides.**—Roughly speaking, it may be said that high-water at any port occurs daily a certain number of hours and minutes after the moon crosses the meridian of the place; of course, the sun's influence makes this only very roughly true. Now, on the day of change or full, the moon must cross the meridian (above horizon in former case, below it in latter), very nearly at noon. For, since the moon's motion in its orbit alters the time of crossing meridian by only about 50min. per day, it is evident that although new or full moon may occur at any time of the day, the moon must cross the meridian on that day within a few minutes before or after the sun. Therefore, the time of high-water must be at nearly a fixed interval after noon on day of full or change—i.e., it occurs at almost a fixed time of day. It is the average time, of course, which is given in the tide-tables. It need hardly be said that whether the moon crosses the meridian at noon above the horizon (as at change), or below (as at full), is immaterial, as the theory of the tides shows that the moon's tidal influence is similar when it is on opposite sides of the earth.

ARCTURUS.

[96900.]—**Grammaphone.**—Yes, I should think the diaphragm ought to be "as thin as you can get it." Perhaps (if the querist uses talc) glass might answer better in his case. Possibly he may not have secured the edges of the diaphragm as tightly as they should be held. Again, the screeching may be the result of some fault in the record or needle. The latter, if not sharp enough, sometimes slips over the edge of the groove. I am afraid I cannot help him with the latter part of his query.

R. A. R. BENNETT.

[96901.]—**Wimshurst.**—TO MR. BOTTONE.—Do not use wood—you will utterly spoil your machine. Procure two discs of ebonite, reaching nearly to the brushes, and cut them into stars, the rays of which reach between the sectors. Cement these on with very thick shellac varnish. S. BOTTONE.

[96902.]—**Gas Explosions.**—The hydrogen alone requires less air mixed with it to form an explosive mixture than the compound gas from the ordinary jet; besides, there is a great difference between a bottle and a room. Very near all gases containing hydrogen require a fixed quantity of air to be at the most explosive point, and an excess of gas or air from this point reduces its explosive character in comparison until it burns quietly.

D. T. W.

[96905.]—**Negatives of Diagrams.**—For this class of work I always use Ilford isochromatic plates. There are "process" plates specially made by the same firm for this work. Give a short exposure in a good light. Use some pyro developer with plenty of sulphite of soda in it, or else hydroquinone. To fasten the diagram opposite window may cause a shadow of the camera on it. I fasten them sideways to the window. If above system is carefully carried out, it is almost impossible to tell the print (if in platinotype, &c.) from the original.

R. A. R. BENNETT.

[96905.]—**Negatives of Diagrams.**—Use less accelerator in the developer than you would in ordinary work; also look to exposure, which must not be over-long. If you have many to do, you had better begin by exposing three or four plates on a diagram, giving different times. The result will give you the best indication as to exposure. The black lines should be nearly clear glass on the negative, so that they will print out black almost at once, and before any light has got through the dense part. DIAGRAMS.

[96905.]—**Negatives of Diagrams.**—Bromide paper offers a ready method of getting a soot and whitewash print. Use a slow plate, backed to prevent halation; and with a small stop, minimum exposure, and plenty of pyro, there ought not to be much difficulty, if the diagrams are in a good black ink and cannot be used as negatives. I have somewhere seen recommended duplicate isochromatic film negatives, printed superposed, but have not tried this. J. D.

[96906.]—**Arc Lamp.**—(1) Yes, with close attention. (2) On a continuous-current circuit the carbons are arranged in pairs—one solid, connected to the negative wire, and the other cored, and connected to the positive. (3) For a current of 13 ampères, the positive carbon should be 20mm. cored, and the negative 13mm. solid. Sputtering is chiefly due to imperfections in the carbons; use only the best obtainable.

A. H. AVERY, A.I.E.E.
Fulmen Works, Tunbridge Wells.

[96907.]—**Wireless Telegraphy.**—TO MR. BOTTONE.—(1) The relay spring is apparently too stiff, and perhaps the iron of the relay retains magnetism, hence the failure in decohering. The core of relay should be a bundle of well-annealed No. 22 soft iron wire. (2) You do not say how your decoherer is made or how it works; but in all probability it does not strike the coherer at the right spot to decohere the filling. (3) One wire can be horizontal, provided it touches nothing but the coherer. The other can be taken to earth. This "vertical" wire may take the form of a strip. (4) Yes, a fourth ball increases the effect. (5) Probably due to the stiffness of the relay spring.

S. BOTTONE.

[96908.]—**To Mr. J. Dormer.**—Contact prints of antiquarian extent are beyond my experience, and bromide paper, though obtainable of this size and printable by gaslight, is, I suppose, not suitable. Some other reader may be able to give the information required. Again, I know nothing about parchment as a substratum; but to palliate this disappointing agnosticism, I append a cyanotype recipe. Take about 80gr. red prussiate of potash and about the same quantity of ammonio-citrate of iron, dissolve each in an ounce of water, mix and apply to well-sized paper; dry quickly, and do not keep too long before use. If you treat paper with iron alone, the ferrocyanide will act as a developer. Clear the whites, if necessary, with a little citric acid. J. D.

[96909.]—**Gilding.**—Put book into press straight and on level with cheeks of press between cutting boards, boards of book thrown back. Screw up tightly, any projection of cutting-board taken away with chisel. If paper unsized or at all spongy, edge should be sized and left to dry. This may be ascertained by wetting a leaf with tongue; if spongy, the moisture sinks right through as in blotting paper. Scrape quite flat edge, and even all equally. When quite smooth, mixture of black lead and thin glair water painted over edge, and with hard brush well brushed till dry. Now cut gold on the cushion. Lift leaf out of book with gold knife, lay on cushion, breath gently on centre of leaf to lay it flat, then cut to size. Edge glaired evenly, gold taken up with piece of paper previously greased by drawing it over the head. Gold then laid gently on edge previously glaired. Whole edge or end being done, it is allowed to get perfectly dry, say, in two hours. Before burnishing lay a piece of fine paper on gold, and gently flatten with burnisher; it then becomes dull gilt. When intended to be bright a waxed cloth should be gently rubbed over the surface two or three times before using burnisher. To peruse J. W. Zaehns-

dorff's "Bookbinding" would well repay—of G. Bell and Sons. REGENT'S PARK.

[96910.]—**Belt-Lacing.**—See "Leather Manufacture," by A. Watt, 1885 (Crosby Lockwood and Co.) Cowhide almost invariably used for belts; lacing-thongs commonly made of leather or good clean cowhide, softened and stretched somewhat to render it firm and even; vary in width from ¼in. to ⅜in., and in thickness from $\frac{1}{32}$in. to nearly ⅛in., according to width. REGENT'S PARK.

[96911.]—**Accumulators.**—Pasted plates are better, insomuch as the active material bears a much greater proportion to the surface exposed than with the Planté.

A. H. AVERY, A.Inst.E E.

Fulmen Works, Tunbridge Wells.

[96914.]—**Astronomical.**—If "Novice" means by the time of rising of a star the time at which its true altitude is 0°, a star which rises exactly in the east must be situated on the celestial equator, and will be 12 sidereal hours above the horizon, or 11h. 58m. 2s. of mean time. But as refraction causes a star to appear on the horizon when it is actually 35′ below it, such a star will appear above the horizon for a slightly longer period, depending on the latitude. In latitude 52°, for example, the time would be about 12h. 6m. of mean time. ARCTURUS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96463. Hovis Bread, p. 22.
96472. Soret's Fluorescent Eyepiece, 22.
96473. Hand-Camera Shutter, 22.
96475. Reflector, 22.
96477. Old Coins, 22.
96480. Preserving Flying Fish, 22.
96485. Humane, 22.
96486. Loune's Vacuum Engine, 22.
96487. Torpedo Boat Destroyer, 22.
96490. Lantern Query, 22.
96496. Canary Complaints, 22.
96498. Boat, 22.
96500. Inspector of Weights and Measures, 22.

96639. Motors and Castings, p. 121.
96644. Marine Engineers, 121.
96646. Hernia, 121.
96651. Transposition, 121.
96653. Sailing Boat, 121.
96657. Laundries, 121.
96659. Joy's Valve-gear, 121.
96664. Sunken Ships, 121.
96667. Wheel-cutting, 121.
96672. Mexican Furnace Chimney, 122.

The German Beer Industry.—The German beer industry has grown year by year, and the increasing capacity of the establishments has made it necessary for the brewers to search for new markets where their overproduction could be disposed of. In the year 1885 the export of German beer reached its maximum, amounting in that year to 1,318,000 hectolitres (28,996,000gal.), representing a value of 24,000,000 marks (£1,200,000). The next year, however, showed a decrease, and since then the export has gone down to about one-half of what it was in 1885. According to the United States Consul at Kehl, the reason given for this decline is that the countries which were Germany's best customers—France, Belgium, and the Netherlands—have increased their output sufficiently to nearly meet the home demand. The high duty placed on foreign beers by France has also had the effect of considerably reducing the import of German beers into that country. In all those years the export of German beer in bulk (barrels) has been greater, contrary to general belief, than in bottles. German beer once had nearly a monopoly of the beer trade of South America; but there also, it is stated, the demand has decreased, while at the same time, according to trade reports, the demand for the United States has increased. The decline of the German beer trade in Brazil alone, during the year 1896 and 1897, is given as amounting to fully three-fourths of what the German brewers had exported to that country in former years. It is a noticeable fact that while the export has declined year by year, the production of beer in Germany has advanced steadily, showing that the home consumption has greatly increased. At present the United States is the best foreign customer for German beer, importing in 1895 522,138gal., and in 1896 689,456gal. The export of beer from Germany to Venezuela, Japan, and China together did not in the years given amount to one-half the exports to the United States alone. Brazil and British India, as consumers of German beer, come next to the United States. The German brewing industry has strong hopes of entirely supplanting the English in Australia and other British colonies.

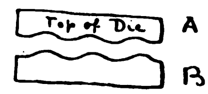
QUERIES.

[96918.]—**Scrap Arc Lamp Carbon.**—Can any reader of "Ours" tell of any use to which the short, burnt ends of arc carbons may be put?—Q. I. E.

[96919.]—**Floating Body in the Air.**—Will some reader please explain how Maskelyne's floating human body is done? Can anyone produce it in public?—TRIXIE.

[96920.]—**Electroid Gas.**—Can anyone please give me information concerning a new gas called "electroid" gas? A daily paper stated that it was used to light a village, but gave no particulars.—J. H.

[96921.]—**Thin Sheet Steel.**—Can I corrugate the above by heating to red heat and fixing between a metal die like the accompanying diagram, A, B, so that it will



be permanently corrugated when taken out of die, and yet retain the spring when tempered?—JASMINE.

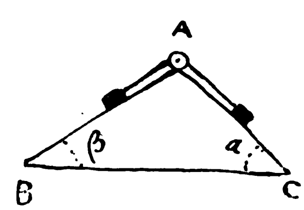
[96922.]—**Stylographic Ink.**—Can any reader kindly recommend a really good ink for stylo. pens, as I find that most of the inks sold for the purpose are unsatisfactory? My idea of a good ink is one that will run freely, have a dense black colour, absolutely free from sediment, dry quickly, and will not smear or run if the writing should happen to get wet. The latter is the greatest fault of nearly all stylo. inks.—S. C.

[96923.]—**Heating Tank.**—Can any reader tell me the amount of heating surface of tubing required to raise the water in a tank containing 1,000gal. of salt water, from a temperature of 80° Fahr. to 160° Fahr., the steam entering the copper coil in the bottom of the tank at 50lb. pressure? The tank is cylindrical in shape, lying on its side, the coil being composed of 1in. bore copper tube.—HEAT.

[96924.]—**Artificial Diamonds.**—I find it stated that some years ago a London firm produced artificial diamonds made of a "composition of glass, lead, and carbon, and tipped with platinum." They were guaranteed to last twenty years, and are said to "have become the rage." I am acquainted with paste "diamonds" made mainly of strass, but in what form would that "carbon" be, and what is meant by "tipped" with platinum?—DOUBLET.

[96925.]—**Panama Hats.**—Are Panama hats made of the fibre of pineapple, and where are they principally made? Are they difficult to make. One London dealer is stated to have sold three in one day at £25 each. These hats (some of them, I presume) are said to be as soft as silk, and can be folded up and put into a waistcoat pocket. Is that true?—C. E. GREEN.

[96926.]—**Velocity of Centre of Gravity.**—Will some reader kindly give me the solution of the following? Two heavy particles of masses, m and m^1, rest upon the frictionless inclined planes A B and A C, and are connected by a string passing over a pulley at A. When the



particles are in motion. it is required to determine the velocity of the centre of gravity of the particles resolved parallel to the two inclined planes after a time, t, from the commencement of the motion.—Q.

[96927.]—**Mercury Gilding.**—Can any reader tell me what is the best way to get mercury out of the system? I have a friend engaged in the trade, and now and then he appears to have a surfeit of the mercury in his body: his hands shake like a palsied man, and he complains of neuralgic pains in the head, but he does not appear sufficiently ill to go to a doctor; in fact, he will not go. Perhaps someone can tell me what will counteract the effects.—GILDER.

[96928.]—**Electro-Magnet.**—The two limbs of a horseshoe electro-magnet may either be wound in series or shunt. Compare results for purposes of motor.—NEW CENTURY.

[96929.]—**Electric Ignition.**—Can any of "ours" give particulars of electric ignition for 2¼H.P. oil launch engine? Tube at present, but would like to experiment. What length of spark, and which is best—accumulators or small dynamo driven by engine? Also hints as to volts, amps., &c., required; also size, speed, &c., of dynamo, if considered best.—SPEED.

[96930.]—**Sound.**—I believe there is an instrument constructed by which it is possible to hear through a glass window or a wooden door, &c. Will any of the readers please instruct me how to make a simple one?—C. G.

[96931.]—**Dry Batteries.**—I have a quantity of No. 6 E.C.C. dry batteries, but cannot get any current from them. Will some of our readers kindly state whether it is possible to recharge them? If so, how? I may say they have lain aside for some time.—A. H. R.

[96932.]—**Polycistina.**—Will any reader kindly give me information where I can procure a small quantity of polycistina, say about ¼oz., unmounted? If I can get it ready cleaned for mounting it would be more convenient, as after attempting to clean some myself by boiling &c., I can only find a specimen here and there.—VERINDER.

[96933.]—**Asbestos Fire.**—When I had the gas-pipes laid on in my house I had them continued to the fire-places in the drawing and sitting room; I am now wondering as to the best method of heating the room by gas, of which I am desirous. Is the asbestos fire cheaper, and does it give out as much heat as the asbestos stove? Although the local gas company hire out gas kitcheners at a very moderate sum per quarter, they do not hire the gas-heating stoves, but only sell them. Perhaps one of "ours" might know, and be able to enlighten me on the subject? I should be glad if so, with probable cost.—SAM.

[A definite question would have more chance of a definite reply. We have Verity's gas fires in library, bathroom, and billiard room, and like them. They are dearer than Fletcher's (first cost), but we like them better. They are dearer than coal fires. We don't like them in a dining or drawing room. They must have plenty of gas behind them. They are of no use with the ordinary ⅜in. pipe. They often disappoint in foggy or frosty weather, thanks to the Gas Companies and clogged pipes!—ED. "E.M."]

[96934.]—**Motor Tricycle.**—I am an owner of a motor tricycle, Beeston make; the same goes well, but after I have ridden about 15 miles at a fair speed the cylinder seems to heat, and the engine makes a grinding noise, and will not drive, though amply lubricated; I have to get off and wait 15 to 20 minutes before I can proceed. This happens frequently, and specially in hot weather, and I understand that most air-cooled motors do the same. I have heard lately that Mr. Stocks, of the Ariel Cycle Company, in his long-distance rides, and also Mr. Edge, use on their machines water-cooled motors; that they have a tank carrying one gallon of water between frame, which boils away and has occasionally to be renewed. I should like to know what there is against adopting this plan, and why it is not generally adopted instead of air cooling. Does the sediment inside the jacket prove troublesome?—W. ATTKINSON.

[96935.]—**Motor Cylinder.**—Will any reader kindly tell me how to bore a steel tube 3in. diameter for a motor cylinder? I have been told it cannot be turned, but must be ground true. If this is correct, how must I proceed? I have a 6in. lathe and plenty of tools.—SENLAC.

[96936.]—**Locus.**—A point moves so that the sum of the distances from two angles of an equilateral triangle is equal to its distance from the other angle. Show that the locus of the point is the circle circumscribing the triangle. I can prove that if any point is taken on the circle the two distances mentioned are equal to the third.—EUCLID.

[96937.]—**Electric Light.**—We use about one million cubic feet of gas per year, the cost being 3s. 8d. per thousand feet. Could we have electric light as cheaply? What power would be required, and what would be cost of engines and accumulators?—ELECTRIC.

[96938.]—**Question in Arithmetic.**—A square field is surrounded by a wall. The part immediately within the wall, all round the field, is covered with gravel, and two straight gravel walks 13ft. in width run across the field, joining the middle parts of the opposite sides. The ungravelled part of the field contains 2¼ acres. What is length in yards of the boundary wall?—CORNUBIA.

[96939.]—**Ebbing Well and Burning Cliff.**—Is the ebbing and flowing well at Brixham (the "Laywell") still in existence? At what period did the "Burning Cliff" near Weymouth cease to justify its name, and of what was the burning mass composed? One often sees the waste-heaps at collieries smouldering, owing to the presence of sulphur; but this would hardly be the case at Weymouth, where the conditions are so different.—A. S. L.

[96940.]—**To Mr Bottone.**—I wish to establish a wireless telegraph (merely to ring a bell) with a house about a quarter of a mile away, but with no need for any reply. Will you please tell me what height of pole is necessary, whether a coil or Wimshurst machine is least expensive for the same efficiency, and, generally, give me an idea of the cost, exclusive of poles (which I could get locally)? Must the pole carry a strip of wire netting, or is a simple wire sufficient? I know the arrangement necessary, but do not know all the details of actual instruments as now constructed.—A. W. L. T.

[96941.]—**Mean Time Dial.**—To "E. L. G." AND "F.R.A.S."—Some time ago "E. L. G." promised to tell us how to construct a "mean time" dial. Unfortunately, he has never done so, and I therefore hope he will not mind my now calling his attention to the matter. I have also coupled "F.R.A.S." with "E. L. G." as another authority on such matters whose help I would ask for. Suppose, instead of a bar, we consider the gnomon to consist merely of its extreme point, or of a small ball in the place of such point. Then, assuming the plate of the dial to have no lines on it, let the hourly positions of the shadow of the ball be marked on the plate, according to a mean time clock, on the shortest day, and weekly thereafter till the longest day. Evidently we shall have, so far, obtained a dial of the required description. Can what has been thus done mechanically be done geometrically, and to what errors would a dial so made be subject, annual or otherwise? I know the dial with the "figure of eight" gnomon, to give mean time, but it is better in theory than practice, as the shadow of the gnomon is too indefinite. I fear the same objection would apply to the ball, but my question is rather one to elicit an opinion on the geometry of the problem than to describe an actual dial.—A. S. L.

[96942.]—**Motor Tricycle.**—Should be thankful for advice from "The Writer of the Articles" or other. I have a Beeston motor tricycle, tube ignition, and have had it running every day for a year. It continues to run well, but I find the oil leaks very much from crank chamber (which is of aluminium), no matter how much I tighten bolts; the leak takes place right at the top, both in front of and behind cylinder, and there is quite a spurt of oil on pushing machinery along. I have had cylinder off, and taken a cutting in lathe off outside where it fits into recess on top of crank chamber, and now it is an easy fit, but still leak takes place. What is best to be done? Shall I "pack" between the two halves of crank chamber, and if so, what with? Or shall I file surface flat? What is cause of surfaces not coming into contact as they did when new? Bolts are all tight as I can make them. I thought perhaps the cylinder, on getting hot and expanding, forced apart the upper part of crank chamber, but I

still cannot bring it together properly, although I have taken cutting off cylinder. Chamber gets very oily, and covered with dirt, and requires fresh supply of oil every six miles.—Cranky.

[96943.]—**Diving.**—Will any reader please inform me to what distance a diver is able to see clearly under the surface of the sea, and whether the use of a powerful electric light would increase the distance?—Enquirer.

[96944.]—**To Mr. Bottone.**—Thanks for information; and would you please oblige me further? Could I put this laminated armature of 3in. diam. 4in. long to any useful purpose as a dynamo, as it is so well made that I do not like to put it on one side if I could possibly turn it to account? There are 24 winding spaces, the ends are slotted to take wood wedges, also a 24-part commutator. —J. Ellis.

[96945.]—**Jointing Machine.**—Will some reader kindly inform me if I can make a machine for making quickly half-round joints on 1in. round beechwood for making furniture?—Yonge.

[96946.]—**Navy.**—Will any reader tell me how I can become an assistant probationary engineer for permanent service in the Royal Navy? I have served 4½ years in the engine works in a large shipyard. Would going to sea for a year or two and getting first and second-class certificates be any help? I have not yet been to sea. Could I go to sea with 4½ years' apprenticeship? I am 20 years of age. Must I serve twelve months at sea (on watch), or will twelve months at sea in the engine-room as fourth or fifth engineer allow me to sit for second-class B.T. certificate?—Apprentice Engineer.

[96947.]—**To "F.R.A.S."**—Many thanks to "F.R.A.S." for answer to query 96834 about lighting wires in a transit instrument. There is no lens over the aperture of the pivot. Should it be convex or concave, and about what length of focus?—R. A.

[96948.]—**Launch.**—Will some kind reader oblige me by giving the leading dimensions of a steam launch for river use? Length over all, 35ft.; B.P., 31ft.; mean draught, 2ft. I want to go up to 15 miles per hour if possible. I should like to know the least practical beam; horse-power required at that speed; approximate weights of triple-expansion engine running about 600 revs. and water-tube boiler working at 200lb.—Rocque.

[96949.]—**Mutoscope Pictures.**—Will any reader kindly tell me how the pictures in the mutoscope are printed? I imagine they are originally taken on films, which I presume would be the negative; but how are they enlarged and made positive? I am desirous of trying my hand at it, so should be glad of all information possible to start with as to apparatus required and probable cost, &c.—Amature, Dudley.

[96950.]—**Slade Micrometer.**—Can it be used for finding position-angle as well as distance? In what respect does it differ from the ordinary filling micrometer? Describe a cheap way of illuminating. Can it be easily arranged by electricity?—Enquirer.

[96951.]—**Inflammation of the Parotid Glands.**—Can any reader help with hints? Age 57, occupation sedentary, temperament bilious, mode of life regular. Fairly good health till twelve months since, when, supervening on a bad attack of influenza, the parotid glands on each cheek began to swell, and remain so, making the face unsightly. No pain, but general feeling of stiffness and unpleasantness, and apparent interference with secretion of saliva so that mouth is always dry. Have seen seven specialists, who confess inability to treat; one would have been inclined to suggest surgical treatment, if on one side of face only, but hesitated on both sides. Have spent some time at the South of France by another's orders, but am no better.—Y.

[96952.]—**Model Boiler.**—Will any kind reader of "Ours" give particulars of model vertical boiler, to work a cylinder ⅞in. bore 1in. stroke? What size, shape, and material should the boiler be made of? Also pressure, and if any tubes and riveting.—Amateur Engineer.

[96953.]—**Steam Exhaust.**—I have a 3H.P. steam-engine, the exhaust from which is carried away through 30ft. of 1¼in. iron pipe, but being in an awkward place, the steam from exhaust-pipe creates a nuisance. Is there any possible way in which I can stop this, by condensing steam or placing some kind of fitting on end of exhaust pipe, which will not cause any back pressure on the engine?—Exhaust.

[96954.]—**Motor for Car.**—Would "Monty" please help me by answering the following question? I am building a 3H.P. Endurance horizontal motor for car, with electric ignition, and what would the simplest and best carburetter be to make? I also have an 8-volt dynamo, with plenty of power to drive it. Would it be suitable for charging accumulators, 4 volt 30 ampère hours, and how long would it take it to charge them? Also how to make an effective silencer for exhaust, and cooler for the water from cylinder jacket? Any other information re Endurance motor would oblige.—Harry.

[96955.]—**Stage Thunder.**—Will some reader give instructions for producing stage thunder, also stage lightning?—No. 7.

[96956.]—**Glass Silvering.**—There are many formulæ given in back numbers. Which is most suitable for use in a workshop? I mixed a lot some years ago from instructions in the "E M.," and did not get a deposit on glass plate. I poured the fluid into a glass beaker, intending to recover the silver. Next morning I found a beautiful coat of silver, so hard that it had to be scraped off with a knife; but I do not know what the formula was.—M. C.

[96957.]—**Quill Pens.**—Will some reader tell me how the fine, clean slit is made in the quill pens sold in boxes ready for use? I like to make my own pens, but seldom succeed in getting a slit that is quite satisfactory. —An Old Subscriber.

[96958.]—**Negatives on Celluloid.**—(1) What is the most expeditious way of making negatives on stiff celluloid supports (such as Frears negatives)? (2) Can a lot be developed together in a large dish, or should a grooved trough be used? (3) Is any modification of developer required? (4) Would the above methods be considered slipshod?—Optical L.

[96959.]—**Moulding Slag.**—Can any reader tell me at what heat the above melts, and if it is possible to mould it into rough bricks or slabs, and if there are any of these at present manufactured, and where? I would also be glad to know if the ordinary limestone slag, from iron blast furnaces, has any injurious chemical effect on lead water-pipes in roadways? Also if it is possible to add anything to the slag in its molten state to make it less brittle? Any information will be acceptable to—A Constant Reader.

[96960.]—**Carbide.**—How much calcium carbide can be kept without a license, and what precautions are legally required to be taken?—Optical L.

[96961.]—**Electrical.**—What is the voltage of a cell of zinc and copper plate one each in dilute acid? Also, if two zinc and three copper plates in one cell? Do the zincs need to be amalgamated?—M. C.

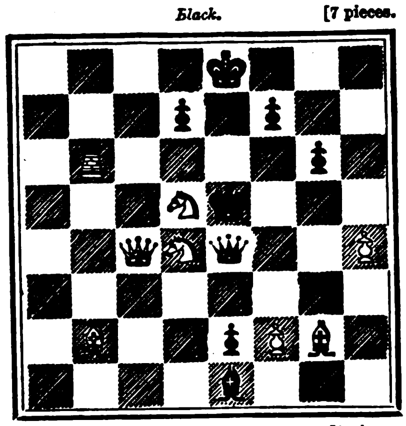
[96962.]—**Multiple Wimshurst.**—To Mr. Bottone and "J. W."—I am constructing one of these machines, and shall be much obliged if you can suggest any reasons for it not exciting. The machine has eight plates, 24in. in diam., made of ebonite $^1/_{16}$in. thick, to which is fixed with knotting another disc of ebonite 15in. in diam. and $^1/_{16}$in. thick, and reaching to the inside (small) end of the sectors, put on to stiffen the plates. Each plate is furnished with 16 sectors, 6½in. long by ⅞in. wide at wide end by ⅜in. wide at small end, and having a boss ⅜in. diam. projecting ⅛in. from face. The sectors are covered with a piece of ebonite extending from the small end against the edge of smaller disc to half-way up, leaving only about 2in. or so of the sectors exposed. The neutralising rods are arranged as shown in Mr. Wimshurst's machine. They are of $^3/_{16}$in. brass wire, with brushes of about 40-gauge brass wire wedged in hole in the end of the rod with clean cooper wire. Each set of rods is connected together, with brass wire passed through a hole in the other end of the rods and soldered. Each two sets, top and bottom, are connected together with a strip of sheet brass soldered to the connecting wires, the top and bottom strips being connected by a brass rod ⅜in. diameter. I have fixed up the machine temporarily, with the neutralising brushes in position, without collecting combs, but on rotation cannot get the slightest signs of excitement; reversing the rotation makes no difference, altering the position of the brushes as much as I can no better. I have put a charge into the machine from a smaller one, but without the slightest result. It is not the weather, although that is not altogether favourable, for I have a smaller machine at work in the same room. Does it matter which way the new brushes are connected so long as they are all connected together, or is it better to connect the top left with the bottom right set, and the top right with the bottom left? I have tried warming the machine as much as I dared, but with no effect. The distance between each pair of plates is 1⅜in. Is this likely to affect the working of the machine? Would a machine work at all if the ebonite is not of the very best quality? I have tried pieces that I have left, and when using a Leyden jar charged at the tension of a 1in. spark (holding the jar by the outside coating in one hand and the piece of ebonite in the other), I get a small discharge, which is dissipated on the face of the ebonite (which is polished), when the knob is $^1/_{32}$in. away, but do not feel the slightest shock. When the jar is charged with ½in. spark I get no discharge at all, or when the ebonite is warmed, so that it appears to be of fairly good quality. Would matters be improved by cleaning the plates with carbonate of magnesia and varnishing with shellac varnish? Even if the ebonite was not of the best quality, I should think it would show some signs, however slight, of excitement. I cannot make it out, as the work has been carefully done. Any information as to the probable cause of failure will be thankfully received.—F. W.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1698.—By F. Schindler.

Black. [7 pieces.



White. [9 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Nov. 6.*)

Solution of Problem No. 1696.—By F. G. Tucker.

Key-move, R-Q 8.

NOTICES TO CORRESPONDENTS.

Problem No. 1696.—Correct solution has been received from Richard Inwards, G. W. U., Rev. Dr. Quilter, Quizco, A. Tupman, J. E. Gore, The Boer, F. B. (Oldham), J. Mason, W. Peters, T. Clark.

W-H. and The O., F. B. L., F. A.—Only solution as above.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Oct. 25, and unacknowledged elsewhere:—

W. T. N.—E. G. Woodhouse.—A Cornishman.—E. L. G. —A Fellow of the Royal Astronomical Society.—Trip. —D. C. G.—H. Brand.—Factorial.—Typewriter.— Veritas.—Invention.—Sixteen Years Subscriber.— T. E. Espin.—Rolande.—Experiment.—Equatorial.— E. N. W. Hume.—Col. Markwick.—Thorn and Hoddle.

J. H., Dublin.—See "Astronomical Notes" and the "Scientific News." The Leonids are expected on Nov. 14, 15, but they may be a little later. They do not arrive with "Greenwich" accuracy, and the best way is to observe on every suggested, or calculated, date.

J. Turner.—You would probably find works of the kind desired in one of the free libraries in your district of London. Culpepers's "Herbal" is a well-known work, and Wesley's "Primitive Medicine" has much to do with herbal remedies, though he was also much too wise a man to use the herbs when other remedies were at hand.

Enquirer.—An analysis of potatoes gives water 75, albuminous compounds 2·3, starch, &c., 18·7, woody fibre 3, and mineral matter 1. Analysis of the ash gives approximately potash 50, carbonic acid 13, phosphoric acid 11, sulphuric acid 7, silica and magnesia about 5 each, chlorine, 2 (more or less), and lime 1 to 2. The figures are percentages, and they vary with the varieties of potatoes and the kind of soil on which they are grown,

A. F. C., Calcutta.—The Fifteen School Girls Problem has often been mentioned in our columns. There is a letter by the late R. A. Proctor, on p. 507, No. 378, in which he gives a method, but says "I have no clear idea why this method succeeds." That letter was followed by others in Vol. XIV., pp. 559, 584, 616. Since then the problem has been referred to at intervals, and it is discussed in several of the mathematical textbooks. See "Mathematical Recreations and Problems," by W. W. Rouse Ball, published by Macmillan. The work is no doubt in one of the libraries at Calcutta.

J. Carlisle.—What is meant by a model? There are plenty of illustrations of battleships to be obtained, but if you want to make a "model" with all the internal fittings to scale, it is scarcely likely that you will obtain the information. You could make a "model" of the exterior by simply copying the illustrations. As to the other questions, please see Hints to Correspondents above.

O. A.—If by "magic" lantern you mean the optical lantern you will find the fullest instructions for making in Vols. LIII. to LVI., commencing in No. 1377, Aug. 14, 1891. There are many hints about the construction of lanterns in back volumes, but it is not quite clear what you mean by "opaque slides." Look through the articles in the volumes mentioned, and you will find all the available information.

W. J. Thomas.—There are several recipes for making writing ink in the back numbers, but it is doubtful if it is profitable to make in small quantities. As to neuritis a medical man should be consulted.

In Type.—M. C.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 3d. each, through any bookseller or newsagent, or 3½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

Wanted, **Harp**, exchange Back-geared Lathe, 4in. centre, 50in. bed, compound slide-rest, treadle motion, sundry fittings. —8, Stuart-street, Luton, Beds.

Exchange **Gas-Engine**, drive sewing machine, or small dynamo, 880 revolutions, for Castings, Forgings, &c., of 1B.H.P. Launch Oil Engine.—EDMONDS, Heavitree, Exeter.

Two Series **Arc Lamps**, with copper corona, and wired for globes, as new. Wanted, No. 4 Kodak, or other high-class hand camera, or 1-1 plate R.R. lens, good make, with Thornton-Pickard shutter.—WHEAT, 27, Stewart-place, Nottingham.

Eight Volumes of "**English Mechanic**" for old Sporting Books.—D. T. WILLIAMS, Gwyn - street, Alltwen, Pontardawe, R.S.O.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of **Screws, Bolts**, and NUTS for model work, drawn to actual size, sent on receipt of stamp. —MORRIS COHEN, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—CLEGG, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—JARRATT, Queen-street, Leicester.

Carving. — Brass, Iron, Burnt Wood, Bamboo, Leather, Fretwork, and Picture Framing. Catalogue free.—HARGERS, Settle, Yorks.

Books.—All out-of-print books speedily procured, any subject. State wants.—BAKER'S GREAT BOOKSHOP, Birmingham.

50,000 Choicest Microscopical Objects.— Bargains. Catalogues free. Microscopes, cabinets. Collections purchased.—SUTER, 10, Highweek-road, Tottenham.

Rubber Outer Covers, 3s. 6d. Prepared Canvas, 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—PEMBERTON.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—PEMBERTON.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—PEMBERTON.

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Nuts and Bolts for Model Work. Illustrated List, 2,800 varieties, 3d.—BUTLER BROS., Haggerston, London.

Screws, Screw-plates, Taps, round and hexagon special steel brass and iron rods. See list.—BUTLER.

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"**Demon**" **Gas-Engines**, awarded prize medal, ¼B.H.P. to 12B.H.P., low price, high efficiency, economical. Guaranteed.—Below.

"**Demon**" **Gas and Oil-Engines** are thoroughly reliable. First-class workmanship.—PASLEY and Co, Sherborne, Dorset.

New **Engine Castings**, ¼-horse, 5s. 6d.; half-horse, 11s. per set. Catalogue two stamps.—TOMLIN, Ironfounder, Oldham.

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Rubber Outer Covers, 3s. 6d. each, 36s. per dozen. —FRANKLANDS.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—FRANKLANDS.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 3, 1899.

INLAYING.—IV.

UP to now our aim has been to point out to the reader the different methods adopted to fashion the material at hand, with appropriate designs accompanying. It remains now to shade them; in other words, to give the necessary relief, so as to present them in as nearly their natural form as possible. The process of browning, or shading, is gained by semi-burning. The pan or other receptacle is filled with about 1in. of silversand, and heated up to such a degree that it will brown, but not burn. Whatever work we desire to shade, it is obvious that to gain the best results the sand must be kept at a uniform heat. If gas is not at hand, a coke fire should prove an excellent substitute. Having regard to the fact that our work assumes varied forms, some simple method must be adopted to shade the work, not only properly, but where wanted. It is not a difficult matter to shade work that is straight, or nearly so; but where the scroll is of sharp contour the sand must be drawn up to the form of the work, ever remembering that the greatest heat is near to the source of heat. It will be seen, then, that to insert the scroll direct, the two ends may just possibly be burned, leaving the upper portion white, or nearly so; but by canting the work a trifle a better result may follow. It is next to impossible to give hard and fast rules for each and every piece; much must be left to the reader. We can only say a gradual heat will give better tone than over-heating. The one is soft, while the latter is sure to be harsh. From long practice, we find the inner portion of a scroll is the most difficult to shade. To get over the difficulty, cut it up, where permissible, into one or more parts. In other words, divide the scroll at a vein, or a leaf can be divided into two portions. But only do that as a last extremity. If it is not possible to separate the scroll, a mound must be formed as near to the curve as can be got. If properly formed, a decent job should result.

FIG. 86.

FIG. 87.

For cross-shading, or the shading that predominates in the centre of an ornament, another means can be employed—and that is a flat-wick spirit lamp, that gives a flat and thin tongue of flame. It may happen such a lamp is not easily procurable, unless made. If so, let the slit be as thin as possible, and the wick correspond. A great body of flame is not wanted. By holding the work at a given distance, a darkening will be gained without burning.

The following points to be observed may help to lessen failures. The work should not be shaded in bulk, until proficiency is gained. Where more than one piece is being operated on, endeavour to keep them as close as possible, so as to have the same heat and depth of tone. Wor k out hollows in the sand for rounds, and little hillocks or mounds for hollow work. In shading coloured woods, watch closely that the heat is such as not to bleach the position between the browned and the dyed parts. Overheating will have a tendency to that end, and too slow or low a heat will also cause the same effect. Wood that has been hastily dried or flattened before partially drying will have a tendency to buckle in shading. If that occurs, reverse the position of the p iece, so that the heat does not play entirely on one face. Constant turning will ofttimes save a delicate piece of cutting. It must not be forgotten that the heat will render the work very crisp, and liable to snap very quickly—a little forethought and care will save hard words.

Again, where the shading is very pronounced in the centre of a leaf, or the segment of a flower, if the part is divided with the saw and equally shaded on both sides of the saw cut, the result will be satisfactory, providing the cut follows the path of the shading as it is intended to. The same holds good in ornamental cutting also.

In solid work that has inlay work chopped in, the rule is to cut the outline and engrave the details. The engraving is done with either very small hollow tools or V-shaped parting tools, handled and held in the same manner as engraving tools. With finer work special tools are used for shading, and are called "sine-gravers." They can be coarse or fine, having a given number of minute flutes or hollows in a given space, and vary from six lines to ¼in. width of face to 24 or even 30 lines to the same width.

All woodwork is engraved when the first stages of polishing are done, and in a hard condition. If the surface of the work is inclining to greasiness, the polish is liable to break up under the graver; or, where the thrust of the tool is too deep, it will have a tendency to lift the polish. Especially is that the case in using the line-gravers, on account of the acute angle of the tool, the lines being below, and the sharpening angle above or outwards. Where the shading is in a direct line, or nearly straight, the tool is canted so as to cut with one or two lines, inclining the tool downwards until the full number of lines are in use. In confined spaces, where the termination of the shading is an abrupt angle, the tool is canted inwards, finishing the cut with the tool canted outwards. It may be that some portion of the work cannot be done with the tools at command: then the etching needle is requisitioned; the final process being the filling in of the engraving with printers' ink.

The following designs have been compiled with the view to enable the cutter to shade with the sand or graver. If the flowers are cut in satinwood and the leaves are of a light green tint, the work will show up well. The petals may be of yellow dyed wood with a darker yellow terminal, which will add to the beauty of the whole when finely engraved; but if it is intended to shade them with sand, the dividing system can be adopted, where the shading is heaviest. The above remarks apply to Figs. 86, 87, 88, 89, and 90.

With respect to Figs. 91 and 92, which are

FIG. 88.

FIG. 89.

Fig. 90.

Fig. 91.

Fig. 92.

Fig. 93.

Fig. 94.

two frieze pieces, and are given as examples of display, they can be shaded either way, as above described. The two corners, which are intended for doors, are also examples of display, the one occupying a hollowed corner, as at Fig. 93, the other for a rounded ditto, as at Fig. 94.

There is yet another darkening agent that may often be required in imitating old work. We are dealing principally with mahogany. Where an inlay has been inserted, it may happen that the groundwork turns up light; in that case it is far better to darken with some soda water, or, if preferred, bichromate of potash in solution can be rubbed over the work. We merely mention it here because it may be that a darkening process is necessary; but the full process will be better treated in the part devoted to "Polishing."

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—VII.

It is generally considered impossible to see the wind; but some investigations which were made a short time ago bid fair to bring this operation within the bounds of the actual. As already intimated, nephoscopes and photography have been the chief auxiliaries which meteorologists have employed to explore the movements of the clouds and the upper currents of air by which they are borne along. An American observer has added the telescope to these useful aids, and although only a very little has been done in the matter, some very useful suggestions have been made for using certain kinds of telescopes for observing the currents of air at high levels. Similarly to so many other suggestions, the notion of thus employing the telescope was discovered, as it were, accidentally, and it was during the course of ordinary astronomical observation that the new line of meteorological reseach was revealed. These observations were being made at the Arequipa Observatory in Peru, some 8,050ft. above the level of the sea, one of the geographical circumstances of the situation being a neighbouring valley, which at night time, as the forces of radiation got to work, served as a sort of conduit for a cold current of air, which, as it flowed downwards, presently enveloped the observatory. Now, it appears that whenever this cold current thus manifested itself and reached the objective of the telescope, the seeing was at once ruined, and the observer states that when once this cold current was established no more good seeing was anticipated for the rest of the night. On one such occasion the planet Mars was under observation, and on removing the eyepiece and placing the eye in the focus it is reported that fine parallel lines could be seen to move rapidly across the illuminated lens in the direction of the wind. Subsequent experiments were made on this basis, and by thus looking, as so speak, at these upper winds, figures were obtained which showed their velocity and distance above the surface of the earth.

It would, at first thoughts, appear that there was a danger of taking the effects of the air currents in the observatory for those of currents far removed, but it is stated that in the foregoing observations it was clear that the lines produced on the lens were not due to currents in the tube of the telescope, or in the dome above it. The lines observed in the lens are of three different kinds. There are, first, straight equal parallel lines, equally separated, and moving longitudinally; and, secondly, fine but twisted lines, which move more slowly; and, thirdly, there are lines which are a mixture of the first two types, the peculiarity about this third kind being that they appear on the lens as bands or ribbons, and move very rapidly. These different lines or waves have been systematically observed, and their direction, steadiness, fineness, velocity, and conspicuousness on certain dates recorded. It has, moreover, been stated that these lines come into focus at certain given positions of the eyepiece of the telescope, and a formula has been used which gives the different heights of these currents based on the extension of the focus, the distance through which it is necessary to move the eyepiece to bring the lines to good focus

being the principal factor in the calculation. Further, it appears that the coarse lines represent the lower currents or winds, while the fine lines are representative of currents moving at higher levels. Thus one such observation resulted in calculations which indicated that the upper current was 12,000ft. above the level of the sea, and moving at the rate of 17 miles an hour. To meteorologists, however, the most interesting statement in connection with these observations is that the lines vary in quality according to the humidity of the air, and that the greater the dampness the finer the lines. If, therefore, these observations could be made to tell not only the height, direction, and velocity of the upper winds, but indicate also whether the upper currents are increasing or decreasing in moisture, they would prove of no mean assistance to the weather prophets. Such researches, from the necessities of the case, can, however, only be carried on by a few observers, and it is for those well acquainted with the uses of the telescope to tell meteorologists whether they may hope for further developments in this direction.

The observations thus made concerning the upper currents in the atmosphere may be checked by comparing them with the alterations taking place in the cloud forms at the time of observation. Considerable progress has been made as regards the discovery of the causes which produce these changes in the shape of the clouds, and it is now possible to make a very good guess as to the velocity of the wind associated with any given kind of cloud. Thus it has been shown that when a current of air blows over another one of different temperature, waves are produced which may be likened to the ripples which appear on the surface of a pond when a gust of wind steals across it. The result of this action on cloud formation is to cause the clouds to appear as long rolls which are grouped in parallel rows. The intervals between the crests of these aërial billows are, however, far greater than is the case with water waves, and the distances, instead of being a matter of 50ft. or so, may be expressed in hundreds of yards. Further, supposing a wind to spring up from another direction and blow athwart these furrowed or billowy clouds, they will be split up into divisions, and will then present that familiar appearance which has been popularly likened to a flock of sheep lying down. Such clouds as these occur at various levels, and when they form at a medium height they are called alto-cumulus, the name cirro-cumulus being reserved for those at the highest levels. The presence of these clouds informs an observer that they are the boundary-line between two winds of different temperatures and different velocities; and the direction in which the long rolls are lying indicates the direction of the upper wind, while similar information is to be gathered from the cross lines or cleavages by which these billows are so often broken up. For providing corroborating evidence as to the trustworthiness of other methods of observation, there are no better witnesses than these rolled clouds. They are very closely allied to the cirrus clouds, and, although they are not so intimately associated with stormy weather as the true cirrus, they, nevertheless, carry important messages concerning the weather, which may be developing in the recesses of the atmosphere.

There are also clouds which degenerate, as it were, and change from a higher to a lower type, and gradually disappear altogether. These changes may readily be observed, and among the clouds which thus alter their character are the cirro-cumulus and the cirro-stratus, and it is worthy of notice that when a cirro-cumulus changes to a cirro-stratus, rainy and stormy weather commonly follows. Thus, when a mackerel sky, which is composed of cirro-cumulus clouds, changes to cirro-stratus, the altered character is often shown by the haloes which are then produced, and these phenomena have always been a popular prognostic for bad weather. On the other hand, supposing the haloes are seen, and the clouds subsequently degenerate to cirro-cumulus, it will be reasonable to anticipate that finer days will ensue with less violent winds.

These researches into the character of the upper winds have made necessary a slight amendment in a well-known rule for ascertaining the position of a storm's centre. As commonly stated, this rule says that when standing with one's back to the wind, the lowest barometer readings will be to the left hand, and it is accordingly in this direction that sailors and others have been instructed to conclude that the worst area of the storm is located. These rules are to be found in the official meteorological publications, and they are, indeed, applicable to all those cases where a solitary observer on sea or land has to depend upon his own observations and the indications of a single barometer for his information concerning the weather. As shown by a weather-chart on which are drawn the isobars, or lines joining all places having a similar atmospheric pressure, the foregoing rule depends for its success upon the fact that the direction of the wind follows the trend of the isobars. The old rule for finding the centre of the storm, moreover, not only says that it is to the left hand when standing back to the wind, but further says that it is eight points to the direction of the wind. Thus, in the Northern Hemisphere, with a wind from the N.E., the bearings of the storm centre would be to the S.E. In the Southern Hemisphere, the circulation of the winds is opposed to that which obtains in the Northern Hemisphere, so that standing back to a wind blowing, for instance, from the N.W., the centre of the storm, according to the old rule, would be on the right hand and towards the S.W.

Seeing also that the winds are circulating in gigantic circles, it follows that in certain quadrants of the storm a ship would be in danger of running across the path or track of the cyclone, so that in the Northern Hemisphere a ship in the south-east quadrant would run a risk of being blown northwards and directly across the front of the advancing storm. The rules and hints which meteorologists have been able to compile for the use of seamen are accordingly among the most useful results obtained by the study of the winds. But as the use of weather charts increased it was noticed that the surface winds did not exactly follow the trend of the isobars, but blew slightly across them, so that if arrows were drawn to represent the observed winds it was found that their flight was directed a little towards the left hand, as if responding to an indraft of air flowing towards the centre of the cyclone. The angle of this indraft varies in different latitudes, but, roughly speaking, it may be said to depart about 20° from the direction of the isobars. Many of the old rules for calculating the direction of a storm's centre need therefore to be considered in the light of this fact.

When the direction of the upper currents in the atmosphere are observed during the oncoming of a storm, it is seen that in nearly all cases they are blowing at an angle to the lower currents, which is never less than 90°, and in many instances are directly opposed to them. These diversities are revealed by the movements of the clouds which form the elevated bank of cirro-stratus in the forefront of an approaching depression. Moreover, just in the same way that the surface winds back and veer, so do these more lofty winds, and there are excellent reasons for concluding that the more rapid are the changes taking place in these upper currents, the more turbulent will be the movements of the surface winds by which these changes will be followed. As regards the middle strata of winds, observations indicate that they blow almost exactly in the direction of the isobars, so that in calculating the bearings of the storm-centre, an imaginary line drawn eight points to the left or right hand, according as the observer is north or south of the Equator, will lead more directly to the desired spot than by applying the rule mentioned above merely to the surface winds. Thus, then, in considering the air currents in a cyclone there are first the surface winds blowing a little to the left of the isobars, then the middle winds blowing directly along them, and, thirdly, the upper winds, whose direction is opposed to those at the surface of the earth. The fact that there are variations introduced into this system by local geographical peculiarities, to say nothing of those changes introduced by the progress of the seasons, only serves to stimulate interest in the pursuit of new solutions to the problems which then arise. By slow degrees, however, the gyrations of the winds are being revealed, and, although many of the methods of research are perhaps only tentative, they are gradually clearing away many of the difficulties which beset the path of the oftentimes-bewildered weather prophet.

THE most important work on the Ghaziabad-Moradabad Railway line is the bridge over the river Ganges, consisting of eleven spans of 200ft. The line is on the standard gauge.

ORNAMENTAL TURNING.—XXX.

By J. H. EVANS.

AS intimated in my last, we now proceed to the circular movement of this instrument, from which, I may say, it derives its name of the spherical slide-rest. When the two slides, as

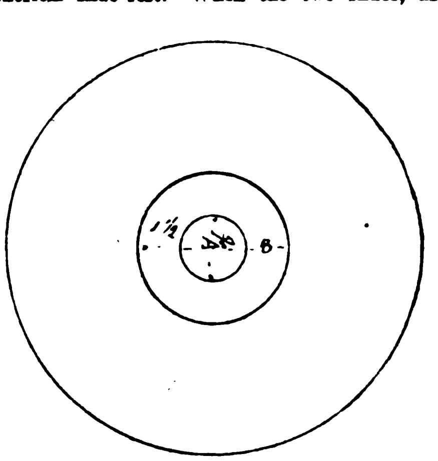


FIG. 1.

already described, are completed, it will be readily seen that the base or lower slide standing as it does at a right angle to the mandrel, the slide is moved parallel with the surface, and by this means the circular movement may have its axis placed immediately under that of the mandrel, or be moved as required to or from the same. The second slide, upon which the rotary action is fitted, moves it in a direction parallel to the mandrel, and the principal purpose of these two slides is to place the axis of the spherical movement at any required position below the work, after which they remain unaltered.

Let us now take in hand that which forms the succeeding part. This consists of a worm-wheel having 120 teeth cut in its periphery. This must

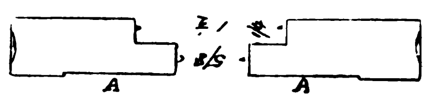


FIG. 2.

be made from a sound gunmetal casting—about $\frac{5}{8}$in. will be the depth; but I may say this must be governed to some extent by the exact thickness of those slides already finished. Sometimes, for reasons innumerable, I may say, the plates will stand up rather thicker than may have been allowed for. If this is so, and the difference is a mere trifle, also the plates are perfectly clean, what little difference there is may be cribbed—perhaps is a good term—from some other part. Reference to Figs. 1 and 2 will clearly show the manner in which the wheel is first prepared. Four inches full will be the required diameter for 120, supposing it is cut 10 to the inch. Some prefer rather a coarser pitch of screw. If this

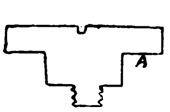


FIG. 3.

happens to be the case, the increase in diameter is a matter of no difficulty to calculate.

The casting should, in the first place, be well burred over, and then hammered to close the grain, and harden to some extent. It should then be chucked in a self-centring chuck, and the centre hole A be turned out to, say, $\frac{5}{8}$in. diameter; and for the convenience of fitting the screw, it is better to turn the fitting slightly taper. Following this, the enlarged recess B must be carefully turned out, taking great care that the face inside is quite true; this is also better if turned slightly taper, but being $\frac{1}{4}$ only in depth, it will be, of course, in a very small degree.

I should have advised that the face be first turned all over to certify the quality of the casting, which, if in any way faulty, must be discarded for another. The wheel must now be

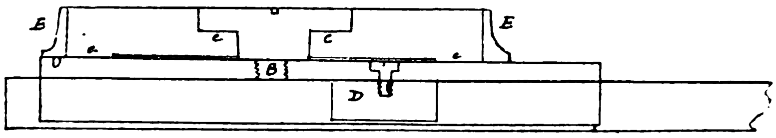


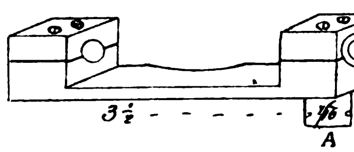
FIG. 4.

removed from the chuck, and a very carefully-made chuck, either of iron or gunmetal, made to fit the recesses perfectly. When thus fitted, the two should be soldered together, as it will be clear we have a lot to do before it will be removed.

When thus chucked, its truth will be certified by the accuracy of face already turned; this must be looked to before proceeding. The diameter decided, also the width, it must be turned to the proportions. In order to relieve undue friction, it is advisable to turn a shallow recess, *vide* A A, Fig. 2, leaving a rim of actual bearing width $\frac{5}{8}$in. wide.

And now we come to the cutting of the thread. Well, this class of work has been referred to many times, albeit there are times when it will bear further reference, and this is one of them. There are many ways and means to adopt, but I must not lose sight of the fact than many of my readers will not be provided with all the necessary tools, as recommended in some instances. In the first place, having turned the periphery to the necessary diameter, a plain horizontal cutter—

FIG. 5.



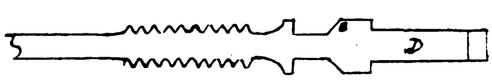


FIG. 6.

preferably one with a swivel movement—will be the tool to employ. In this is fitted to revolve between the centres a single cutter, which is a facsimile of one thread of the screw.

Now the object of my recommending a cutter-frame with a swivel movement is that it is necessary to incline this cutter to an angle suitable to the rise or pitch of the screw. However, assuming the swivel frame is not at hand, the frame must be carefully set over by pieces of angular packing. This will appear to some extent a makeshift; so it is, but if it effects our purpose, what matters? This series of articles is not written with any view whatever to showing forth expensive tools as made either by myself or others, but to help our amateur friends to enter into the interesting pursuit of making many, in fact, all, of the apparatus connected with the art that we are discussing, if they feel so disposed, so that any little dodge—workshop secrets some call them (I have none)—that I may explain will, I hope, be accepted in the spirit in which it is given.

The cutter, then, by the means explained, having been set to the desired angle, it is placed in position by the slide-rest. A slight curve (shown in Fig. 2) should be turned as a guide, also to relieve the friction after the single tooth has been cut. The index point is now fixed in the zero of the division, which will give the 120 consecutive incisions. The cutter is then inserted to an equal depth all round, the latter being signified by the division on the micrometer, which must, of course, be turned to the same number for each consecutive cut.

We will take it as a matter of course that the single tooth cutter has done its work satisfactorily, and the next thing will be to substitute a cutter made after the form of a master tap, but to revolve between the centres of the cutter-bar in the same way as the one it replaces. The diameter of the worm being half, the cutter must be accurately made to this size, and about four cuts will be sufficient. By cuts I mean flutes, throughout the length of the thread, and I think I may say that these, as a matter of fact, are more serviceable when put in with a triangular file than when cut with a round-edge circular utter. The cutting edge is too rank for our urpose with the latter. I have had in use now when required a cutter that I made myself 25 years ago, which I would not exchange for any number of the best that could be offered me. I cannot tell how many wheels it has cut, but a great many, as may be supposed. We have grown up together in the service.

This cutter finished, it is placed in the cutter frame, and our little dodging, in the shape of packing pieces, may be put away. Don't discard them. They will be sure to come in again. The cutter-bar is now placed simply on the bed of the slide-rest, which will, or should, present it quite truly in the perpendicular plane. The cutter must be gently and carefully presented to the wheel while revolving, and it will, of course, soon be obvious that the cutter carries the wheel round all the time it is cutting the teeth gradually deeper, the pressure being kept up by the screw of the slide-rest until the desired depth is obtained, which will be when it is cut full and sharp.

We have now completed a very important item in the construction of this instrument, and may, provided all has gone well, feel very satisfied, and our next proceeding will be to get it fitted to its place on the plate of the second slide.

The first thing to do will be to make a cast-steel screw as shown in Fig. 3, and this must be very accurately fitted to insure a successful result. The screw is obviously made with a large head, for the purpose of forming as much bearing as possible at the under surface A, and it will also be seen that when in its place the rotary movement takes place between the under surface of the wheel and the lower surface of the recess. The screw must fit well, and be screwed home thoroughly to its place, and then the circular bearing may be carefully ground up to a finish; so far, then, we have the wheel and screw ready to fix.

The correct position for this I have shown in section in Fig. 4; it must be in the centre of the plate as to its width, but about $\frac{5}{16}$ only from one end, the left, as seen, the object of which will become apparent as we proceed. By this section it will perhaps be more clear to some where the actual bearing of the circular movement really takes place; it is *c c c c*. Fig. 4 defines this in every respect. The screw B can have its hole tapped through the plate.

The present is perhaps a good opportunity for showing the proper place to fix the nut of the main-slide; it must be under the wheel, as shown by D, and is fixed by two screws, as previously explained, countersunk into the plate. One of the most important matters in the action of the tangent screw and worm-wheel is, they must be kept free and clean from dust, dirt, or shavings, which we all know do accumulate during the progress of the work. To avoid this, the periphery of the worm-wheel works within a circular fitting, as illustrated by E E, Fig. 4. This is simply a ring of gunmetal turned to fit the wheel, and is attached to the plate on which the wheel revolves by three small pins on its base. The tangent screw is ultimately covered with equal care by a plate over the frame which carries it.

Having the wheel thus correctly fixed to its place, the screw that actuates it will be our next consideration, or, rather, I should say, the frame in which it works, both, however, forming part of the same job. Now, of tangent frames there are many kinds, good, bad, and indifferent; in connection with the character of the work we have in hand, I do not propose to refer to any other than that which is the best in my opinion of the present time. I am very indisposed to take up the valuable space accorded me by our ever-courteous Editor with references to that which concerns us not. At times it may be desirable to show extreme differences; now it is not so.

It must be our great object to have the rotary action entirely free from any semblance of loss of time in its movement, and experience has proved to me that the frame which holds the screw, if made as seen in Fig. 5, renders this not only within our powers, but is simply a matter of good and careful fitting.

The first thing to do is to procure a steel forging the shape given, and as nearly as possible the dimensions. This should then be held in a jaw-chuck by the square; the base turned over perfectly true to the stem A, which is tapped to receive a screw. With the base thus prepared we have the groundwork to proceed from, and from this the whole frame must be filed up square and true. This is not by any means a difficult matter, care alone being required.

It will be seen that at each end the frame is cut through in order that the bearings become adjustable. The top bearing, as shown, is held to the lower by two steel screws. All this work should be done before the holes in which the screws work are bored. When the parts are severed, the centre should be filed perfectly flat, and from the base it must be made to exactly correspond in height with the centre of the worm cut in the wheel, so that when the hole is bored and the screw fitted, it will allow the latter to fit well into the worm of the wheel.

This surface thus obtained, the two top bearings must be accurately fitted to their places. We have now the centre line for the height, and only have to set out the frame in other respects. The top bearings must be screwed down tightly to the lower parts. Having correctly set out the work, it is advisable to drill a small hole through each end in the first place, this being a guide for the larger drills to follow, and helps considerably, preventing the drills running out of the proper course.

The finished size of the plain hole will be as nearly as possible the diameter of the bottom of the thread of the tangent-screw. This I have shown approximately in Fig. 6, and reference to this will show that the frame is countersunk at each end to suit the angle shown in screw at B. Of course, the particular angle of the cone is of no importance, but the idea will be fully gathered from the illustration. We have in this fitting a considerable scope for the display of skill, and the object of the cone will be fully appreciated when we see that it forms a means of adjusting the revolution of the screw within its bearing, so that not the least semblance of loss of time will occur. It may seem at first sight to be a rather long and tedious job; but, as I have already explained, it is the best, and it cannot be too good for our present purpose. Although not shown, both ends of the screw must, of course, be alike; that part which extends beyond the cone of the same diameter is utilised for the micrometer, and may be divided into ten equal parts. The extension beyond this mark D is slightly taper, to facilitate the filling of the pipe handle, the stem of which will be required of considerable length. This I will treat in my next, as we approach the third slide, which is fixed to the top of the worm-wheel. The present will afford plenty of practice and thought for those engaged upon the work.

MILLWRIGHT'S WORK.—XV.

ELECTRIC power has not yet displaced the belting from our factories. A few progressive firms have adopted it, so that the system is well on its trial. But the time is not yet ripe to express a pronounced opinion about its economical aspects. Much may be expected of the new method of transmission. The confession must be made that none of the present methods in use are entirely satisfactory, even when they exist under the most favourable conditions. When the opposite set of conditions predominates, then results are eminently disappointing.

There are five methods of transmission of power adopted: (1) belting, (2) ropes, (3) chains, (4) toothed wheels, and (5) frictional arrangements. The last two, of course, work under special con-

ditions, and do not come under exactly the same category as the three agents named first in order. Toothed wheels are used to connect adjacent shafts, friction arrangements are employed similarly, the other agents connect shafts which are usually separated by relatively long distances.

(1) *Belting.*— Few, if any details of millwright's work have caused more persistent trouble than belting. Rules, apart from experience, are of little aid in practice. The whole subject bristles with difficulties. Differences in length of drive, in proportion between thickness and width of belt, speed of driving, size of pulleys, and of belt tension complicate matters, and increase or lessen power cost very materially. Hence it follows that while some firms have incessant trouble with their belting, others experience immunity therefrom. Yet there is no chance work at all about this, but effect follows surely after cause, and common sense carries one farther than formulæ.

Any old engineer knows that belting is often a source of great trouble, that it is very expensive, and deserves much more attention than it receives in many shops. The spectacle of weak belts, patched belts, wavy, uneven belts, slipping and screeching belts, belts too short, belts too long, belts too tight, belts too loose, belts badly laced, and much more is witnessed in many shops. It is proposed, therefore, to devote a rather large section to this wide and somewhat involved subject.

The breakdown of belting, when that unfortunately happens, is often nearly as serious as that of the prime mover. It is bad enough when it stops for half an hour a machine, but immensely worse when it stops a whole line of machines, or an entire shop. Yet this is what frequently happens when belting is in the charge of an ignorant manager or attendant. The case is worse in some factories than in engineer's shops, in cotton-mills and flour-mills especially, where there is a sequence of dependent operations. We, therefore, as a rule, find better driving arrangements in the mills than in the engineer's shops.

Belting is made of leather of various grades, of canvas, of camel hair, llama hair, cotton, indiarubber, and guttapercha.

It is as well to say at once that no class of belting whatever is equally applicable and suitable to all the conditions which arise. So that before the most suitable agency for driving can be determined in any case, the conditions must be known. A matter which has to be considered in some situations is the ability to stand great heat, steam, frequent changes of temperature, moisture, and so on. A belt of good quality for some purposes will often be unsuitable for use because of the conditions of situation imposed.

But for the general purposes of transmission indoors, at ordinary temperatures, for the driving of machines in general, my own belief is that there is "nothing like leather" after all, provided it be good, honest leather. A good belt will live three or four times as long as an inferior one. It is not meant to imply by any means that the woven beltings are not good. But there is a durability, a rigidity about the best leather which renders it better qualified for hard, severe duty, than anything beside.

The reputation of belts has suffered in consequence of the employment of inferior leather and of ignorance of conditions which conduce to long life. If people will have cheap belts, they get the inferior parts of the hide, the flanks and offal, instead of the butt; such belting is dear at the best. It has a short life; is always stretching and giving trouble, and does not last a fourth as long as the best. A good leather belt, well cared for, will last the average man's working lifetime in the shops, and cannot be beaten by any other material.

Uniformity in the texture of a belt is an important characteristic as affecting the wear. This is not insured in the cheaper classes of leather belting, which are composed of various qualities sewn together. The result of non-homogeneity becomes apparent in unequal wear, which entails patching, and ultimate wavy motion. This evil is more likely to be developed in leather belts than in the woven ones.

The most favourable conditions for belt-driving are when the pulleys are of large size and situated at a reasonable distance apart, and the belt leading on the top of the driving pulley.

The least favourable conditions are those in which there is a wide disparity between the diameters of the pulleys, reducing the arc of contact on the smaller one, an evil which will be greater the closer the centres are brought together. The distances of pulleys apart cannot, however, always be regulated to fulfil the best conditions. Pulleys set too close together are very badly situated for belt-driving, requiring binder pulleys to tighten the belts, which increases their wear and tear. On the other hand, belts between pulleys far apart sag a good deal, especially at high speeds. Vertical belts are a bad arrangement, because there is no assistance derived from the sag of the belt.

The reason why vertical driving is not economical is that the tension is insufficient, unless the belt is very tight, and maintained thus. If such a drive is necessary, the best results are obtained by using a wide thin belt, rather than a narrow stout one. Diagonal drives as a rule are objectionable when they approach too nearly to the vertical. In such cases binder pulleys are often employed to intensify the grip.

The larger the pulleys the better for the belts. But here, again, the diameters are imposed by conditions in the shops, and small pulleys must often be used to transmit high powers. Broad thin belts are then preferable to narrow thick ones, because the latter are greatly strained in their outer layers in passing round the pulleys.

Within economical limits, it is best to reduce the weight of belting as much as possible. The weight has to be carried round by the engine, and excess means wasted power. The centrifugal force, too, of the belt becomes increased by increased weight, again absorbing power. Belts too tight on their pulleys tax the bearings and shafting, and require more power to drive than those which fit easily—another reason for using light belts, and those possessing a maximum of strength with a minimum of weight. It may be laid down as an axiom that belts should be as slack as they will run without slip. When a belt is in the habit of slipping off its pulleys, there is evidently something which should be looked into. Either the belt is too narrow, or the pulleys are not hung truly, or the bearings and shaft journals are too tight. In short, something is wrong with the fitting, or else the belt has too much work to do. A slack belt which is strained a long way within its maximum capacity will not run off, provided other conditions are carefully safe-guarded; and the life of such a belt will far exceed that of a highly-strained and tightly-fitting belt, and it will not cost so much power to run.

A belt that is constantly overstrained may slip off or break several times in a year, causing delay to work every time. Multiply that by the number of delays, and the result is a serious item of loss. Fracture is prevented by keeping the working strains low, and this is the secret of a good belt design. It is best to keep a long way within the limits given in textbooks, which are based on the ultimate strength of leather and laced joints, but which do not take sufficient account of the severity of working conditions. In this respect, belt users may take a hint from the designers of rope drives, who long ago found out that the stresses on ropes must be kept very low if trouble is to be avoided. With low stresses, the life of a belt may be prolonged to an almost indefinite period.

If a belt, true in itself, runs in a wavy manner, the pulleys should be looked to. If these are not set truly on their shafts, they will produce a wavy motion.

Friction is the principal element in belt-driving. It is compounded of two elements. That due to contact between the belt and its pulley, which is governed by the natural action of the surfaces in contact, and the dimensions of the arc of contact. The other is dependent on the amount of tension given to the belt, which diminishes rapidly, due to stretching. The amount of natural friction is termed the "coefficient." This, taken alone, would be of little value. In practice, the flexibility and tension of the belt are of greater importance. From this point of view, a thin flexible belt is better than one which is comparatively stout and inelastic, and a belt which stretches but little is better than one which lengthens rapidly under tension.

Thick belts sag less than thin ones; but they bend with difficulty, and do not lie so closely round the pulleys as thinner ones.

Belts continue to stretch when not running, which is the reason why they are often thrown off the machines at night. As they stretch, they slip, and cause increased creeping, and in time they require relacing.

The flesh side of a belt should run next the pulley. The grain side grips better when new; but it is not the proper way to run, because the belt is more flexible when running against the flesh side. The latter will soon grip as well as the former if the surface is dressed with boiled linseed oil. The oil oxidises and gives a smooth driving face, slightly gummy, which is better than a hard face. A belt dressed thus does not slip, and does not polish the surface of the pulleys. Messrs. Tullis recommend three coats of linseed oil once a year. Resin is often used on belts, but it does harm, and its gripping effect is only transient. Dubbin is also recommended for application.

Belts are cleaned by washing them in warm soda-water, leaving the belt wet for a couple of hours, after which the grease can be scraped off, a clean surface resulting. If a belt becomes foul with oil from bearings, chalk, finely powdered, will absorb it.

Rounding or crowning the faces of pulleys keeps the belts well about the centre. Pulleys running on vertical shafts should have more rounding than those on horizontal ones. From $\frac{1}{16}$in. to $\frac{3}{16}$in. is enough for high-speed pulleys of about 6in. in width—about $\frac{1}{32}$in. per foot of width. Those on vertical shafts may have double this. There is no advantage, but rather the reverse, in increasing this amount. Fast-and-loose pulleys should not be rounded, but left quite flat.

An excessive amount of convexity has often been given to pulleys, with the idea of keeping the belt from slipping off. This is now known to be a mistake. Really, it too often was a consequence of the bad fitting of shafting, bearings, and pulleys. If these are set out of line, the belts will run off, in spite of crowning. Actually the slightest amount of convexity is better than a deal. Much rounding means that the belt, if only moderately thick, does not bear nearly across its entire width; and, if a double belt, it will probably not bear so much as one half, and its frictional grip, on which so much depends, is thereby diminished.

The evil is increased with increase in speed, because the effect of centrifugal force comes into force, throwing the belt off the pulley, to which it ought to adhere closely.

The edges of belts become frayed when they run against flanges or against the forks of striking gear. This cannot be avoided—the only thing is to take the capability of a given quality of belt to resist the action as a point in its favour. Belt forks must be polished, and large belts must be shifted by rollers instead of by plain forks.

J. H.

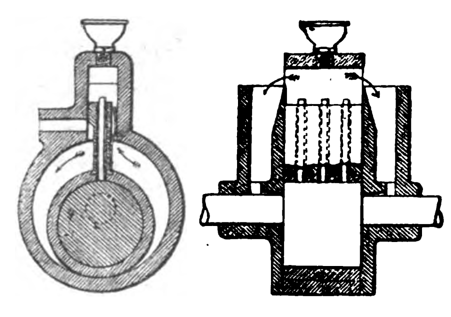
FRENCH SUBMARINE BOATS.

THE flotilla of submarine boats in France promises to present as great a variety of types as the battleships. After the enthusiasm following upon the performances of the *Gustave Zédé* had simmered down, and people began to look at it from a more practical standpoint, it was recognised that its small range of action was calculated to lessen considerably its utility as a war engine. The new vessel, it was said, had, at any rate, proved the practicability of the submarine boat, and in the hope of getting something better the naval authorities gave fresh attention to the somewhat despised Goubet boat. This vessel, however, showed a tendency to dive to the bottom and stay there, and the naval experts begin to pin their faith in boats of the Morse type. Recent trials with the Morse submarine showed that as regards the range of action it had scarcely any advantage over the *Gustave Zédé*, and it had to be admitted that the boat could not be used for any other purpose than harbour defence. After all these experiments, however, it did not seem as if much headway had been made, but the naval department, with praiseworthy optimism, conveyed its favours to the *Narval*, simply because absolutely nothing was known as to the behaviour of this type of vessel, and plenty of scope was consequently allowed for the exercise of a vivid imagination. The *Narval* has been constructed upon the plans of M. Labeuf, a naval engineer, who secured the gold medal in the competition for submarine boat projects organised by M. Lockroy. She was put upon the stocks at Cherbourg in July, 1898. Constructed of steel, she has a length of 34m., a width of 3·75m., and draws 1·60m. of water when navigating at the surface. Her displacement is 160 tons. The motive power is supplied by a Forest oil-engine, which not only drives the propeller when the boat is either navigating at the surface, or with only her look-out and chimney exposed, but also operates a dynamo for charging batteries of accumulators, these being used to propel the boat when she is entirely submerged, and the chimney unshipped. Sailing at the surface at 12 knots, the *Narval* promises a range of action of 252 miles, and at eight knots the range is

to be 624 miles. When submerged the accumulators will propel the boat 25 miles at eight knots, and 70 miles at five knots. The *Narval* is equipped with four torpedo tubes, and carries two officers and nine men. The boat was launched at Cherbourg, and the greatest interest is being taken on the other side of the Channel in her forthcoming trials, and it is this type of vessel which carries the hopes of France. —*The Engineer.*

ROTARY PUMPS.

THERE is a difficulty in using rotary pumps for exhausting air on account of the airtight sliding contact, which, if airtight at first, does not long remain so in working. A patent has been obtained in this country by Siemens Brothers, Limited, on behalf of Siemens and Halske, of Berlin, in which the difficulty is said to be obviated. The pump consists of a cylindrical casing through which the driving-shaft passes centrally, having fixed upon it an eccentric cylinder that revolves within a cylindrical piston or slide, and which is so arranged that by its rotation the piston (which does not revolve) is always in sliding contact at one point with the inner cylindrical surface of the casing. The cylindrical piston or slide has projecting from it a flat plate, which, as the piston performs the motion, slides with a combined vertical and slight lateral motion in a corresponding vertical rectangularly-shaped extension of the cylindrical



casing, of sufficient width to leave the piston extension free play. In one side of this extension, near to its lower end, is the inlet branch by which the pump is connected to the chamber to be exhausted of air, and the upper end of the piston extension has on the same side a lateral rounded projection which, in bearing against the side of the casing extension above the air inlet, causes a space to be left between the piston extension and the casing through which the air passes from the inlet into the cylindrical part of the casing on one side of the piston, which, by its before-described eccentric motion, first causes the air to be drawn in on that side, and then expels it on the other side of the piston and extension, the air being made to escape through lateral holes in the upper end of the casing extension. The lateral projection of the piston extension is kept in close contact with the surface of the casing by a spring or springs placed between the back surface of the extension and the opposite wall of the casing. A more or less viscous lubricant is introduced into the upper end of the casing extension, and flows down first between the projection of the piston extension and the casing, so as to insure an airtight contact between the two, and secondly down vertical channels formed on the piston extension (in which may be contained loose rods for facilitating the flow), and between the eccentric cylinder and the annular piston or slide, from the ends of which it passes into the casing, forming airtight joints at all sliding contact surfaces between piston and casing. The excess of lubricant is then expelled from the casing, together with the air on the expelling side of the piston, passing up between the back surface of the piston extension and the casing extension, and eventually escaping through the before-mentioned holes in the latter. From these the lubricant flows down in external vertical channels, the lower ends of which communicate with the bearings of the driving-shaft, the said lubricant being made to pass through channels in such bearings into the pump-casing again, where it is made to circulate as before. A continuous circulation of one and the same body of lubricant through the pump is thus effected, insuring the airtight working thereof, while any loss of oil is made good from a cup at the top of the casing extension.

HELICAL SLOTTING ON THE MILLING MACHINE.

IF the milling-machine is not well adapted for turning the rims of hand-wheels and other kinds of lathe work, I send herewith sketches of a planing, or, rather, a slotting, job, to which it seems, and has so proven, admirably suited. We had the job of putting five grooves in a piece of

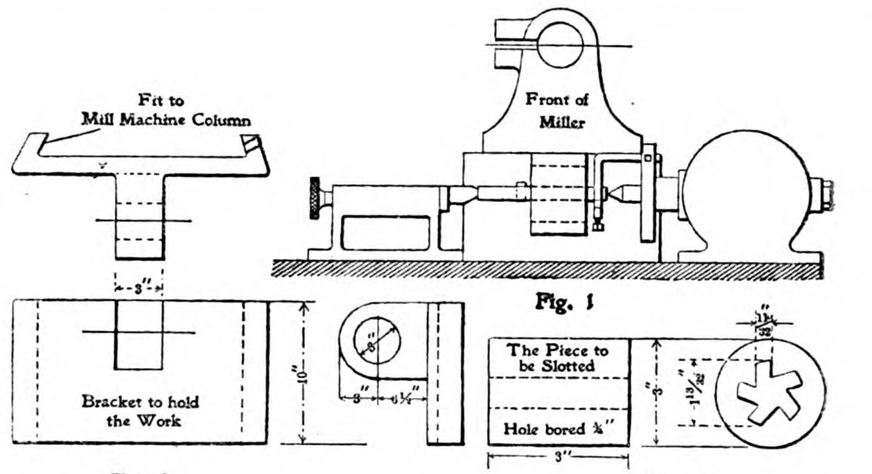


Fig. 2 Fig. 3

tool-steel (see Fig. 1). These grooves are helical, making one turn in 60in. A casting was made to hold the work (see Fig. 2), this casting being planed to clamp to the front face of the milling-machine frame, where the table-bracket slides. A bar was slotted, and tools of different sizes inserted, one after another, and put in position on the index centres. The spiral head was geared up to give the proper amount of rotation, and the feed was speeded to give a fairly good cutting speed. The cutting was done by the feed motion, and not by the right or machine movement. The machine being started up and the feed thrown in, consecutive cuts were made until most of the stock was removed for the reception of the finishing-bar. This bar was made with five ribs to fit loosely in the grooves already made, and was very stiff. Several tools were made, each tool being about ·002in. wider than its predecessor. When running the table back to take a new cut, the tail centre was slackened to save the edge of the tool. The time made on this job was good, and the results first class.—E. BURY, in *American Machinist.*

THE TOOL-SMITH.*

IN the reports of our proceedings tool-steel has been very prominent, the various articles leaving little to be added. But nothing is said about the tool-smith, who, if not the most important workman in a large establishment, is next to him. He is as a rule not easy to replace, and is conspicuous by his absence if that is even temporary.

Whence do we derive a substitute to fill this important, or, rather, responsible, position. Some advance an old smith, others a carriage or country smith, others again take a handy helper and put him to the roughest part, such as dressing track-tools, until he is advanced enough to fill the vacancy at the tool fire. I do not deny that many of these men have turned out the best kind of work, but at the same time many have proved failures. This branch above all others in the trade makes the strongest call upon the intelligence and reasoning powers of the workman. This trade is not learned from books, but is the outcome of reason and experience; therefore it calls for men above the average to comprehend its intricacies, such as the points suitable for the various metals, angle and twist in cutting-tools, heating and tempering, making special forgings of tool-steel and the many odds and ends which are used in any large establishment. The tool-smith knows by intuition what kind of steel he is working on, and his memory is taxed often to accord a certain mode of treatment to a certain brand of steel. He attends to this without any apparent effort, although the material he works in costs from six to thirty cents per pound. This is dearer than copper; but you can sell copper scrap to better advantage than steel scrap.

In these days competition follows in every line. The best articles at the lowest figure. But it is not economy to take cheap steel and expect it do the work of the best in the market by bringing the resources of the trade to bear upon it, and do about once or twice what it should do always. A visit or two to the shop equalises the cost in two various grades of steel. But I digress. I will ask you: Is this material cheap enough to place in the hands of a novice? Or, worse still, a man who is careless, and ignorant of the properties of steel?

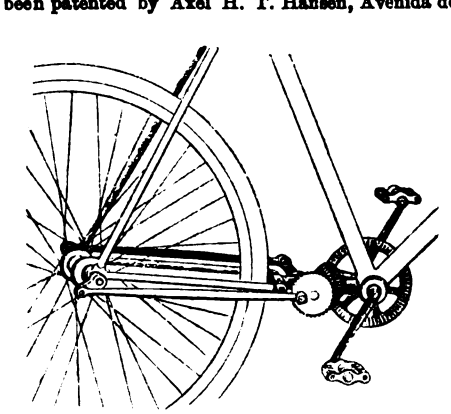
The mechanical Press of late years gives recipes for apparatus and hardening solutions, generally emanating from the tool-room of a manufacturing establishment, the presiding genius being a machinist. He, by the bye, does his own forging and tempering. Does not this strike you as something strange, that a man of another trade offers to do the most artistic and scientific part of yours? Suppose you were to advise this: do my own forging and fitting, understand gearing the micrometer, vernier, &c.? This is easier to learn than to work steel to perfection, and there must be something wrong.

The wrong lies, as far as I am able to judge, in the selection of men who are placed at the principal fire doing the steel work, and instead of the experience of one being handed down to the next, it becomes, like an unwritten language, lost in the absence of the speaker. I need not point out to you what all of us would be without the art of writing or printing, which gives us the crystallised thought of bygone generations. But, to return, we wish to educate the tool-smith, so that he will be above believing in liquids or solutions to restore burnt steel. All of these stand in line with charms and incantations. Our progenitors passed through all of this and learned. Well? Wisdom and distrust. Development is the order of the day, and this is surely a case of the survival of the fittest. In short, the tool-smith should be taught his business, and that well, and if he cannot be brought beyond the bridge, must be relegated to whence he came, and the sooner the better.

* By T. C. LACK, a paper read before the Annual Convention of the National Railroad Master Blacksmiths' Association, Milwaukee, 1899.

HANSEN'S CHAINLESS BICYCLE.

THE chainless bicycle shown in the illustration, in which one-sided strains are avoided, has been patented by Axel H. T. Hansen, Avenida de



Mayo 748, Buenos Aires, Argentina. It is noteworthy for its strong construction and for the novelty of its driving mechanism, which consists of a bevel-gear in place of the usual sprocket-wheel on the pedal-shaft, meshing with a wheel bevelled on both front and rear faces, and mounted in ball-bearings on the rear stay, which is made single instead of double as usual. The rear face of the doubly-bevelled wheel on the side opposite the first-mentioned bevel-gear engages a bevel-pinion secured upon a transverse shaft journalled in the rear stay. The pinion is provided with a crank-pin, and at the opposite side of the pinion the shaft carries a crank.

THE new Royal yacht *Victoria and Albert* will be undocked at Pembroke Dockyard on Nov. 18, instead of Dec. 6, as was previously intended. The engines will then be subjected to a series of trials, which will probably occupy about a fortnight. If the result is satisfactory, the ship will immediately thereafter proceed to Portsmouth to be completed.

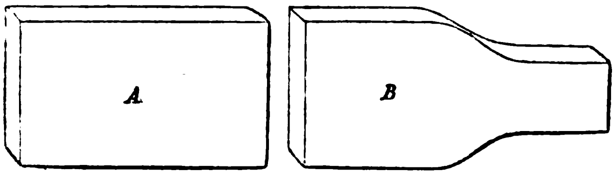


FIG. 1.

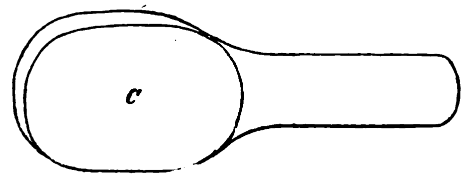


FIG. 2.

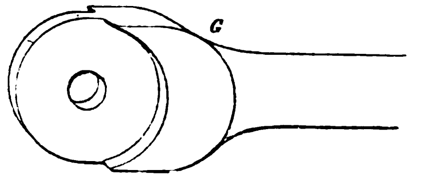


FIG. 3.

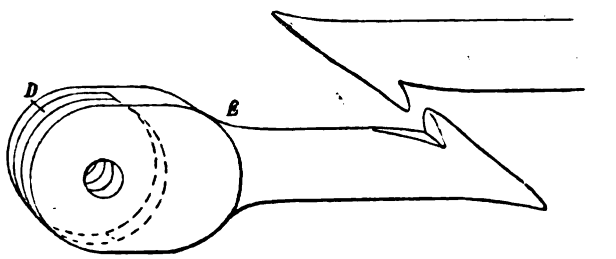


FIG. 4.

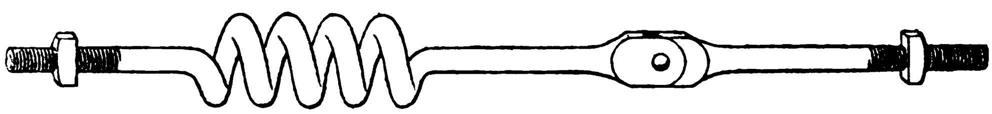


FIG. 5.

MAKING A SPRING SHAFT.

THE following method of making a spring shaft is given in the *Blacksmith and Wheelwright*, by Mr. Clyde C. Henderson, of Lyons, Kansas:—I inclose some sketches showing the steps in the making of a spring shaft such as is used in a salt plant—not a very familiar job, but which is interesting, and at some time or other any smith might be called upon to do. In Fig. 1 is shown the piece of Norway iron, 4in. square, 7in. long, A, and the same is forged into its first shape, B. The corners are then dressed, as shown in Fig. 2, C, and it is drawn out and cut open with a tool as shown at D in Fig. 4. Fig. 3 shows the other portion of the shaft as it is made to fit into D, Fig. 4. Scarf the ends, as shown in Fig. 4, after which it is welded to the shaft spring and the ends threaded and nuts put on. The completed job is shown in Fig. 5.

THE COMING METEORS.

ONE thousand years ago almost, on the night of 12th October, 902, King Ibrahim-Ben-Ahmed passed out of this world, and as he lay a-dying a strange thing happened, for throughout that night "a multitude of falling stars scattered themselves across the sky like rain."

This record from the pen of Conde resembles a genuine Arabian tale in all respects, save only that it is altogether credible. And now the significant period of 1,000 years is nearly completed and we are once again, though without misgiving, expecting the return of the self-same portent. Thirty times save one since the night that the old Moorish King died the full torrent of the same shower has rained down on the earth. Of his fact calculation makes us sure, and we are able to foretell within narrow limits the day and the hour, shortly approaching, when the stars will again fall from heaven.

Much general interest is manifested in the coming event; but to avoid disappointment as far as possible it will be well to consider briefly the main facts of which we are in possession. Records through many hundred years go to show that showers of the same meteors—called Leonids from the fact that they always issue from the constellation Leo—must have occurred at three distinct periods in each past century, and as a rule in the same years in each century. Or, in other words, at intervals of approximately 33 1-3 years.

Prior to the last display in 1866 the researches of Prof. Newton, of Yale College, America, made it appear that the meteors must travel in one of five possible paths; but it was left to the unrivalled genius of Prof. Adams to determine which of these was the true orbit. The immortal discoverer of the planet Neptune succeeded in showing, from considerations of the calculated disturbing effect of the planets, that the path of the Leonid meteors (which are known to follow in the wake of Tempel's comet) must extend beyond the orbit of Uranus, and, avoiding technicalities, it will not be difficult to form a mental picture of the physical circumstances of the case thus:

Conceive a circuit line of railway of an elliptic form extending some 21 miles in its greatest length, and along it to be circling ceaselessly once in 33¼ years a train of mineral trucks of the usual breadth but of the inordinate entire length of some four or five miles. Further, near one extremity of the elliptic line, and lying athwart it in a slanting direction, suppose there to be a level crossing formed by a track nearly circular and of some two miles diameter, along which a 6in. globe is creeping once round in each year. Now in imagination transfer this system to space, augmenting linear dimensions a hundred million-fold. Let the mineral train become a flight of meteoric bodies sweeping out to the confines of the Solar System, and the globe our own earth confined within its true orbit. We shall then have sufficiently grasped our true relation to the meteors which we are about to encounter.

It will at once be seen that at each period when the meteor train is passing the level crossing, it is certain, owing to its extreme length, to be met by the earth once, or possibly twice—i.e., two years running—and the width of the train is such that the earth may occupy, say, some five or six hours in traversing its more central and denser stream. It then becomes a question on what part of the earth will the more concentrated portion of the shower fall, and this admits of no certain answer. It chanced that in 1866 the earth encountered the advanced portion of the main train during hours when the Eastern Hemisphere was exposed to its attack, while the year following the earth came in contact with the after portion of the storm, which on this occasion fell over the hemisphere of the new world.

The cause of this uncertainty is to be found, as already hinted, in the interference caused by our brother and sister planets which come sufficiently near the field of the meteors to disturb their motions, and in some degree to divert their path. Indeed, a careful calculation of the past disturbing effect of the planets led Le Verrier to suppose that the meteors must, as a cluster, have been actually captured from outer space and introduced into our system in the year A.D. 126, since which time, during more than 50 returns, they have been drawn out into the extended train in which they are now found.

A very little reflection will show that when the meteors manifest themselves they are seen proceeding from a definite region of the starry vault which will hold its true position with regard to the constellations as they rise and set in the heavens, and it will be necessary to bear in mind that this region, "the eye of the storm," will not be well risen above the horizon in England till near midnight, at which time it will be found slightly north of east somewhere within the curve of the well-known and well-defined "sickle" in the constellation Leo.

Every individual of the meteor train which the earth entraps will rush into our atmosphere at this point, and, being rapidly raised to incandescence, the spectacle presented to the observer will be that of a multitude of brilliant trails apparently radiating outwards, in obedience to the laws of perspective, as they approach. Past observations combine in showing that the flying bodies—supposed to be individually small—commonly descend in bursts of 10 or 20 per minute amid perfect silence, and become consumed utterly in the higher portions of the atmosphere, most of them flashing out as brilliantly as the brightest stars; many of them leaving phosphorescent tracks of light lingering on for several minutes.

The most probable hour of the *maximum* display, according to latest calculations, is in the morning of November 16, and unfortunately at that time the neighbourhood of a moon not many hours from the full will tell greatly against the effect observed. At the same time, a full moon notwithstanding, we have record of a "grand display" in 1864, and even if, as has been explained, the main shower should not fall on our side of the globe, it is scarcely to be doubted that at least some of the many outlying streams which are known to accompany the central swarm will fall to our share and exhibit a rare and sublime spectacle through the early morning hours possibly of both the 15th and 16th.—*The Times.*

WHITE SPOTS IN BROMIDE PRINTS.

SPEAKING some time ago before the New York section of the Society of Chemical Industry, Dr. Leo Baekelandt dwelt on the sources of trouble in the coating of emulsion papers, and instanced a case, the particulars of which may be noted by those engaged in a similar occupation. A certain raw paper was coated with bromide emulsion; on development, the paper, which bore a baryta coating, was covered with millions of small white spots, some round, others elongated. Dust, defective emulsion, defective mechanical appliances are among the causes capable of producing these spots; but as the defect only appeared on this particular brand of paper, another reason for it had to be sought.

However, with a view to settling the question, the author cut out of the prints small portions where the white spots were most apparent, and, imbedding these strips in paraffin whilst holding them in an upright position, cut cross strips of paper by means of a microtome. These sections, which were only $\frac{1}{1000}$in. in thickness, were examined successively until the microtome reached the centre of the spot. The fact that the film presented everywhere a uniform thickness, without any depression of the film where the spot was located, was evidence that air bubbles or mechanical imperfections were not responsible for the defect. Examination by reflected light under the microscope did not show any dust or foreign matters where the spots existed, but in some of the white spots a central black nucleus was faintly visible, which, in some cases, could be rendered plainer by gently scratching the film away with a small dissecting scape. Treated under the microscope, with a drop of dilute hydrochloric acid, these black nuclei at once showed a yellow bronzed appearance, as copper would do; and on neutralisation, and addition of potassium ferrocyanide, the characteristic brown colouration for copper was obtained. Moreover, the ashes of the prints yielded an appreciable amount of copper.

Now metallic particles yield, in the case of a printing-out paper, the well-known "metallic spots" which appear soon after the paper is made. They are due to the reducing action of the metal on the soluble silver salts in the paper, an action which is assisted by the presence of the organic acid. The case is different with bromide prints, which are neutral in reaction and contain the silver as insoluble bromide. Then again, the spots under examination were white (pointing to zones of insensitive emulsion). The way in which the metallic particle can give rise to an insensitive patch was thus explained and illustrated by Herr Baekelandt: the metallic particle, imbedded in silver emulsion, sets up an electro-chemical action, becoming itself electro-negative whilst the surrounding zone is "electro-positive." As a result, the metallic particle is gradually dissolved and replaced by silver,

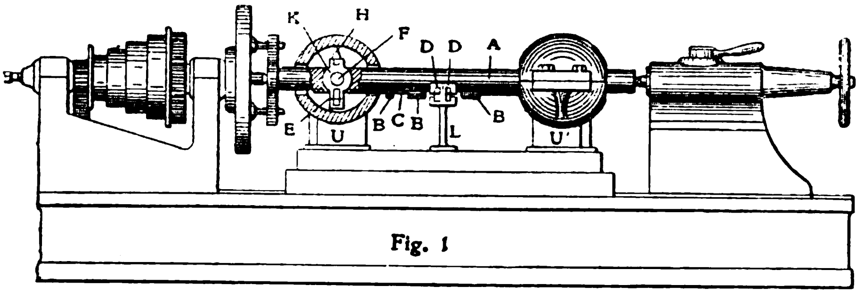


Fig. 1

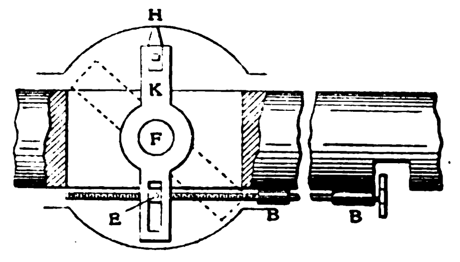


Fig. 2

whilst in the surrounding emulsion a very small amount of bromide or other electro-negative element is liberated, destroying the sensitiveness of this portion. That this was the probable explanation of the trouble was made clear by the following experiment. A sheet of bromide paper was placed (in a dark-room) in a dish of water, containing a little potassium bromide to increase its conductivity, and two platinum electrodes placed about a quarter of an inch apart on the paper, connected to the terminals of a Leclanché cell and left for about twenty minutes. After removal and washing of the paper, short exposure to light, and development, it was found that the spot covered by the positive electrode was white.—*The Photogram.*

BORING SPHERICAL BEARINGS.*

AMONG the early designs of electric generators was one with spherical bearings, as shown in my sketch. The bearings were extra heavy, to stand the pull of the belts. As we had a number of them to make, it seemed expensive to bore by hand-feed in a lathe, and it was very difficult to do them in a boring-mill with ordinary cutters. The method here shown suggested itself, and was adopted. A strong lathe was selected, and a cast-iron plate was fitted to the bed and bolted fast. On this we clamped the bed and bearings of the generators for boring. The bar designed for the job was of cast iron, and fitted with two swivel-heads, K, or tool-holders, the right distance apart for the bearings. Into one end of each head K was clamped a cutter, H. The other end was slotted, and a swivel-nut was fitted for the feed-screw C. There were two bearings B B fitted to the bar, for each feed-screw to run in. On one end of the screw was fitted a star, operated by the bracket L bolted by the generator-bed. There were collars fitted on the screws to receive the thrust when in service. D D are the stars for feeding, and are let into a recess in the bar A. This was necessary on account of the feed-screw being located so near the bar in order to clear the open end of the bearing U.

The arm K rotated on a pin, F, in the centre of the bar, and was made a good fit, so as to bore a smooth surface, free from chatter, for the bearing. Fig. 2 is an enlarged view of the bar, showing the circular boring device. With this arrangement we were able to bore both bearings at the same time, and, with two cuts, to make a true spherical surface in each. By using different lengths of arm K we could bore any diameter required.

Sometimes we look at a job of this kind and say, "The designer might have worked out a bearing very much cheaper than that, and would have saved a good deal in special tools." But the shop does not always understand why these designs are made so apparently expensive, and takes the work as it comes to it and suits the tools accordingly.

MAKING WROUGHT-IRON AXLES.

THE following report on the "Best Method of Making Wrought-Iron Axles" was presented by the committee (Mr. T. Wren and Mr. H. Jeffrey) to the Annual Convention of the National Railroad Master Blacksmiths' Association, at Milwaukee, this year:—

As car and locomotive axles in almost all roadroad shops are produced from scrap iron, the first operation is the selection of the old material for the purpose; this is an important matter, and should be in charge of a competent man, as the best quality of scrap only should be permitted to be placed in the piles preparatory to making into slabs for axle purposes. All scrap material from old boilers that have been badly coated with scale from impure water or other foreign substances adhering to the old material should be thoroughly cleaned by passing it through the rattler before placing it in the pile. Low carbon steel should be avoided in all cases. Slightly oxidised or rusty iron is not injurious, as the rust is pure oxide of iron; this same oxide will become a flux similar to slag, which is absolutely required to more perfectly cement together the atoms of iron which have been reworked many times over and become what the smith terms "dry iron" when brought to a high heat.

The next operation after the iron has been carefully selected is to put it up in piles of 160lb. or 200lb. on boards about 10in. by 14in. The long pieces of scrap should be placed lengthwise on the board on the bottom and sides; the centre should be filled in with short pieces; care should be taken to have the short pieces lap each other for the purpose of producing fibrous iron. Sufficient binders should be placed across the ends of the pile, so that they will not fall apart in handling. The careful selecting, cleaning, and piling of scrap your committee considers important factors in the production of good axles. Often the initial point in the manufacture of axles is not properly looked after; the consequence is that much material gets into the piles that has no affinity to iron. Defects from this cause will be very pronounced in the finished axle.

The next operation is placing the piles in the reverberatory furnace to be brought to the proper heat for working into slabs; this is one of the most important operations in the manipulation of scrap material for axle purposes. Quality of fuel has its influence for good or bad; fuel impregnated with sulphur or other elements that are injurious to iron will be absorbed by the semi-molten porous scrap piles, causing what is known as red short and cold short iron; its injurious effects can never be eradicated. Undoubtedly gas is superior for heating purposes, as the elements referred to have been partially removed before the heat comes in contact with the iron.

The man in charge of the furnace should see that silicon from the furnace bottom or any of the furnace lining does not adhere to the surface of the heated piles while manipulating the same in the furnace. Each pile should be turned over for the purpose of heating it through thoroughly; should any foreign substance adhere to the piles it should be swept off while passing from the furnace to the hammer.

The heated pile is placed under the hammer; the forger should square up the pile by light blows of the hammer, then draw the slab to the required dimensions. It is often the case that the forger plates the pile thin with the first two or three blows, then turning the plated slab edgeways, doubling the same over. This is a bad practice, and should not be permitted, as the scaria or impurities that may have adhered to the surface of the pile while being manipulated in the furnace, will be worked into the centre of the doubled-over slab and prevent a perfect union. Defects of this character will not be visible from the outside; such imperfections cannot be eradicated in the after process of completing the axle.

The slab should be drawn to about 1¼in. or 1½in. thick and about 6½in. wide for the standard M.C.B. axle. The quality of the axle depends in a great measure on the proper working of the slabs.

The next operation after the slabs are cut to the proper length is to lay a sufficient number together to produce the axle required; as many of these piles are placed in the furnace as the capacity of the same will permit. The same conditions exist as in heating piles for slabs, as regards fuel, foreign substances adhering to the surfaces, &c., and should be guarded against the same as when producing the slabs from the scrap pile.

The axle pile being brought to the proper heat is in charge of the forger. The first operation is to shape the pile roughly in round dies the entire length; this requires considerable dexterity, and should be done quickly. The method practised in the Southern Pacific shops is to grasp one end of the heated pile with a pair of tongs at the furnace door, and swing the heated pile under the hammer, roughing the opposite end down as quickly as possible. A pair of tongs is ready on the opposite side of the hammer to receive the end so treated. The tongs that took the pile from the furnace is quickly released, and the same operation performed as on the other end of the axle pile. A rough, uniform billet is produced. About two-thirds of the billet is placed in the reheating furnace, the same operation gone through with all the piles in the initial furnace, and the rough ingots placed in the reheating furnace. The first furnace is again charged with cold piles, and the heat progressing while the axles are being finished from the reheating furnace.

The reheating of the rough shape to a proper welding heat about two-thirds of its length is the most important part of the whole operation. If care is not taken, or the bridge wall of the furnace is not in proper shape, the end of the ingot will become overheated before the centre of the axle is sufficiently hot to form a perfect union in the centre of axle. The end, if finished after being brought to too high heat, will produce a bad crystalline journal, and will also be defective at the wheel fit. In our opinion this defect is the cause of many axles breaking at the wheel fit. If the centre of the billet is not sufficiently hot a perfect union of the different layers is not produced, although the outside can be worked over, so that the defects in the centre of the cross section are not visible.

Three axles broken at the centre came to the writers' notice inside of four weeks; on examination the broken section showed good fibrous iron, but the different layers had not been welded in the centre, which was the cause of the axles breaking. The forger is responsible for the perfection of the axle, and if he is a reliable man, will destroy a defective axle at once by cutting in two for re-slabbing.

The portion of the axle to be finished being brought to the proper heat, the full length of the portion to be worked, the forger should place the centre of the pile in the roughing recess of the die, manipulating the same until the end is reached as quickly as possible. Should the pile have a slightly higher heat at the centre than at the end, the operation should be reversed, commencing at the end and working back to the centre. The axle being worked down sufficiently in the first large swedges, is placed in the next smaller die or swedge for finishing the half of the axle to the proper dimensions; this swedge should be a little high in centre, as shown in diagram, for the purpose of giving the axle the proper taper to its centre. The third swedge or recess is provided with a projection at the bottom of the swedge, tapering to nothing at the upper sides of the die, for the purpose of cutting in the journal. The end of the axle should be placed in this die at as high a heat as practical for the purpose of producing good journals. The forger has become so expert in making axles that the portion operated on is almost down to its proper dimensions at a white heat. The metal does not attain its strength or ductility, however, until it is worked at a low red heat, and for the purpose of expediting the work a trough of water should be placed convenient to the hammer and crane, and the heated portion of the axle partially cooled. After cooling, the iron should be again placed in the finishing dies and lightly hammered over until the axle attains a blood-red heat, or until it will cease oxidising in cooling.

We often see axles finished at too high heat, causing scales in cooling. Such axles, on being broken, will show a crystalline structure. The proper weight of hammer is an important factor in the production of good axles. A light hammer will affect the iron on the outside only, even though the same dynamical force is attained. A hammer of the proper weight will affect the iron to the centre of the ingot. J. W. Nystrom advises that the weight of the hammer "at least should be in pounds the diameter of the shaft squared, multiplied by 80 in inches"; consequently a 2,880lb. hammer would be the weight necessary by the rule. The writer of this article gets much better results with a heavier hammer, and would advise that it be not less than 4,000lb.

Large locomotive axles are produced by similar methods as car axles, but being much larger are not so easily and quickly manipulated; consequently the scaria is more apt to settle between the layers, and when finished in the lathe dark streaks will sometimes appear in the journal and the scaria can be picked out with a sharp instrument or in service will work out, giving the appearance of a defective journal. To avoid this, in the Southern Pacific shops our master mechanic suggested placing plates of iron over the seams formed by the different layers or slabs, the full length of the journal, the fibre of the plates running in the same direction as the axle. This method properly carried out will produce perfect journals. We have had but little cause to

* By H. S. Brown, in *American Machinist.*

reject axles on account of imperfect journals since this method has been adopted.

Another method of producing axles is to hammer the slabs, then roll them into smaller dimensions for piling. In the opinion of your committee either method will produce a good fibrous axle if attention given to all details as above described.

THE MAGICIAN'S OMELETTE.*

THE magician has never proved himself an adept at the art of cooking, from an epicure's standpoint, yet the ease with which he can bake cakes in borrowed hats and cook omelettes in empty pans has long been a source of wonder to the economical housewife as well as to the professional cook. To see the magician hold a small, shallow, empty pan over the blaze of a spirit-lamp for a few moments, when an omelette, done to a turn, appears in the pan, and is cut up and distributed to the audience, one is almost convinced that at least one person has solved that most perplexing of all problems, how to live without work.

But has he solved it? No! my friend; no more than you or I. He has merely deceived you, but most cleverly, you must admit. The pan is without any preparation whatever; but so much cannot be said of the wand, which he is continually stirring round in the pan. This wand is hollow, with an opening at one end only, and in the wand, previous to the trick, of course, is placed the properly-seasoned ingredients of an omelette, after which the end is closed with a metal plug, that is turned and enamelled to correspond with the opposite end of the wand.

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When the pan is being examined, the performer is holding the wand in his hand, and such an innocent-appearing black stick is never suspected of being in any way connected with the trick.

Just before holding the pan over the lamp the performer finds it a most easy matter to remove the plug from the end of the wand, when by holding the wand by the closed end he can empty the contents into the pan in the mere act of passing the open end of the wand round the inside of the pan.

The metal of which the pan is made being thin, and there not being a great quantity of the omelette, assisted by a large flame from the lamp, it only requires a few moments to cook the omelette, when it is turned out on a plate and carried down to the audience.

It is hardly necessary to say that when the cooked omelette is carried down the wand is left on the stand, which prevents any inquisitive person asking to see it.

THE power-plant at Niagara Falls is to be extended, doubling its capacity. Estimates have been asked for the excavation of a new wheel-pit on the opposite side of the canal from the present station. This pit is to be 400ft. long, 20ft. wide, and 180ft. deep, cut out of the solid limestone, accommodating ten of the 5,000H.P. units adopted.

ACCORDING to tests recently made by Mr. A. S. Cooper, and described by him in the current issue of the *Journal* of the Franklin Institute, the use of salt or sea water in gauging cement is bad practice. The tests were made with both natural and Portland cement mortars, and comprised tensile and compressive tests. The ages of the briquettes when tested were one week, four weeks, three months, six months, and one year. In the short-time tests the briquettes gauged with salt water stood ahead of those gauged with fresh water, but the long-time tests nearly always showed the superior strength of the briquettes mixed with fresh water, and this was just as pronounced in the compression as in the tension tests. The deteriorating effect of the salt water seemed to be the greatest with the richer mortars.

* By WILLIAM B. CAULK, in *Scientific American*.

SCIENTIFIC SOCIETIES.

BRITISH ASTRONOMICAL ASSOCIATION.

THE ninth annual meeting of the members of the B.A.A. was held on Wednesday, October 25, at Sion College, Thames Embankment, Mr. W. H. Maw (the president) in the chair.

The names of 13 candidates for admission were read and passed for suspension, and the election by the council of one new member was confirmed.

Mr. Petrie (hon. sec.) read the report of the scrutineers of the ballot, who declared the following persons to have been duly elected as officers and council for the ensuing session:—President, Mr. W. H. Maw; vice-presidents, Messrs. N. E. Green, G. M. Seabroke, G. Johnstone-Stoney, and W. H. Wesley; treasurer, Mr. W. H. Maw; secretaries, Messrs. J. G. Petrie and W. Schooling; librarian, Mr. F. W. Levander; other members of the council, Rev. J. M. Bacon, Dr. Downing, Mr. A. Kennedy, Mr. G. J. Newbegin, Capt. Noble, Miss M. A. Orr, Dr. Rambaut, Mr. S. A. Saunder, Dr. Smart, and Mr. C. Thwaites.

Mr. Petrie also reported that the following had been appointed editor and directors of sections, subject to confirmation at the present meeting:—Editor, Mr. E. W. Maunder; Sun, Rev. A. L. Cortie; Moon, Mr. W. Goodacre; Mercury and Venus, Mr. Henry MacEwen; Mars, Mr. E. M. Antoniadi; Jupiter, Mr. Arthur Cottam; Saturn, Mr. G. M. Seabroke; Comets, Mr. A. C. D. Crommelin; Meteors, Mr. W. F. Denning; Star Colours, Mr. G. F. Chambers; Variable Stars, Mr. J. E. Gore; Double Stars, Mr. G. M. Seabroke; Spectroscopy, Mr. J. Evershed; Photography, Mr. R. Wilding; and Zodiacal Light, Capt. P. B. Molesworth. These appointments were unanimously confirmed.

The President said all the members had received a copy of the statement of accounts for the past session, and he, as treasurer, would be pleased to give any explanations with regard to them that might be desired. On the whole, it was by far the most favourable statement he had had the pleasure of submitting. They had written a very substantial sum, over £28, off the value of their stock of journals; they had added £60 to the reserve fund; and they had a surplus of income over expenditure of over £63. The number of members in arrear was much less than a year ago, and a very substantial proportion of those in arrear last year had paid up—45 out of 80. Unfortunately, a large proportion of the arrears in respect of the past session was due to the Australian sections. There were 71 members in arrear for the last session, and 19 of those were Australian members. The arrears, including the Australian deficiencies, represented under 5 per cent of the main body of members—by far the best result they had had for some years.

The accounts were then unanimously adopted, as was also the report of the council for the past session.

Col. Burton-Brown proposed a cordial vote of thanks to the retiring members of the council, Mr. Cottam, Sir Wm. Huggins, Mrs. Maunder, and Dr. Isaac Roberts. The Association, he said, had made its way, owing, to a large extent, to the untiring energy, zeal, and ability of the members of the council. Not only had they on the council men of note and distinction, but men who were hard workers, and it was their cordial co-operation which had led to the prosperity achieved. Then they had been favoured by the fact of two or three eclipses of the sun having taken place in the period during which the Association had existed, and, if all were well, they were going to have another in May next. He hoped to go to Algiers to witness it, and if, as he proposed, he went out in advance of the main body of the Association's expedition, he would be glad to render them any personal service in his power.

Mr. Crawford seconded the motion, [illegible] approved.

On the proposition of Mr. J. D. Hardy, seconded by Mr. Cottam, the thanks of the Association were tendered to Messrs. Miller and Ellis, the auditors: and a similar vote of thanks was accorded to Messrs. Crawford, Adams, and Holmes, the scrutineers of the ballot, at the instance of Mr. Ellis, and Dr. Smith.

The Presidential Address.

The President, upon rising to deliver his address, was enthusiastically received. In opening, he reminded the members that with the present meeting the Association commenced its tenth session, and remarked that inasmuch as it had been his duty as treasurer during the past nine years to look after the finances, it might perhaps naturally be expected that now, when he addressed them as President, he should say something concerning the progress which the Association had made, and the position in which it at present stood. Mr. Maw then pointed to a diagram which he had prepared, showing at a glance the progress which had been made with regard to the number of members, and also how the Association's finances had stood from year to year, from several points of view. Having mentioned that the present membership totalled 1152, he proceeded: I do not, however, regard these figures as indicating that we have even now closely approached the probable limit of our membership, but rather as showing that we should take steps for developing fresh districts in which, as yet, little has been done. The establishment of our provincial branches has always been attended by an increase of membership, and there are several districts, notably in the south and south-west of England, and in Ireland, where such branches ought to meet with substantial support. Our membership, large as it is, for a society of this kind, really represents but a very moderate fraction of those strongly interested in astronomy in this country—a class which I am glad to say is, with the spread of scientific knowledge, steadily extending every year. After dealing with several financial matters he went on: Having thus dealt briefly with the past history and present position of our Association, I have next to say something of its future prospects as they appear to present themselves to me. Our Society has now reached such a stage of development that the composition of its membership may be regarded as fairly representative of what it is likely to be for many years to come; and it is thus possible to form a just idea of the work which the Association can profitably undertake, and of the value which such work is likely to possess. Roughly, our members may be divided into three classes—viz., first, the professional astronomers, connected with established observatories, and having at their disposal more or less ample instrumental equipment; second, amateurs having instruments fitted for serious work, and possessing, moreover, a fair amount of experience in the use of such instruments; and third, members who are students of astronomy, but who are either not possessors of instruments at all, or who have not facilities for observational work of an original kind. This third class may possibly be advantageously subdivided, as I shall indicate later on. As regards the first class, the professional astronomers, it is, I am sure, a great satisfaction to us all that we have been able to enrol so many of them in our ranks. A reference to our list of members will show that it includes professional astronomers in nearly every civilised country—men whose names are household words, and the history of whose work constitutes to a great extent the history of the recent progress of our science. It is impossible to overrate the value to our Association of the collaboration of these professional astronomers. Their contributions to our publications may be comparatively few, for, as a rule, the accounts of their researches are, almost of necessity, issued through other channels; but we are indebted to them for some very valuable papers, while we have constantly benefited by their presence at our meetings and by their aid in various ways. Without them the status of our Association would certainly not be what it now is. Next, as to the second class, that consisting of amateurs possessing more or less excellent instrumental equipments. It is this class which has formed the backbone of our observing sections, and to it is due the bulk of the original work which has been recorded in the publications of the Association. . . . It is satisfactory to know that this second class of our members, upon whom we depend so much for original work, is an ever-growing one, while year by year it is becoming possessed of more powerful and more perfect instruments. And this brings me to a point on which I wish to say a few words—namely, the influence of the large telescopes, with which some of our more important observatories are now provided, on the usefulness of the work of amateur observers. In considering this point it must be borne in mind that the great telescopes of the present day are of a very different class to the giant instruments of the past. The great reflectors of Herschel, of Lassell, and of Rosse were all instruments made and used by

amateur astronomers, and although they possessed great light-grasp and did some admirable work, they were, owing largely to the nature of their mountings, utterly unfitted for the class of observations on which the large telescopes of the present day are chiefly employed. The 36in. and 60in. reflectors of Dr. Common may, perhaps, be regarded as the latest of this older class of large telescopes, although it would probably be more just to consider Dr. Common's instruments as forming a connecting link between the giants of the past and present. In the case of such large refractors as those at Pulkowa, at Washington, at Vienna, at Mount Hamilton, at Nice, at the Yerkes Observatory, and at Greenwich, the cost of the telescope itself is but a small portion of the total outlay incurred. Not only must such an instrument be thoroughly well mounted to fit it for modern research work, but it must be protected by a well-constructed dome, and, in order that every moment of good seeing may be utilised, provision should be made for effecting all movements of both telescope and dome with the least possible amount of labour to the observer using the instrument. How perfectly this can be done is well shown by the great Yerkes refractor, which, notwithstanding its enormous size and weight, can, with its dome, be so readily handled by the electric motors with which it is provided, that it can be—and is—efficiently used by a single observer through a whole night, without any assistance whatever. It is satisfactory to know that two of our own members, Messrs. Warner and Swasey, were responsible for both the design and construction of this admirably perfect mounting, while the rising floor, which forms such an important feature in the equipment of both the Yerkes and Lick Observatories, and contributes so much to the convenient use of these large telescopes, was the invention of another of our members, Sir Howard Grubb. But by the time a refractor of this kind had been erected and equipped the outlay upon it will have become so large, that it would be utter folly to use the instrument for work other than that for which its great power renders it specially fitted. The result of this is that our modern giant telescopes are, with few exceptions, employed not in doing work which was formerly done by smaller instruments, but in doing work which formerly could not be done at all. Such, for instance, is the bulk of stellar spectroscopic work, including determinations of velocity in the line of sight, the measurement of close double stars, the spectroscopic examination of nebulæ, the discovery of new planetary satellites, and similar matters. We see, therefore, that the establishment of these powerful telescopes has been accompanied by the development of new fields of research, and that the work which was formerly done—and can still be well done—by instruments of moderate size, has not been reduced. On the other hand, many professional astronomers have withdrawn from the work which they formerly did with the instruments then available, and they have thus left to amateur observers the continuance of their former labours. We thus see that there is ample work for the members forming our observing sections, and that such work, if faithfully carried out and recorded with judgment and discrimination, is calculated to be of great and permanent value.

The President next dealt at some length with the character of the reports of the observing sections, and with the mode of recording the work of those sections, in which connection he suggested some improvements which might be made. He continued: I have now to deal with the third class of our members, namely, those who are either non-observers, or who, if they observe at all, are provided with a very limited instrumental equipment. This is a very large and important class, and it may, as I have already hinted, be conveniently subdivided into at least two sections, one comprising those who already possess a considerable knowledge of astronomy, and the other consisting of those who are more or less beginners in the study of our science. To both these sections our Association should be of considerable service, while both, on the other hand, can materially aid the objects which the Association has in view. To our members forming the first sub-division much really useful work is open. In the first place, they may render valuable aid to our observing sections. . . . Then, again, there are other directions in which the class of members with whom I am now dealing can do useful work. Some may strike out original lines of mathematical or geometrical investigation, as has been done by Mr. Whitmell, whose papers contributed to our *Journal* aid us so much in realising aspects of the Solar System regarded from other planets than our own; others may take up optical matters and assist in the perfecting of our telescopes and spectroscopes, while still others may afford to our hard-working editor much-needed assistance in his preparation of those abstracts of foreign astronomical publications which form so valuable a feature in our *Journal*. I have, however, I think, said enough to show that the fact of not possessing an observatory or instrumental equipment is no bar to the accomplishment by competent members of work of real value to our Association, and to astronomical science generally. I have now finally to deal with the second section of the third of the three classes into which I have ventured to divide our members. This section, it may be remembered, consists of those who are commencing the study of astronomy. I will not call these members "learners," because that is really not a distinctive term. An astronomer devoted to his science never ceases to be a "learner" however eminent he may become, and, in fact, with the growth of knowledge comes inevitably the growth of the conviction that great as has been the progress of astronomical discovery we have as yet only touched the fringe of that great science whose possibilities are as limitless as space itself. Using then, for the want of a better, the term "beginners" to denote the class of members of which I am now speaking, I wish before concluding this address to offer a few remarks on the manner in which I consider that the study of astronomy can be most advantageously commenced. . . . . I trust that the remarks which I am about to make on the commencement of the study of astronomy will not lead anyone to suppose that I in the least underrate the value of the numerous popular works on our science, or the admirably illustrated magazine articles dealing with astronomical subjects, of which so many have appeared during recent years. On the contrary, I believe such books and articles have done great good, and have, by the interest they arouse, caused many additions to be made to the ranks of amateur astronomers. But the beginner who, wishing to study astronomy, confines his attentions solely to such writings as I have just referred to is much in the position of a man who thinks he can become a soldier by reading glowing accounts of hard-won victories. Such a beginner, who has had his imagination stirred by the examination of beautifully reproduced photographs of comets, or nebulæ, or lunar views, is apt to experience more or less severe disappointment when he is shown these objects through a telescope of moderate size. Not having had experience in observing, he misses much detail which even such an instrument can show, and realising how far what he sees falls short of what he had been led to expect, he is apt to jump to the conclusion that observational astronomy, at all events, offers few attractions to those who have not at command an expensive instrumental equipment. Now, this conclusion is an utter mistake—a fact which the beginner who approaches the study of astronomy in the proper spirit will soon recognise. It has to be borne in mind that, great as are the attractions of modern astro-physical research, the real basis of our science is that which is sometimes called, by way of distinction, "gravitational astronomy." It has, further, to be borne in mind that the earlier astronomers working with instruments of a very elementary kind obtained a considerable knowledge—which was in many respects really remarkable for its approximate accuracy—as to the motions of the heavenly bodies, and as to the phenomena presented by the chief members of our Solar System. Now, what was done in the olden times can be done in the present day; and I wish to prominently direct the attention of beginners to the fact that by the employment of quite simple apparatus they may make observations which will bring home to them, in a way which mere reading can never do, a knowledge of many astronomical phenomena which they will find to be, not only of immediate interest, but of great value to them in their further studies. What I wish to urge, therefore, is, that those commencing the study of astronomy should not be content with reading only, but should work in the open air, faithfully and systematically recording their observations, however elementary these may be. I lay great stress on this latter point, because unrecorded observations have, as a rule, little educational value. The mere fact of describing in writing any observation, however simple, which has been made, is of immense assistance in securing completeness and accuracy. . . To the beginner who has thus taken up the study of celestial motions an endless number of problems will suggest themselves for examination, and it will be found that the solution of these problems will afford work which is not only of great immediate interest, but will lead to the acquirement of knowledge of considerable future value. It has been often said that "learners should not be ashamed to ask questions." This is quite true in a certain sense, and no beginner should be ashamed to acknowledge that he has much to learn. But the practice of asking questions is not one to be advocated, except within certain strict limits. The beginner who immediately he gets into a difficulty asks for aid to get out of it, is not likely to make any great progress. It is the battling with difficulties, the habit of regarding a problem from various points of view, and the practice of "getting at the bottom of things," which impresses truths and principles on the mind, and a few facts so learned are worth ten times the number acquired by the question and answer method. The statement I have just made appears to me to apply with special force to the use of instruments. Many present have no doubt been struck, as I have, by the character of numerous queries respecting the use and adjustment of instruments which, from time to time, appear in print. These questions suggest the idea that those proposing them are of opinion that scientific instruments should be made on the "You-touch-the-button-and-we-do-the-rest" principle, and that their employment should require no special knowledge on the part of the user. Now, this is a frame of mind which is much to be deprecated. Nothing is more essential to secure the best results with any instrument than a clear comprehension of the principles on which such instrument is constructed. It is only by the possession of such knowledge that the user of a telescope, a spectroscope, or other astronomical appliance can determine whether or not any defect in performance is due to a radical fault in such instrument or to a comparatively trivial fault in adjustment. For this reason I would thoroughly urge beginners, when they take up actual observing, to study carefully the theory of any instrument they may employ, and make themselves familiar with its principles and construction. Were this more generally done, much disappointment and loss of time would be saved, and instrument makers would be spared many unjust complaints and much worry. I am afraid that my remarks on the section of our members which I have classed as "beginners," have run to an undesirable length; but it must be remembered that the "beginners" of to-day are those from which we shall at an early date expect work which will promote the interests and strengthen the position of our Association, and any suggestions which may aid in their training may thus possibly be regarded as excusable. In conclusion, I may quote a passage from the works of Bacon, which was written to have a wide significance, but which appears to me to apply with peculiar force to the science to which we are all devoted. Says the great philosopher: "Knowledge is not a couch whereon to rest a searching and restless spirit; nor a terrace for a wandering and variable mind to walk up and down with a fair prospect; nor a tower of state for a proud mind to raise itself upon; nor a fort for commanding ground for strife and contention; nor a shop for profit or sale; but a rich storehouse for the glory of the Creator and the relief of man's estate."

Mr. Maunder was sure there was only one feeling amongst all the members present, and that was one of very great gratitude to their President for the address he had just given them. They had been greatly indebted to Mr. Maw from the very foundation of this Association, for he had undertaken the charge of its finances from the first, and although, of course, the money side of an undertaking of this sort was not the highest, yet one thing was perfectly certain—that if such an association were not financially sound, its usefulness would very soon come to an end. Consequently, they were deeply indebted to Mr. Maw for having kept them from the beginning upon a sound financial basis. Mr. Maw had not only carried out the ordinary duties of a treasurer with extreme diligence and faithfulness, but had added a variety of other duties to it far more numerous than he (Mr. Maunder) could describe. Only those who had been behind the scenes could tell how much of the actual work of the Association had been done by Mr. Maw himself. It had been a rule amongst them from the beginning, when in any difficulty whatever, to go to Mr. Maw and have it cleared away. And now they had had from Mr. Maw, as their president that evening, a most helpful address upon the position and prospects of the association, and he (Mr. Maunder) hoped that address, when it reached the hands of the members, would be carefully read, and the advice contained in it taken heed of and adopted. They had had in the past nine years a most gratifying amount of success, but there was no reason why they should not have a great deal more in the future. Nor was there any reason why what many of them felt to be somewhat weak places should not be strengthened, why their various sections should not be doing a great deal more work even than they were doing, and why the membership should not develop much more even than it had in the past. If they paid good heed to the address which Mr. Maw had delivered, he thought very much of that would be seen in actual practice. Mr. Maunder concluded by moving that a very hearty vote of thanks be accorded to the President for his address.

The vote was heartily accorded.

The President, in acknowledging the compliment, said he had only done what all the other members of the council, the secretaries, and the directors of sections had done. He thought that without any self-glorification he might say they had all worked very hard for the association. Good work had been done by the council right away from the beginning, and they had always worked together very harmoniously, which was a great point. They had all done their best for the Association, and he had certainly done no more than anyone else.

Mr. Maunder read a paper by Mr. Cecil J. Dalmage on "The Apparent Enlargement of Heavenly Bodies when in the Neighbourhood of the Horizon." The writer referred to the fact that

many attempted explanations of the phenomenon had been offered from time to time, and desired to add yet another. He pointed out that if an observer looked up towards the zenith and considered the expanse of sky presented to his gaze, he would notice that it contained practically no trace of curvature. This was evidently because his field of view was not extensive enough to include any appreciable portion of the dip of sky towards the horizon. If he lowered his eyes gradually towards the horizon he would notice that on account of the dip of the sky in front and, particularly, on either side of him coming more and more into the field of view, the plane heaven which he had just been looking at would little by little assume an appearance of concavity, this appearance of concavity rapidly increasing and finally reaching its maximum when the gaze was directed to a point on the horizon. Pointing out the effect this change would have upon a definite portion of the sky as seen by an observer, Mr. Dolmage said it must be clear to anyone who for a moment considered the matter that the distance between markings upon a plane elastic surface would be increased in proportion as the plane was bodily hollowed out so as to assume a concave shape, the boundaries of the plane being always preserved at the same initial distance from each other. This gave the clue to what took place when an observer viewed the heaven. The eye, looking zenith-wards, perforce considered the expanse as a plane; then, as the gaze was lowered, and the dip around the sky towards the horizon came increasingly into view, the eye unconsciously considered this plane as gradually becoming more and more concave towards it. Therefore the total area of the field of view of sky (regarded chiefly in its lateral extent), and, in consequence, the area of any definite portion of it, was considered as having enlarged.

Mr. Maunder said that some years ago a Belgian astronomer, M. Stroobant, made a number of experiments with pairs of electric lights in a large dome. He had a pair of electric lights put overhead, and another pair at the same distance from him against the wall, and then he had the two altered in distance until to him they seemed as if they were the same distance apart; then, measuring, he found that this same apparent expansion of objects looked at straight forward on the horizontal plane took place with regard to the electric lights as held with regard to the stars: the distance apart of the pair of lights before him seemed exaggerated, that of the pair above him seemed diminished. He regarded it, therefore, as purely and entirely a physiological effect, due to something connected with our ordinary upright stature, so that when looking straight ahead an object looked very much larger, at the same distance, than it did when overhead.

Mr. McCarthy remarked that the effect alluded to by Mr. Dolmage was one upon which an explanation was reasonably asked. The only answer which it was possible to give at present was that they did not know. In order to obtain information on the subject, the librarian of the R.A.S. had looked through a large number of articles which had appeared in the ENGLISH MECHANIC. He found a series of suggestions to account for the apparent enlargement of these celestial objects on the horizon, and their corresponding diminution at the zenith. The suggestions made in some cases were that this was caused by the atmosphere, one writer endeavouring to show that the effect observed would be apparent, supposing the atmosphere surrounding the earth could be regarded as a huge crystal; in looking along the horizon they looked through more of it, and in looking to the zenith they looked through less. Of course care had been taken not to confuse this effect with that due to refraction. Another group of writers pointed out that it had been suggested that the effect arose from a comparison with objects on the earth, and seen against the sky. The complete refutation of that suggestion was arrived at by making the observation on the ocean, where the constellations appeared wider apart and the moon and sun appeared larger when near the horizon and gradually diminished in size as they approached the zenith. It was also said that when they took a hollow tube and looked through it at the sun (or the moon) just after it had risen, its apparent magnitude sank to the ordinary magnitude of the sun when seen at the zenith. He tried this, and found that when he shut one eye and looked through the tube the moon always looked smaller; but if he viewed the object with one eye when it was at the zenith it looked smaller than if he used both. Consequently he took two tubes and looked at the moon carefully night after night with both eyes and found the tubes made no difference whatever. The suggestion was that these tubes cut off the view of the surrounding objects, and confined the vision to the moon when rising, and then, of course, the moon was sure to appear as it did at the zenith. He found that would not stand the test of so simple an experiment. He would suggest to all interested in the science of astronomy—that a certain amount of attention should be given to this question to see whether a satisfactory conclusion could not be arrived at with regard to it. If, however, the explanation suggested by Mr. Dolmage could be taken as reliable, then the alteration in the position of the person observing, from standing up to lying down, would entirely overcome the difficulty. But that had been tried many times, and every attempt to alter the position had failed to remove the apparent difference. If the effect arose from the construction of the eye, then the atmosphere might be entirely removed without altering the effect, which, to say the least, was doubtful. He quite understood the suggestion that there was a wider vision taken in by the eye when looking towards an object on the horizon; but he had explained previously that a person altering his position found the object just as much enlarged or diminished in appearance whatever the position of the observer.

Mr. W. H. Wesley said Mr. Dolmage's explanation was somewhat similar to the well-known suggestion that the celestial vault does not appear to us as half a hollow sphere, but as an ellipsoid in form; so that it is apparently much nearer to us in the zenith than at the horizon. The question still remains: if it is due to an illusion of this kind, is the illusion optical or mental? He had tried the experiment of turning his head downwards, and looking at various objects in this position. They all appeared the same way upwards as they are in reality; but if he looked at a page of a book in the same way, that appeared to be upside down. This seemed to show that what at first sight seemed an optical effect was really a mental one. He was inclined to think that the cause of the apparent difference referred to was mental rather than optical.

Mr. E. M. Nelson suggested that it would be a good plan to photograph the moon at the zenith and on the horizon. There was no possibility of refraction cheating the photographic eye. Most of them were photographers, and everyone would have noticed in photographing a cliff with a lens 10in. focus how very much dwarfed the cliff appeared in the negative when developed. He thought the phenomena were identical.

Mr. T. Clapton, referring to the suggestion as to photographing the moon or sun, said the result would be more accurately arrived at by measuring the disc with a sextant. That had been done over and over again, and the diameter was just the same whether the object was at the horizon or the zenith. It seemed to him that the whole thing was a matter of mental perspective. Let them measure 40ft. on the ground and see how little it looked; yet that was a respectable height for a house.

The President remarked that the apparent enlargement was vertical as well as horizontal. Anyone watching the rising of Castor and Pollux could see this. That, he thought, was the most striking instance that existed in the sky.

Mr. Clapton said the fact remained that, measuring the angle with the sextant, it would be the same in every position, except that the upright angle would be affected by refraction.

Mr. L. B. Tappenden mentioned what he considered a cognate illustration. If a person went out of doors on a starry night, and fixed on a star which he assumed to be at an elevation of 45°, and afterwards took the measurement of the angle, he would find, as a rule, that the elevation was considerably less. If he took two stars which he thought to be at an elevation of 30° and 60°, he would find the 30° was considerably less, and that the 60° was also less, though not quite so much. He thought these mental illusions were very cognate.

The President said 60° was a most deceptive angle. Anything at 60° looked very much higher than it really was.

Mr. Maunder said the sun and moon had, of course, often been photographed at almost every conceivable altitude above the horizon, and the only difference in the diameter of the photographs was that due to refraction, the effect of which, of course, compared with the apparent difference now under discussion, was quite negligible. For instance, on the solar photographs taken at Greenwich, after correcting for the distance of the earth from the sun and for refraction, they got just the same diameter in midwinter as in midsummer. The photographic plate, therefore, knew nothing whatever of this enlargement near the horizon. It struck him that M. Stroobant's explanation might be tested by the simple experiment of looking at the rising or setting moon, when lying on one's back with the head towards the moon. If the suggestion of that gentleman were correct, it would seem that the rising moon, when so viewed, should appear to be of the same diameter as it ordinarily appeared to be at or near the zenith. M. Stroobant's experiment seemed to show that the effect had nothing to do with the atmosphere, because he conducted the experiment in a building and had his electric lights, those on the level and those which were overhead, both at the same distance from him.

The President remarked that the discussion was an interesting one; but he did not think they had got much nearer the explanation than they were before. With regard to refraction, he might point out that the effect of refraction would be to tend to decrease the distance between any objects situated one above the other, as was the case with Castor and Pollux, and the lower star would be raised more than the other.

Mr. Petrie read a paper by Mr. Edwin Holmes, being a sketch of the life and work of John Bird, who in the early part of this century visited nearly every town in the kingdom as a lecturer on astronomy. Concluding his paper, the writer said, "Mr. Bird, apparently, may never have possessed an astronomical telescope, or entered an observatory. His observations were upon wooden orbits and tin stars and planets, which troubled him not with vagaries of definition. He never found any canals on Mars or Venus, or elongated the satellites of Jupiter. He never divided double stars one-tenth of a second apart with 6½in. Gregorians, or other telescopes of that aperture, as three anonymous observers have done of late. He may not have framed any theory of the colour of Martian vegetation, or of the varying intellectual capacities of the inhabitants of that and other planets, but he did such work as was within his scope—such as lay next his hands—and enlarged the ideas of many thousands about the phenomena of the heavens, who, but for him, would have had no conception that the twinkling lights of the midnight sky were of any more importance than the moving discs upon his calico screen produced by Mr. Bird for their instruction."

The President said they were much indebted to Mr. Holmes for this interesting piece of history. Mr. Holmes had rescued it from pages which doubtless they would never have seen.

ROYAL MICROSCOPICAL SOCIETY.

AT the last meeting (Mr. E. M. Nelson, President, in the chair), the President called attention to an old microscope made by Cary, presented to the Society by Mr. Gleadow, which was a very interesting addition to the Society's collection. An instrument of the same design was figured in the *Journal* for 1898, p. 474. Messrs. Watson and Sons exhibited their new School microscope, which was provided with a diagonal rack-and-pinion coarse adjustment, but no fine adjustment; their idea being to produce a strong well-made instrument at a low price. Dr. Dallinger had seen this instrument, and thought it would admirably answer the purpose for which it was intended; the coarse adjustment was so well made that he had no difficulty in focussing a ⅙in. objective with it. The President thought the microscope was strongly made and well fitted, and would be found to be a very useful instrument. Messrs. Watson also exhibited a new form of eyepiece named the "Holoscopic" which was fitted with an adjustment to render it either over- or under-corrected, and suitable for use with either achromatic or apochromatic objectives. Dr. Measures exhibited a microscope for photo-micrography made by Zeiss, having a new form of fine adjustment which admitted of the arm being made of any length without throwing extra weight upon the fine-adjustment screw. Dr. Dallinger considered the way in which the speed of the fine adjustment had been reduced was most ingenious; the motion was extremely slow, being only $\frac{1}{315}$in. for every revolution of the screw. A protest had always been made in the Society against the fine adjustment having to carry much weight, and it was therefore satisfactory to to find that this one had only one-fifth of the weight usually put upon the fine adjustment. The President said the application of an endless screw was a novel way of slowing down the fine adjustment. The reduction of weight upon the thread was an important improvement, and the increased length of arm was another good feature. The President then described a new form of fine adjustmunt by Reichert, which was shown applied to his "Austrian" model, exhibited by Mr. C. Baker. The indicator to this fine adjustment was movable so that it could be set to zero when required, thus greatly facilitating the reading of the divisions on the head of the screw. The instrument was fitted with the English standard substage, and the axis of the trunnions was placed above the stage to insure a better balance. Two other microscopes by Reichert were also exhibited, one being a student's, without fine adjustment, but fitted with a dissecting loup as a substage condenser. The President next showed a microscope fitted with his new stepped rackwork coarse adjustment by Messrs. Watson and Sons. There was no loss of time, though the pinion was pressed but lightly into the rack. The President also exhibited a dissecting stand by Andrew Ross, which was about 40 or 50 years old, and was still a thoroughly good working instrument, and though the lenses were not achromatic they gave very good images. Mr. C. Lees Curties exhibited some stereoscopic photo-micrographs taken on the Ives principle by Mr. E. R. Turner, who briefly described the method of taking them. Dr. Hebb said they had received Part VI. of Mr. Millett's report on the Foraminifera of the Malay Archipelago, which would be taken as read and published in the *Journal*. Mr. F. Enock gave an extremely interesting account of his observations on the life-history and habits of the British trapdoor spiders, illustrating the subject by most excellent optical lantern views.

SCIENTIFIC NEWS.

THE new planet Eros, the nearest to the earth, although numerous observations are now available, seems to puzzle the skilled calculators of orbits; but in *Ast. Nach.*, No. 3597, Herr H. Osten, of Bremen, gives provisional sets of elements, which, however, vary considerably.

Someone, advising Reuter from Santiago, Chile, states that Biela's comet has been observed, and is visible to the naked eye. It is not probable that the object seen was Biela's comet, which has not been identified since 1852.

The Rev. Edward Lyon Berthon, M.A., F.R.A.S., late vicar of Romsey, died on Friday last in his 87th year. He was the inventor of the Berthon collapsible boats. Mr. Berthon was educated at Magdalen College, Cambridge, and was ordained deacon in 1845 and priest in 1846 in the diocese of Winchester. He was perpetual curate of Holy Trinity, Fareham, from 1847 to 1857, and vicar and rural dean of Romsey from 1860 to 1891. He did much to restore the ancient Abbey Church of Romsey. The deceased was well known by his works throughout the civilised world, for, besides his collapsible boats, pontoons, &c., he made several useful inventions in connection with astronomical instruments, and constructed some notable telescopes, amongst others an 18in. reflector for the late Rev. Cooper Key, and a smaller one for the late Rev. T. Webb. The Berthon observatory is well known to all our readers, as is also the Berthon dynamometer. At the beginning of this year, Mr. Berthon published "A Retrospect of Eight Decades," a notice of which will be found on p. 146, March 31 last.

Prof. Edward Orton, president of the American Association for the Advancement of Science, died suddenly of heart disease at Columbus, Ohio, Oct. 16. He had been state geologist of Ohio for the last fourteen years, and for a number of years was president of the Ohio State University. He resigned the latter position in 1881, but remained professor of geology, a science in which he attained an eminent reputation.

Dr. John Thomas Arlidge, the author of numerous well-known medical works, died at Newcastle-under-Lyme last week. Dr. Arlidge, while medical inspector of factories in the pottery districts, first drew serious attention to the evils in the lead processes, and the public agitation which followed ended in the framing of special rules. He held among other medical degrees that of M.D. of London (1867), and was physician of the North Staffordshire Infirmary. His best known work is "The Hygiene, Diseases, and Mortality of Occupations," delivered at the Royal College of Physicians as Milroy Lecturer.

The death is announced by cable of Mr. Otthmar Mergenthaler, at Baltimore, Maryland, the inventor of the Linotype machine, the first patent for which was, we believe, taken out in 1884.

The late Lord De Tabley, besides being a numismatist of no mean order and a collector of book-plates, was a botanist and collector of dried plants. His "Flora of Cheshire," published recently, proves beyond a doubt his skill as a botanist and his intimate acquaintance with the flora of the district. It is not generally known, however, that he had an entire collection of the whole British flora, comprising some 20,000 sheets of specimens. This herbarium, which completely filled three of the rooms in his London house, 62, Elm Park-road, has been generously given by his sister, Lady Leighton, of Tabley House, Knutsford, to the Science and Art Museum, Dublin, and the Keeper of the Herbarium, Prof. Johnson, D.Sc., considers that it will form a very valuable acquisition to the Museum. Lady Leighton has also met the cost of remounting and labelling, and each specimen bears the name of the genus, species, and locality, besides the name of the collection.

In a presidential address delivered at the Birmingham and Midland Institute last week, Sir J. Evans, F.R.S., said that forty years ago the almost universal belief of those who had but superficially approached the question was that a literal interpretation was to be placed on the opening chapters of the Book of Genesis, and that the chronology of Archbishop Usher and others in fixing the creation of man at the year 4004 B.C. was beyond all reasonable question. It was not until 1859, when the subject was investigated by the late Sir Joseph Prestwich himself, and others, that the presence of objects of human workmanship in association with the remains of extinct mammals in beds of gravel, sand, and loam was almost universally regarded as an established fact. The long-continued studies of Mr. Joseph Landon, of Saltley College, Birmingham, had resulted in his discovery in the gravels of the valley of the Rea of an implement of the same general type as those from many other valley gravels in England and France, but formed from a brown quartzite pebble, and not, as usual, chipped out of flint. If further discoveries of this kind were made, our present views as to the northern limits of the existence of such implements would have to be materially modified, and the area over which discoveries of this character were made might be considerably extended. Assuming that the occupation of the earth by man had been continuous, there must at some time or other have been a transition from the palæolithic stage of culture to the neolithic, but of such transition little trustworthy indications had as yet been found, and over a great part of Europe, at all events, there appeared to be "a great gulf fixed," which at present it was impossible to bridge over in a satisfactory manner.

A memoir has been presented to the Paris Academy of Sciences by M. Henri Moissan on the production of ozone by the decomposition of water with fluorine. A current of fluorine was passed rapidly into water which was at the freezing point, and the oxygen set free was analysed and found to yield a percentage of ozone, on some occasions reaching 14 per cent. The ozone was said to be practically pure, and may possibly be useful in some manufacturing processes, as it can be produced (most probably) at a low price.

The report of the Committee of Council on Education for England and Wales has been "presented to Parliament," and is not without historical interest. In April next the new Board of Education will come into existence, and will absorb the functions of the Education Department and of the Department of Science and Art.

The whaler *Esquimaux*, which was purchased last year by Mr. Andrew Barclay Walker, of Liverpool, has returned to Dundee from a successful trip to the Arctic regions. Mr. Walker and his party joined the vessel at St. John's, and she sailed thence for Davis Strait in April. The party have brought home a quantity of gold quartz, the value of which remains to be determined, but it is believed to be "rich."

According to M. A. Debierne, in a communication to the Paris Academy of Sciences, a new radio-active substance has been discovered in pitch-blende, differing from polonium and radium, and not spontaneously luminous. The rays emitted are stated to be about 100,000 times stronger than those given off by uranium.

A conversazione of the Geologists' Association is to be held in the library of University College, Gower-street, W.C., this evening.

The discussion about the poisonous properties of yew-leaves and shoots, so far as horses and cattle are concerned, continues; but so far the conclusions are not definite. It is stated in most of the textbooks of botany and vegetable physiology that yew-leaves contain a toxic principle injurious to some animals, and Gilbert White stated positively that they were certain death to cattle. Taxine, which is probably the toxic alkaloid, was obtained by Marmé in 1876.

Payta, in Peru, is said to be the driest spot on the face of the earth, as the "average interval between two showers is seven years." "The flora of Payta consists of about nine species; of these seven are annuals, the seeds of which must remain dormant in the ground for eight years. Notwithstanding the scarcity of rain, the natives subsist by the growth of the long rooted Peruvian cotton, which is able to maintain itself without rain for seven years in the dried-up river bed, and yields profitable crops of the coloured short staple cotton, which is used as an adulterant for wool." Travellers' tales must be taken with "caution." Possibly some of our correspondents can give information about this district, which is in about 5° south of the Equator, it is explained—which seems somewhat superfluous.

The exploration of Mount Kenia, in British East Africa, seems to have been thoroughly accomplished by the expedition which left England for the purpose last June, and the leader (Mr. Halford Mackinder, reader in geography at Oxford) is now on his way home, and may be expected to reach London shortly. The work was one of danger as well as difficulty, for the natives were decidedly hostile.

At the opening meeting of the Institution of Electrical Engineers on the evening of Thursday, Nov. 16, the premiums awarded for papers read or published during the session 1898-99 will be presented, and the President, Prof. Silvanus P. Thompson, will deliver his inaugural address.

MM. Jean and Louis Lecarme, in a memoir presented to the Paris Academy of Sciences on some experiments in wireless telegraphy carried on between Mont Blanc and Chamounix, state that the signals were not interfered with by the ice nor by the absence of water in the soil. Atmospheric electricity was without effect, but whilst the electric light was in action at Chamounix it was impossible to signal.

Lieut.-Col. G. F. R. Henderson, in the November *Blackwood*, makes some interesting comparisons between the battles of to-day and those of years ago. The former, he says, differ as much from the latter as did those of Alma and Inkerman from Flodden Field. The quick-firing field-gun, sweeping the ground with a hail of 1,500 shrapnel bullets at the rate of five aimed rounds a minute, is as far superior to the smooth-bore cannon as the smooth-bore cannon to the catapult. A few machine-guns would have destroyed the massed batteries of Napoleon before even the limbers were unhooked. High-explosive shells have turned walled cities into veritable death-traps. The new powder has entirely altered the aspect of the battlefield. The assailant is shrouded by no friendly veil of smoke, and all open ground is covered by the fire of unseen defenders to a distance outside the limits of accurate vision. Nor have auxiliary appliances failed to make corresponding improvement. Balloons, become a component part of every army, have but little in common with the clumsy machines used a century since at Fleurus. Signalling, by flag and heliograph, supplies a means of communication which renders tactical combinations far simpler than in the days of Wellington. The telegraph, annihilating distance, has so altered the relations between time and space, that principles of strategy which have held good since the campaigns of Alexander are no longer applicable; while railways, pontoons, steamers, and compressed food-stuffs have greatly lightened the difficulties of supply.

It would appear, says the *Athenæum*, that the authorities at the Patent Office Library do not keep their copies of the *Proceedings* of the Royal Society up to date. The last number available was issued as far back as January 23rd, 1899, thus leaving a blank of thirteen numbers, almost a whole year's scientific record. The Science Library located at South Kensington Museum is scarcely more helpful as a centre of reference. Here bound volumes are purchased, and as these only appear at intervals, it follows that the library is always a good deal behind the numbers published in separate form.

Some curious patents are granted in the United States; but one recently issued to Gustaf M. Westman, of Broadway, New York City, will attract some attention, for it is stated to be the "application of a new physical principle to engineering." The "title" is a "Method of and Apparatus for Generating Power," and is briefly described as follows:—"The operation of the motor involves the free expansion of the motive fluid. Free expansion is the condition of the fluid in which it can expand to the surrounding pressure without doing any work or putting other bodies in motion. In such condition the velocity of the fluid is increased; but when putting other bodies in motion, the fluid necessarily loses velocity proportionate to that acquired by the body set in motion; consequently the fluid loses power or ability to expand, and its temperature cannot sink as low as it would have done if no body had been put in motion. This may be regarded as the application of a physical principle to engineering."

IT is stated that the deepest oil-well in America is situated in the Monongahela River Valley, about 25 miles from Pittsburgh. The hole has been drilled to a depth of 5,532ft., but work has been suspended owing to a break in the 2¼in. rope used. As a result 1,000ft. of rope and a string of tools are at the bottom. Experts are at work, and hope to be able to resume drilling soon. It is proposed to sink the well 6,000.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE MOON AND THE WEATHER—A POPULAR OBSERVATORY—SEA-SICKNESS—STEREOSCOPIC VISION—RAINBOWS: OR HALOES—REFRACTION — MOUNTAINS QUAKING—BLAIR'S FLUID OBJECT-GLASS—SUN VIEWS BY DIAGONAL PROJECTION — DRAWING AN ECCENTRIC ELLIPSE — TIDES — TWELVE-HOUR DIURNAL ARC—NUMBER OF COMETS IN THE SOLAR SYSTEM — STARS ABOUT ε LYRÆ AND VEGA—PARALLAX OF 61 CYGNI—THE "VESTIGES OF CREATION" — EVENING AND MORNING IN A NEBULA — MEAN TIME DIAL—LIGHTING THE FIELD OF A TRANSIT INSTRUMENT.

[42973]—THERE are few, if any, greater authorities on meteorology than Prof. Hazen, and hence his paper on "The Moon and the Weather," which you reproduce on p. 227, is deserving of the most serious attention, exploding, as it does, one of the most widely-extended superstitions in connection with atmospheric changes. Over and over again in these columns have I insisted that the moon has *nothing* to do with the weather, and now I have one of the first meteorologists in the world not merely repeating my allegation, but giving irrefragable scientific facts and statistics in support of it. Not, by the way, that this will influence your genuine lunatic. A most valued friend, who was almost a second mother to me, would listen patiently to my exposure of the nonsense about the (so-called) "changes" of the moon and the weather, and would answer: "Yes, my dear, all you say is absolutely true—but I shall go on believing it all the same." An intellectual attitude I am afraid assumed by a good many others besides dear old Lady S.

All honour to the Lincolnshire men, who (as you state in your "Scientific News" on p. 229) have consented to the erection of a public observatory in Lincoln Castle; but, merely as a matter of course, that observatory will have to be endowed, and the amount of capital to be sunk to provide adequate remuneration in perpetuity for a competent astronomer must of necessity be very considerable. I seriously doubt if such a sum can be raised—for such a purpose—by public subscription, and I don't know what the rank and file of the ratepayers will say if any future demand is made upon the rates. Perhaps, though, this has been provided for in some fashion not at present apparent.

Your announcement of the death of Admiral Colomb, on the same page, reminded me that on the final trial of the Bolton and Colomb system of flashing signals prior to their adoption by the Admiralty and the War Office, he and I were together on board H.M.S. *Pigmy* which went out from Portsmouth nearly to Cherbourg, exchanging signals with a station on the top of St. Catherine's Down in the Isle of Wight; and that on going up on deck after mess, Admiral (then Captain) Colomb was, to use a vulgar phrase, "as sick as a dog." Considerably astonished, I said to him, "Why, bless my soul! this is your bread and cheese; are you sick when barely out of sight of land?" To which the answer was, "If I am at sea for six months, I am ill every day." Nothing, I venture to think, could show more forcibly than this how purely constitutional, and, if I may so say, idiosyncratic, sea-sickness is, and how fallacious any universal remedy for it must be. By the bye, an uncle of my own in the Navy was always ill every time his ship was fresh commissioned; but, then, that was only for the first day at sea.

My experience in connection with any single picture is identical with that of "Carlos" (letter 42947, p. 234). I think that anyone will find the stereoscopic effect of an oil-painting (say at such an exhibition as that of the Royal Academy) materially enhanced by viewing it with one eye only.

In reply to Mr. Harman (query 96879, p. 237), I did not observe the rainbows to which he refers on October 11. having been occupied as a member of a County Licensing Committee in confirming (or refusing to confirm) licenses, at the hour he specifies. Moreover, I doubt if the particular phenomena he describes were visible at any distance from Tunbridge Wells. Such bows as he describes have their origin in reflection from, and refraction through, the spicules of ice in the cirro-stratus clouds between 20,000 and 30,000ft. above the surface of the earth. I assume that he understands how an ordinary rainbow is formed, and how purely local it is.

If I were to work out the pretty little calculation set me by "Miner" (in query 96880) on p. 237 in detail with rigid accuracy, I should have a very nice morning's work indeed before me. I trust, however, that the following formula will furnish him with what he requires:—

Call the star's zenith distance z, and 57″ × tan. star's zenith distance r; h, the height of the thermometer (Fahrenheit); b, the height of the barometer in inches. Then the refraction, which we will call—

$$R = 57'' \times \frac{b}{29\cdot6} \times \frac{400}{350 + h} \times \tan.\ (z - 3r) \text{ nearly}$$

In the example given for solution this becomes—

$$R = 57'' \times \frac{24\cdot3}{29\cdot6} \times \frac{400}{385} \times \tan.$$
$$[75^\circ\,20' - (3 \times 3'\,37\cdot79'')]\text{—i.e., } \tan 75^\circ\,9'\,6\,64''.$$

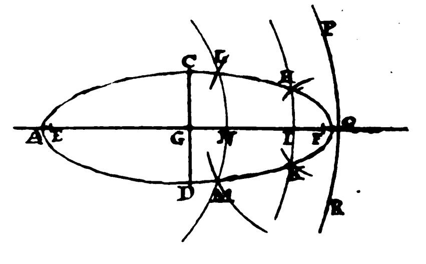
If "Miner" will calculate this out, he will find that with the data he gives the refraction will be 3′ 3·38″ very approximately indeed. As he says nothing about dip, I assume that he obtains the altitude of his star (or other celestial body) by measuring the angular distance between it and its image, as seen reflected in an artificial horizon, and halving the quantity thus obtained, to determine its apparent altitude above his true celestial horizon.

Yes, "E. L. G." (query 96888, p. 237), we do read in Exodus xix. 18 (there is no 27th verse at all) that "the whole mount quaked greatly"; but any one who will read the Bible as he would another book, and will note what is previously said in vv. 12, 13, 16, and 17, will see that this "quaking" was confined to the mountain itself, a novel phenomenon in earthquakes! and that the whole occurrence is related as miraculous. Moreover, when (not "shortly," but) twenty years afterwards, "the earth swallowed up Korah and his company," it is again idle to speak of such an occurrence as an earthquake in any legitimate sense of the word at all. It must have been a curiously *eclectic* specimen of seismic disturbance.

"Curious" (query 96889, p. 237) has evidently come across a specimen which has been preserved of the long disused "fluid object-glass" invented by Dr. Blair during the last decade of the 18th century. He inclosed solutions of chloride of antimony and corrosive sublimate (diluting them with pure hydrochloric acid) between a plano-convex crown glass, and a meniscus of the same material so placed that their convexities faced each other and the solution formed a double concave lens. As for the value of such a thing nowadays, it has none, save that incident on its archæological interest and as a curiosity. I mean, of course, pecuniary value.

I do not possess Proctor's "Half Hours," and am hence unable to check or verify the quotation from that work professedly given by "E. G. R." (query 96891, p. 238); but surely there must be some extraordinary mistake about employing a reticle of lines ruled only $\frac{1}{200}$in. apart on glass. Such an arrangement might exhibit coarse diffraction phenomena; but would be utterly useless as a micrometer. I should think that Slade's micrometer, which is not a costly affair, might suit your correspondent. Any reticle arrangement placed between the lenses of a Huyghenian eyepiece in the focus of the eye-lens is accurate enough in the middle of the field, but not equally so at its edges. The Ramsden form gives a flatter field, Of course, in the latter case the ruled glass is outside of the field-lens. The question with which "E. G. R." concludes can only be answered categorically when the position of the diagonal reflector is known. Suppose, however, for the purpose of illustration, that it is used with an ordinary Huyghenian eyepiece, and that it is so placed as to cast the sun's image vertically downwards on to a sheet of paper, then (in north latitude) will the sun's north limb be at the top of the field, the south limb at the bottom, his east limb at the right-hand side, and his west one at the left. Hence it will be seen that the ultimate reversal will be in the direction of his diurnal motion only, and he will seemingly travel from right to left, or west to east, instead of from left to right, as he does when viewed with the naked eye.

As "B. B. M." (query 96896, p. 238) does not apparently possess an ellipsograph or "trammel," and seems to fail in describing a symmetrical ellipse with the old-fashioned pins and thread, I think that the method of description explained in Chambers's "Practical Mathematics" is as likely to insure what he wants as any one, and so copy it verbatim, with a very slight modification of its illustrative figure. The problem is "to describe an ellipse, having given its major and minor axes." Let A B be the major axis. Draw a line, C D, bisecting it perpendicularly, and make G C, G D each equal to half the minor axis; then C D is this axis. From C as a centre, with half the major axis A G as a radius, cut A B in E and F, and these points are the foci. Produce



A B to Q till E Q = A B; then from E as a centre describe an arc, P Q, and this arc is a species of directrix to the ellipse. With any radius E I, from E as a centre, describe an arc, H K, and, with the distance I Q as a radius from F as a centre, cut H K in H and K, and these are points in the curve. Describe from E as a centre any other arc, L M, and find as before the points L M. Proceed in the same manner until a sufficient number of points are found, and the curve passing through them—namely, A D C B—is an ellipse. I should unhesitatingly recommend "B. B. M." to obtain Moy's most ingenious patent ellipsograph, but for the fact that it can describe no ellipse whose major axis exceeds 1½in. in length.

It seems to me that "Fleur-de-Lys" (query 96899, p. 238) is to a certain extent creating his own difficulty. The times of high water given in the tables "at Full and Change of the Moon" are reckoned from *apparent* noon, and give the actual times of high water when the moon and the sun are on the meridian together; or the intervals between the times of the moon's transit and those of high water on full and change days.

Query 96914 (p. 238) is a curious one. A star which rises due east must be *on* the Equator, or have no declination, and will obviously remain 12 sidereal hours (= 11h. 5m. 2·04s. of mean time) above the horizon. I have excluded all notice of refraction, which is so curiously irregular on or near the horizon as to make a notable difference in the times of rising and setting of the stars and planets under varying conditions of pressure and temperature.

"D. B." (query 96915, p. 238) may rest assured that no one worthy for one instant of the name of an *astronomer* ever pledged himself to the monstrous assertion that there are at least 17,000,000 comets of all sizes in the Solar System. This is the veriest penny-a-lining, and destitute of the slightest atom of proof.

Has Mr. Ashby (query 96917, p. 238) no friend who could obtain a sight for him of any of the plates of the regions to which he refers, taken for the International Astrographic Chart and Catalogue? A comparison of these with Mr. Bassnett's chart and with the map (if such exists) of α Lyræ and its neighbourhood would show at once how far the alleged statements as to the number of stars in the vicinity of the respective objects are trustworthy or not. I have said above that I do not possess Proctor's "Half Hours," so in that matter must walk by faith.

I cannot answer the query put by Mr. Monck (in letter 42951) on p. 251 without a very great amount of research; research, moreover, for which I do not possess the materials in my own library. My data were derived from No. 3590 of the *Astronomische Nachrichten*, whence I roughly computed the position of the star, to whose use as one of reference for the determination of the parallax of 61 Cygni your correspondent so legitimately demurs. But it is pretty evident that Dr. Schur himself is not satisfied with his own results, as he proposes to reinvestigate the parallax of this particular object, the star *a* of my paragraph, *ab initio*.

Surely your "Subscriber," who wrote letter 42952, on p. 251, does not imagine that Hugh Miller wrote "Vestiges of the Natural History of Creation"? Why, I thought that by this time every human being who has ever read the book was aware that its author was the late Dr. Robert Chambers.

I had to complain (in letter 42896) on p. 184 of the disingenuous character of Mr. Garbett's polemics, and here I find him furnishing a fresh illustration of the truth of my charge in letter 42967, p. 254. "The 'F.R.A.S.'" he there says "is quite mistaken about the Nebula in Andromeda, which he tells us in p. 184, appeared in 1884." Now passing over, as a possible *lapsus calami*, the allegation that I ever made this idiotic statement with reference to the *nebula* itself, who was it who supplied me with the date of the apparition of the temporary sun which blazed forth in its midst in the '80's? Let us turn back to letter 42878, p. 159, where we shall find the infallible and

ominiscient Mr. Garbett himself saying "the new world that appeared in the Andromeda nebula in 1884"—and so on. In commenting on this (letter 42896, p. 184), I never for an instant dreamed of attempting to verify the *date* of the apparition as given by Mr. Garbett himself, because it was utterly irrelevant to the question at issue. I myself repeatedly observed the star as well as Mr. Maw did, and, although it was not situated absolutely centrally in the nucleus of the nebula, it was, to my eye, evidently immersed in it, and, this being so, it is idle to talk of even a dark body experiencing the phenomena of day and night, or evening and morning, when *surrounded by light*. However, as it was vividly self-luminous, and itself a sun, this really matters, for the purpose of legitimate argument, nothing whatever.

In reply to query 96941, p. 258, I quite fail to see how the dial suggested by "A. S. L." could be geometrically constructed—or, for the matter of that, mechanically either—owing to the inequality of the motion of the sun in the plane of the Equator. In using the shadow of a gnomon to determine time we must use the actual sun and apparent day, and your correspondent must know, e.g., that its length on, say, March 16, 1904, will certainly not be identical with that of March 16, 1899.

I think that if "R. A." (query 96947, p. 259) will get a plano-convex lens of 1in. or less in focal length, and insert it in the pivot of his transit instrument, with the convex face outwards, he will find the field fairly well lighted with the ordinary little bull's-eye lantern supplied with such instruments. Again, though, I must say that this is on the assumption that the diagonal reflector in the telescope between the pivots is in order, and has not become dull or scraped.

A Fellow of the Royal Astronomical Society.

COLOURS OF STARS.

[42974.]—A trained eye can no doubt see distinctions in colours which are not visible to ordinary persons; but the great difference of opinion between apparently competent observers as to the colours of particular stars leads me to think that imagination is not wholly inactive in the case. As to the five stars mentioned by Mr. Ellison in his letter 42948, on p. 251, last week, four of them seem to me to be white stars without the bluish tint which he mentions, save that a white star seems to me always to assume this tint when viewed with a high magnifying power. The fifth star, Rigel, however, seems to me always to exhibit this flash of blue, which is noticed by Mr. Webb. Mr. Ellison will find distinctions between the spectra of these five stars noticed by Miss Maury. Rigel belongs rather to the Orion type (the B of the "Draper Catalogue") than to the ordinary Sirian (A).

Of the four brightest stars (after Sirius) visible in this country, Arcturus, Vega, Capella, and Rigel, it is worth noticing that the "Harvard Photometry" places Arcturus first and Rigel last, while the "Oxford Photometry" exactly reverses this. Have the colours of stars any effect on these methods?

W. H. S. Monck.

OMICRON CYGNI—A PRETTY PAIR—NEW COMITES TO Σ 2707, AND 15 CEPHEI — THE RING NEBULA IN LYRA—THANKS.

[42975.]—Omicron Cygni is a fine wide object for a small telescope. o^2 is of mag. 3·7, and pale orange. The most distant of the two stars is o^1, and is of the 5th magnitude, and the nearer is 6·5 mag. Both these stars appear blue by contrast. Burnham has added several distant *comites*, which are lettered *b*, *c*, *d*, *e* in the diagram inclosed. On Sept. 20, 22, and 23, in bright moonlight, I re-examined this object, and noted one or two things which may be of interest.

The most distant star of the group, o^1 (which is too far away to be shown in the diagram) has a faint *comes* for which I got roughly the following:—

A B. P. = 251·8° D. 36·1″ Mags. 5, 13.

Burnham's *comes* *d* is itself double, which I estimated as—

$d\,d^1$. P. = 268°± D. 5″± Mags. 12·7, 14·0.

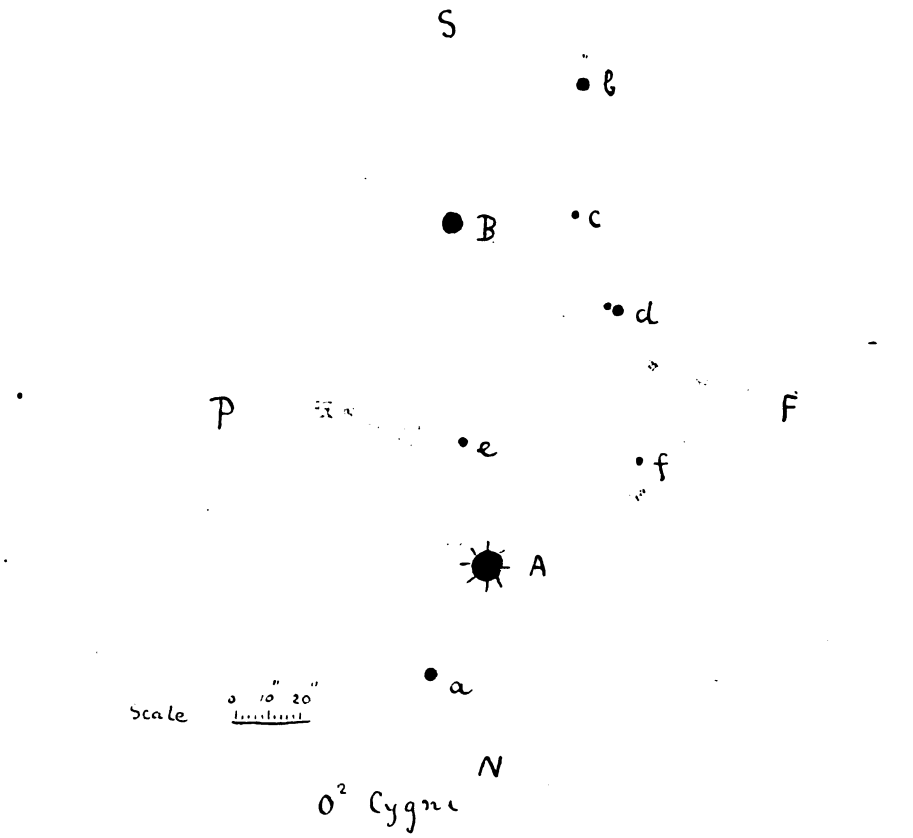
The following are the means of my estimates of the magnitudes of the small stars:—

a (Sm.'s companion)	11·8
b (β's companion)	12 0
c " "	13·8
d " "	12·7
e " "	13·6
f " "	14 3

There are several more distinct *comites*. Following A (0^2) by 39sec., and 3·8′ N. of it, is a pretty pair hitherto unrecorded, which I roughly measured as follows:—

P. 252·3° D. 3·6″ Mags. 10·0 10 3.

This star is B.D. + 46·2886°. The star Σ 2707, "Celestial Objects," p. 99, lies 0h. 24·1m. following, and 1° 9′ N. of 0^2 Cygni, and is a wide triple. Σ's mags.



7·1, 7·9, 8·6. I looked it up on Sept. 20, and found a minute star nearer than the Σ companion. I re-observed it on Oct. 19, when it was seen with difficulty, on account of the bright moonlight. I got the following results from the settings:—

A B (new).	P. 188·7°	D. 18″	7·1, 14
A C (Σ 2707).	31·0	22·5	— 8·0
A D. "	196·7	55·6	— 8·5

The star 15 Cephei ("Celestial Objects," p. 78) has a faint companion which was found by O Σ, and is O Σ 461, and rated by him as 10·6. While examining it on Sept. 22, I found a second and more distant companion. This was seen again on Oct. 19, but was so difficult in the moonlight that the attempt to measure it was a failure. I give the results, however—

A B.	P. 200·6°	D. 11·0″	6·0, 11
A C (new).	336·9	17·6	13·5

Some time ago a question was asked as to the magnitude of the little star *f*. the Ring Nebula in Lyra. I looked it up on Oct. 19, and saw it the same as I have always seen it. I should estimate the magnitude as 13·5. I have to thank various correspondents for their information concerning ε Lyræ. I have had several interesting letters privately as well. Had the object been examined on a dark night instead of in bright moonlight, perhaps the other stars mentioned by your correspondents would have been seen. **T. E. Espin.**

Tow Law, R.S.O., Co. Durham, Oct. 24.

METEOR.

[42976.]—A beautiful meteor was observed here on Oct. 25 at 10h. 8m. G.M.T., particulars of which follow:—

Path: 127° + 77° to 180° + 86°, length ± 11°.
Duration: 1·2sec.
Magnitude: Brighter than Venus.
Colour: Bluish-white.
Appearance: Brightness increased during flight; had a dense streak visible for fully three minutes, fading gradually to an irregular oval shape.
Probable radiant: Camelopardalis (47), No. XCII. in General Catalogue (Denning, 1899). Certainly not very far from its radiant.

Farnborough, Hants. **J. H. Bridger.**

PERPETUAL MOTION — TELECTROSCOPE—CALCULATING MACHINE.

[42977.]—I think "perpetual absurdity" would more correctly describe F. W. Baker's attempt, as well as the thousand and one previous attempts, to attain the impossible. As, however, he asks to be shown its defects, I will try to oblige him. So far as I can understand the machine, the ultimate object of all the links and levers is to induce the weight c^1 in descending from its position in Fig. 1 to its position in Fig. 2 to lift up the pendulum weight c^2 to the position in Fig. 2, whence in falling it drives back c^1 to its original starting point. On applying a scale I find that the descent of c^1 (measured vertically) is about the same as the ascent of c^2, and as these two weights are said to "counterbalance" each other, there can be no surplus force to overcome the inertia and friction of the moving parts. If the experiments referred to lead to any such conclusion as that mentioned, it may be taken for granted that some mistake has been made in carrying them out.

As to the telectroscope, I have a vague idea that I once answered a query about it; but I will give H. Mather a few particulars of the arrangement, as described in Szczepanik's specification, though I doubt whether the scheme has ever got beyond the stage of taking out a patent for it.

A ray of light from a small lamp in passing through a glass prism is decomposed into the primary colours, one only at a time being allowed to pass through an opening in an opaque screen. If, however, the prism be rotated on its axis, any colour at will can be sent through the hole in the screen. As H. Mather apparently knows, the conductivity of selenium is varied by letting light fall upon it, and thus the strength of an electric current actuating the mechanism that moves the prism is varied. It is here, however, that the fallacy appears to me to come in. Though the selenium is sensitive to variations in the *intensity*, there is no reason to conclude that it is sensitive to variations in the *colour* of the light, and, therefore, the assumed power to correspondingly alter the angle of the prism has no foundation in fact. There are other difficulties, such as the enormous rapidity of motion needed to build up a series of coloured dots into a continuous image, that help to render the idea impossible of attainment on the lines indicated.

I wish to strongly support the request for further particulars of Babbage's calculating machine. Though I have myself (in a manner) worked it, I could never follow out its action, more especially the way in which the connection was made from one line (or "cell") to those above and below it. Of course, it is possible to obtain a series of square numbers by adding a series of differences. Thus, taking the squares 1, 4, 9, 16, &c., their differences are 3, 5, 7, &c., of which latter series the difference is the constant number 2, and it is not difficult to imagine a mechanical method of dealing with such a case. It is also quite possible to design two curves which shall, in working together, produce the same result; but when it comes to higher powers than the square, or to intermediate values as in tables of logarithms, the problem necessarily becomes very complex. A clear description of how it is managed in Babbage's machine would therefore be very interesting. I think there is a mistake about the printing mechanism not having been attached to the calculating part, as I remember seeing pages of figures printed off from such an attachment, which may, however, have been merely a temporary arrangement. If I recollect right, some

of the printing showed white figures on a black ground.

As the result of a lawsuit, it was decided that the machinery and tools belonged neither to the Government that paid for them, nor to Mr. Babbage who designed them, but to Clements, the workman who made and used them. It would be curious to know what ultimately became of them. Is it not rather a fallacy to assume that a machine must necessarily make calculations more accurately than an ordinary computer? In working the machine, one movement of the handle too little or too much (a quite possible error) would entirely vitiate the result, without it being possible to discover that any such mistake had been made. Even a warning-bell may be wrongly fixed or fail to act. A. S. L.

MORE PERPETUAL MOTION.

[42978.]—In his letter 42965, Mr. F. W. Baker describes a perpetual motion machine, and asks the opinion of other readers with regard thereto. Having considered the letter with his accompanying sketch, it is, in my opinion, impossible to balance the weights C^1 with C^4 *in every position*, because whereas the former moves in a straight line, the latter moves in a circle, and this is fatal to his principle. Any arrangement I could think of to obviate this would result in the same objection turning up in some other form. Please go on, nevertheless, ventilating this fascinating subject. It is a grand and enjoyable hobby, and this striving will, I verily believe, sooner or later, be crowned with success.

The critics who talk about ignorance on the part of those endeavouring to produce a machine of this kind should reflect that a man working in this direction, and with such bent of mind, has, in all probability long passed the "elementary stage of applied mechanics," which is, after all said and done, merely the knowledge that by doubling the length of the lever you double the power half the distance, and vice versâ. J. H. Schucht.

THE WIMSHURST FOR X RAY "FACILE PRINCEPS."

[42979.]—Referring to p. 251 of your issue dated Oct. 27, as a subscriber of your paper since its commencement, I ask your permission to assure Mr. Bottone that he is not quite correct in stating that the Wimshurst is *facile princeps* as compared with the coil for X-ray purposes. He is probably aware that one important objection to the influence machine for X-ray work is the length of the exposure required owing to the very small ampèrage of the current. The thicker parts of the human trunk when an influence machine is used require an exposure of three-quarters of an hour, whilst a good coil takes only ten seconds. Mr. Bottone may have sent out from his works several hundreds of special X-ray influence machines; but I venture to object to his statement in regard to these being *facile princeps*.

The large number of E.P.S. Small Storage Batteries supplied by my company for X-ray work with coil during the past two and a half years is, I submit, a proof that influence machines are a considerable way from being *facile princeps* as compared with the coil and storage battery.

J. W. Barnard,
Sole Agent for Electrical Power Storage Co., Ltd.'s, Small Storage Batteries.

[42980.]—In addition to Mr. Bottone's letter respecting his use of the Wimshurst for X rays ever since 1897, it is worth drawing attention to the fact that in America many of the chief workers with X rays have been using influence machines since 1896, and they claim to produce rays of quite as much power, at least, as with a coil. This is possible, because they have designed tubes specially suited to the static current, which do not overheat, and which last without danger of perforating, and with the correct convexity. The heart can be seen beating plainly with the screen from 10ft. to 20ft. away. M.

[42981.]—A letter (42955) appears in this week's issue bearing on this subject. It may be well for your readers to know that the Major called unexpectedly upon Mr. Wimshurst, and was at once shown all the apparatus in working order. After certain tests he inquired as to the best form of the machine for field work. Mr. W. told him that at the request of Messrs. Newton, of Temple Bar, he had made a drawing of the best arrangement, having all vulcanite in substitution for glass, and that Messrs. Newton would show him the drawing, &c. About six weeks after this I learned that he had gone elsewhere and obtained a machine with glass plates, the plates being covered with paraffin. Well, we know how unsuited glass is for a portable machine, and that when loaded with paraffin they must be more liable to injury. Then, looking a long way back for experience with plates coated with paraffin, we have the work of Mr. Spottiswoode, who found the keeping in order and the cleansing a serious labour.

Next we may take the work of Mr. Wimshurst. He first tried the coating of the glasses and the sectors with shellac, and following this he cemented two glasses together, the sectors being between the glasses; but with neither of these did the results justify the added cost and complication.

With these works before us, we may easily conjecture the individually known lessons which the Major will acquire. The influence machine is unquestionably and by far simpler and better for X-ray work than is any coil yet made, and it is a great pity that the present opportunity for trial in the field has been so unfortunately and so certainly wasted. J. W.

REDUCING LIGHT IN TELESCOPES.

[42982.]—I tried perforated zinc, as Mr. Ellison did, on a 6in. o.g., and got exactly the same results. When I advised the use of a 16° angle prism, I meant that it would be the best also for reducing light of stars and planets when the aperture is large enough to need it; it would be available for all objects. G. Calver.

THE DIALYTE—TELESCOPICAL MECHANICS.

[42983.]—I am glad to find our Transatlantic friend Mr. Clark has been so successful in the cleaning and adjusting of his old Gregorian, of the ultimate performance of which I hope those of your readers interested like myself in that form of telescope may soon receive an account. Of course, there are Gregorians and Gregorians, but Mr. Clark's may well happen to be of similar excellence to the one of which Mr. Stielow has just given us so admirable a record.

Concerning the "corrector" lenses of his dialyte, the proper placing of which, Mr. Clark tells us, turns out to be different from that indicated by me (42842), he is good enough to mention—and that courteously—that I there admitted the question of correct position in his case, and in the absence of certain data, to be a somewhat uncertain one. May I here add that the position I gave (the convex crown-glass lens in front with its least curved side outwards) is that shown in the inventor's (Roger's) original paper, as well as in Herschel's account of it, in his work "The Telescope"?

But, clearly, much depends upon the curves of the simple object-glass, and the way these are placed; besides, it must also be noted that just as the flint-glass concave in some forms of the double achromatic object-glass is placed in front of, instead of behind, the convex lens (the latter being the usual position), so may the lenses of Mr. Clark's *particular corrector* require to be placed in a position differing much from the customary one. For example, at present I am finishing the lenses of a 10in. aperture achromatic, in which, contrary to the usual practice, I have placed the concave lens in front, the reasons for which procedure I shall explain when I come to give an account of that lens on its completion. It would give me much pleasure to respond to Mr. Clark's request for helpful advice in the matter of his projected dialyte, had I not already referred him to a superior source of information,—Mr. Ingall. That gentleman's address I now give in full, as it stands in the latest list of Fellows of the Royal Astronomical Society:—Herbert Ingall, 1, Champion-grove, Champion Hill, London, S.E. I shall be much surprised if your correspondent does not from the above source meet with a courteous and intelligent response.

It pleases me much indeed to find your polite and energetic correspondent bringing to the practical construction of an amateur-made telescope the skill of an experienced mechanic; for, in remembrance of the exhibition of the "fearfully and wonderfully made" pieces of celestial artillery that has now and again been made in "Ours," one is almost constrained to think that while a certain modicum of knowledge of theoretical mechanics, and of the use of tools, not to speak of the proper choice of material, seems to be a necessity with amateur makers of model engines, fancy turning machinery, or even of children's toys, the average amateur maker of telescopes would appear to have made heroic attempts to get along without such cumbrous qualifications. Indeed, there seems even reason to believe that in order to preserve the proper family likeness, certain caterers for amateur observers adhere to the same rickety styles of mounting so much affected by the designers and makers of home-made telescopes—styles and qualities of workmanship which, while good enough, perhaps, to sustain the trunk of a Newtonian reflector for casual star-gazing, need scarcely be said to be totally unfitted for proper observing telescopes, where either accuracy of vision or of place is a requisite condition. H.

MOTOR CYCLES, ETC.

[42984.]—Replying to Mr. E. H. Micklewood (42940), I cannot say, without experimenting, whether the vibrating contact-breaker on the induction coil can be dispensed with. Without it there would only be one spark; with it there are several at each contact of the cam on the springs. However, it would be worth trying, and if found satisfactory, the trembler could easily be screwed up and rendered inoperative.

I beg to thank him for his suggestion *re* motor car. I had already intended to commence with a general arrangement, as I agree in what Mr. Micklewood says. The motor will not be the same as for the tricycle. I propose using a single-cylinder engine with water-jacket. The castings and forgings will be obtainable from the Inflexible Works Co., Wolverhampton.

I will endeavour to follow Messrs. Miller's and "R. M. G.'s" suggestion (letters 42958 and 42959) *re* getting the castings made simultaneously with or shortly after the publication of the drawings in "Ours."

My thanks are due to the readers of "Ours" for the hearty reception my articles on Motor Cycles were accorded. I will endeavour to deserve their approval in the forthcoming series.

The Writer of the Articles.

THE LIGHTNING-FLASH AND WITCH'S KITCHEN.

[42985.]—It is a remarkable coincidence that the magic believed in during the 15th century has become the actual science of the 19th century. The exemplification of this is to be found in the development of many sciences. For instance, Paracelsus, in the infancy of chemistry, was searching for the elixir of immortal youth when he discovered alcohol and died drunk on the floor of his laboratory. It was the magic believed in during that age, the same as the "Philosopher's Stone," which was to turn everything it touched into gold, that gave birth to our glorious knowledge of chemistry. One of the most startling illustrations of the above is to be found in the scene of the "Witch's Kitchen" in "Faust," where that celebrity is looking into a magic mirror and sees "Margaret at her spinning wheel" in a distant town, and in the recent issue of *Pearson's Magazine*. In the latter is given a descriptive article of the electrical machinery by means of which it is alleged the magic of Faust of the 14th and 15th century can be instantaneously accomplished. Your readers are aware (and here is the difficulty which makes me incredulous) that the magazine also gave diagrams of the camera, revolving discs, slits, vibrating selenite plates, and electric light. In that article the author stated that the Polish inventor was under a fine of 2,000,000f. if he exhibited his discovery before the Paris Exhibition of 1900. Is it at all likely that he would have forfeited the money by giving the information in *Pearson's Weekly*? Or is it a case of an "exploited invention." By this I mean that it often happens that an inventor submits his invention, showing the "principle" to a firm, or, perhaps, a manager of the firm, and he never hears anything further thereof; but soon after another form of machine, embodying the same principle, is patented in America. It is this species of dishonesty which operates as a drag upon industries, and the direct cause of it is unquestionably our expensive and elaborate patent laws, which are no protection or encouragement at all to inventors who are not capitalists. Thus it happens that many of the most beautiful things never see the light of the day; and unless a man wants to be robbed, he does not submit his inventions to others, but patiently waits until he is able to put them on the market himself, or not at all. It was this feature of our national character to checkmate which the Patent Office was founded, but which it does not carry out, that drove Edison to America.

If the Polish schoolmaster really has accomplished the magic in "Faust," and has placed himself under a pledge of secrecy to the committee of the Paris Exhibition of 1900, how comes it that the article, with illustrations, appeared in *Pearson's*? Or is the whole thing a hoax, or has someone broke faith with the schoolmaster by letting the cat out of the bag? Consequently, I am incredulous of the whole thing, but I am not so of the fact you have stated that something similar, though not completed, has been already accomplished. Writing can be conveyed by electricity, wherefore, not pictures?

Having said this much, what I wish to call your special attention to is the lightning-flash, and its capability of conveying impressions. The invention of the Polish schoolmaster is acknowledged to be a practical application of this power of lightning flash, and I also wish to bring in review before your readers several important features respecting the *essential nature of lightning*. The object I am driving at is not to assert in any dogmatic or conceited manner any statement, but to start a most important inquiry in order to elicit, if possible, something *new*, and it may perchance prove *definite* knowledge.

It is astonishing how little we know, after all is said and done. Dalton wrote in 1801 that "This world is founded upon one that was; it is now

furnishing the means of a world that is to come. This process is from everlasting to everlasting, without limit of duration, and there can be discovered in the Solar System no vestige of a beginning or signs of an end." We have got not one jot further than this even yet. The ancients believed in fire being the cause of all things, and there existed once a wide-spread faith called, to the best of histrionic evidence, "Æther Fire." In the Pagan mythologies there was the "Black Fire," or the fire of hell, which burnt, but did not consume, and there was "The Sacred Fire of the Sun," whose altar was tended by the Vestal Virgins. It was an old-world notion, and it is a modern one, and, to use a form of words which are a modern "caddism"—an "up-to-date" notion that the ether pervades all space. Priestley was undoubtedly the first chemist who froze oxygen into liquid air, although he did not use the modern means of doing it; but that he did it will be at once apparent by looking into the chemical works of the scarcely less celebrated John Dalton, chemist, Manchester, published in 1801. It is an ascertained fact that all metal is full of what chemists term "fixed air," and it is also known that magnetism is not electricity. It does not become so until it passes through the atmosphere. The essential parts of a dynamo are the iron horseshoe and the vibrating cylinder consisting of layers of metal alternately insulated, generally with layers of mica. When this is set revolving it instantly lays hold of, and sets in motion, the fixed air in the metal, and when the circuit is completed, contact at any point of circuit cannot be broken without the liquid air instantly leaping from point to point, and the intensely cold liquid air coming into contact with the hot or warmer atmosphere, fires it, and this is the lightning-flash. After all is said, heat and cold are only relative conditions. The proof of this is that a stick of charcoal, which is very loth to absorb and retain heat, and which is of the same temperature as the surrounding atmosphere, instantly becomes red-hot if plunged into liquid air. How, then, is the lightning flash to be reasoned out and accounted for? Simply enough. Away in what is simply infinite space, above our heads to an illimitable infinitude of distance exists the ether—liquid air—it matters not how attenuated, though of this attenuation there is no proof. Beneath this imponderable—unelemental, as some would say—ether there are the waves of hot atmosphere, and the moment the circuit is completed, either between the liquid air in the earth or that of the realms of space, a stream of magnetism, or of liquid air, results, and there follows the lightning-flash until equilibrium is established, the thunder being simply the detonations or explosions of the dissolved atmospheric gases all along the line of the flash in the atmosphere. On this exposition it is easy to see the why and wherefore that thunderstorms so rapidly cool and clear the hot summer air. The lightning, although it comes round its immediate course in the shape of the hottest fire, is really diffusing every flash and explosion a certain necessary amount of liquid air, many hundreds of times colder than zero, or ice, and it is so instantaneous that a gentle, genial, pervading, cool, and refreshing breeze diffuses itself directly after the flash has done its work.

It now becomes apparent why sometimes, when people or animals are struck by lightning, they are not burnt. It is because the stream of more than icy-cold liquid air has destroyed their life while passing through them without contact being broken; but if from any movement at the time going on contact is broken, then shoes may be ripped off, portions of the body, or even the whole of the body, sometimes reduced to charcoal. There is a recorded instance of two persons sitting on a seat and on being struck by lightning, both were dead, but the body of one was not burnt, while that of the other was reduced to ashes. Now on examining nature a little further, it was an old-world notion that "electricity is life," and moderns have suspected it to be more than true. Galvani discovered its motive muscular power, and everyone now admits that our bodies never cease to be full of this mysterious element in its all-pervading magnetic form. The two conditions have been pointed out—viz., its cold form and its form of fire; the former must precede, it matters not how infinitesimal in point of time, which is only a relative condition, its explosive fire form or condition. It is not reasonable to suppose that magnetism can be the conscious thinking element of life, but it is more than probable that it is the force made use of by the life force as a motive power. Is there anything in nature which points to this conclusion? Yes, there are the two conditions of magnetism to be found in animal physiology—viz., the hot and cold blood. The heart of every living creature is a dynamo, generating and kept in motion by the magnetic vibrations of all-pervading æther; hence its continued unwearied action. It has long been known that the heart of a fish is a *two*-lobed heart, that of a reptile is a *three*-lobed heart. The heart of a bird is a three-lobed one; but the bird possesses organs which neither the fish nor reptile does possess. The heart of a mammal and of man is a *four*-lobed heart. The hearts of the fish and reptile generate magnetism in its first form—that of liquid air; hence the cold blood and cold skin of a frog, lizzard, or snake. The heart of a mammal or of man generates magnetism in such a way, that at every beat of the heart contact is broken sufficient to give the body warmth. This also bears out the fact of what are called "cold sweats" generally before people die, because the part which breaks contact ceases to do so until the obstruction is removed. First there is formed the dark, thick, purple blood of arteries; the next change is into the bright scarlet blood of veins [?], and I hold that the final change is made by the white corpuscles which the blood has extracted from the food, becoming the fluid which circulates in the nerves, which I hold are a continuation of the venal system; also, it is the absorbent system which builds up or pulls down the flesh or bones; the latter in health and the former in disease and old age. Can anyone gainsay this? The reason why fire pains is simply because it is acting on a body which it throws into a state of violent combustion. This seems so simple that any poor fool could understand it; but is it really so simple as it looks at first sight? If the substance of our bodies were not combustible—had no oxygen or hydrogen in them—light, no matter how brilliant, would neither hurt the eye, nor yet heat, no matter how fierce, burn the body. To the Almighty the sun is a dark simulacrum.

A Constant Subscriber.

ACETYLENE.

[42986.]—We send the inclosed letter in reply to the article you reprint from the *British Journal of Photography*, [p. 203] and as the statements contained in that article are really calculated to impede the development of the new industry, we trust that you will kindly give publicity to our remarks.

Thorn and Hoddle.

[COPY.]

The Editor *British Journal of Photography*,

"SIR,—Your article upon acetylene in last issue is, we are sure unintentionally, calculated to do harm to this new industry, and we crave your favour to supplement it by further information. The Fire Insurance Offices do not 'continue to throw in the way of would-be users difficulties of a harassing and obstructive character'; on the other hand, many of the offices have taken great pains to make themselves acquainted with the characteristics of and conditions surrounding carbide and acetylene, and, speaking generally, their regulations are only such as to protect themselves from careless or ignorant persons. One office has gone so far as to issue a notice that they do not charge an increased premium when acetylene is used.

"The remark that impurities are liable to produce explosive compounds when in contact with metal, or to initiate spontaneous combustion, is a relic of the early days, when the gas was not properly understood. Such ideas have long been swept away by practical experience.

"Mention is made of several foreigners who have experimented with methods of purification; but, as Englishmen, we cannot help remarking that in 1897 we patented a purifier, with a special mixture, which has been extensively used ever since, and has never failed to satisfactorily remove the unpleasant smoky fumes, which render the use of the gas in closed rooms unbearable without purification.

"The grave source of danger, said to result from the after-formation of gas in the generator when the carbide has been removed, is only present in machines of unscientific construction, or self-contained generators such as used for bicycles, &c."

SMOKE FROM LOCOMOTIVES.

[42987.]—IN these days of "fogs," some attention should be given to the locomotive engines on our railways. Why are they allowed to make the smoke they do? Is there any law upon the subject? For instance, the Railway Regulation Act of 1845 I believe refers to the matter.

On the 1st August last the London County Council decided to put the law in force, but nothing has been done. It would be interesting to know what is required in a locomotive so as to burn its own smoke.

Loco.

THE largest insect known is the elephant beetle of Venezuela. It sometimes attains a weight of half a pound.

GLASS plates cast with wire gauze inclosed in the substance, submitted to tests at the Chemnitz Technical Institute and the Vienna Technological Museum recently, were found to possess great consistency, as well as resistance to pressure, shock, and the effects of heat, the resistance being 3611b. per square inch, and the consistency 3,610lb. per square inch of the transverse sectional area. While plates of ordinary glass frequently broke under the sudden application of pressure, the strengthened glass was only cracked; and the cracks caused by rapid changes of temperature permitted neither damp nor flame to pass. Glass so made has already been used for water-gauges.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96487.]—**Torpedo-Boat Destroyer** (U.Q.)—Sections of American destroyers appeared on page 818, Vol. LXVI. *Engineering*. I do not think you can obtain the sections of boats by British builders.

GLATTON.

[96496.]—**Canary Complaints** (U.Q.)—I know nothing of the subject; but probably "General Management of Canaries," which describes diseases and their treatment, would be of use to you. It is published at 2s. 6d., by L. Upcott Gill, 170, Strand, W.C.

GLATTON.

[96555.]—**Equation.**—Mr. Burgess is quite right as to the possibility of x being a surd provided x and y contain *the same* surd; the three values of x y and z given by him may be put in the form $a\sqrt{6}$, $b\sqrt{6}$, $c\sqrt{6}$. This subject is interesting, as the method I have introduced enables us to dispense with a tiresome biquadratic, and even to solve an equation with three unknown quantities with only two equations, so that if Mr. Burgess (to say nothing about our Editor!) is not tired of the subject, I would like him to refer to the equation at foot of p. 163. Reducing two of the fractions under the radical to their lowest terms by dividing by 7, the radical term can be put in the form—

$$\frac{4x^2}{3 \times 36}\sqrt{3 \times 4 \times 13 - \frac{9 \times 5 \times 83}{2x^2} + \frac{9^3}{8x^4}}$$

To find what values of x^2 will make the terms under the radical sign a square number, put $x^2 = \frac{q^2}{p^2}$, the two last terms become—

$$\frac{-9 \times 5 \times 83 \times \frac{1}{q^2}}{\frac{2}{p^2}} + \frac{9^3 \times \frac{1}{q^4}}{\frac{8}{p^4}}$$

Then equating the denominators (see my last reply, p. 234), $p^2 = 4$, and the two terms become—

$$\frac{-2 \times 9 \times 5 \times 83}{q^2} \times \frac{2 \times 9^3}{q^4};$$

the value of q^2 which will divide them without remainder is 9; it may be objected that if we put $q^2 = 3$, giving q the surd value $\sqrt{3}$, q^2 will divide out; but this value is a mere logical consequence of the first value given to q, as it is evident that if any number is divisible by m^2 without remainder, then *à fortiori* it is divisible by m. Hence, $q^2 = 9$. This value of q^2 makes the terms under the radical sign $784 = 28^2$, and the whole expression becomes $\frac{7}{3}$ as before. Hence there is no ambiguity as to the value of x, unless we put $q = 1$; but this gives no square number.

Bath. M.I.C.E.

[96574.]—**Jets** (U.Q.)—Are these really facts? Where have you seen them stated? GLATTON.

[96651.]—**Transposition** (U.Q.)—I am afraid it would take too long to explain. The method will be found in every work on algebra. You must complete the expression by putting some symbol for the quotient—say x for instance; your sum then reads thus—

$$\frac{A \times B \div c}{d + e} = x,$$

which is the same thing as—

$$\frac{A \times B}{c\,(d + e)} = x.$$

Hence $A \times B = x \times c \times (d + e)$.

Now, to find the value of any of the terms on one side of the sign =, it is only necessary to place the other terms on the opposite side as divisors. Thus—

$$A = \frac{x \times c \times (d + e)}{B}$$

$$B = \frac{x \times c \times (d + e)}{A}$$

$$C = \frac{A \times B}{x \times (d + e)}$$

$$(d + e) = \frac{A \times B}{x \times c}$$

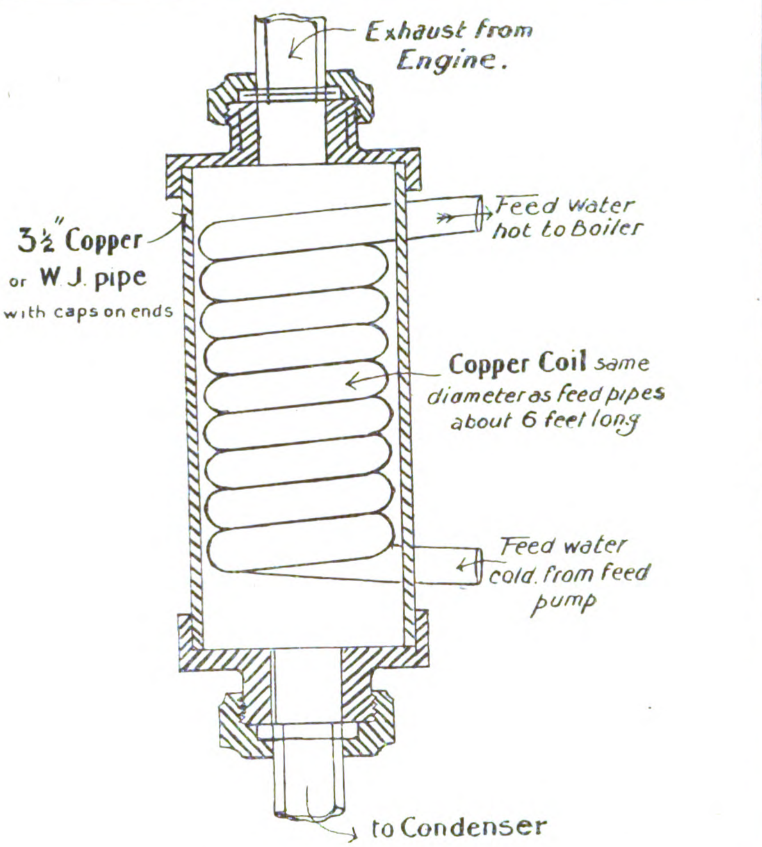
$(d + e)$ I have considered as one term. To find the value of either, place the other on the other side with a (−) sign before it. Thus—

$$d = \frac{A \times B}{x \times c} - e$$

$$e = \frac{A \times B}{x \times c} - d$$

GLATTON.

[96633.]—**Green Water.**—The little bubbles on the surface of the water confirm my opinion as to the cause of the greenness. These bubbles are oxygen, resulting from the breaking up of carbon



dioxide by Euglena. In regard to a remedy, I can think of no other plan than by killing off by chloride of lime or permanganate of potash (say about half a pound of the latter, for the quantity the tank contains), then rinse out and refill. They may not appear again. I had a glass-fronted aquarium tank containing 400 gallons quite green through Euglena. They died off at the end of the season, and none have appeared since. If "Quex" will send me, say, a one-drachm bottle of the green water, I shall be able to give him more information.

12, Royal Crescent, Jersey. J. SINEL.

[96659.]—**Joy's Valve-Gear** (U.Q.)—The objections you state appear well founded; but I have no personal experience of this gear. Marshall's valve-gear would probably suit you better. I have not a diagram by me, but it is shown in Seaton's "Manual of Marine Engineering." GLATTON.

[96681.]—**Boilers with Projecting Studs.**—I do not know in what respects these systems of fitting studs to boilers differ, but I think I know that neither is worth bothering about. Naturally the more surface that is exposed to the source of heat the more of that will be captured; but the idea of applying studs to kitchen ranges or the bottoms of ovens has not yet been introduced into the manufacturing world. The one place where it is necessary to capture all the available heat is the boiler of a cruiser or that of a locomotive, and I have not heard that any designer has used studs under these conditions. METOPS.

[96759.]—**Bikes and Prams.**—As s. 85 of the Local Government Act, 1888, expressly enacts that bicycles are to be deemed "carriages" within the Highway Acts, there is no necessity for a court of law to decide the question. Nothing is said therein about prams, nor is any distinction made between a ridden or led bicycle. The word carriage, according to Chambers's Etymological Dictionary, means "a vehicle for carrying"; according to "Rota's" contention, an empty carriage is no longer a "carriage." Will he say what it has become? Prams are, I agree, frequently a nuisance, especially when they are wheeled along three abreast while the peculiarities of "missus" are discussed, and their propellers are legally liable for obstructing the pavement, not on the ground that they are by law "carriages" (as they are not), but because any undue blocking of the footway is an obstruction. They have, however, been tolerated for so long that, as "F.R.A.S." pointed out, the police wink at the offence, and a magistrate would probably not inflict a fine as the practice has been in use for years. To compel prams to go in the roadway would endanger both nurses and infants, while the mere cyclist is supposed to be able to take care of himself; hence, probably, the license accorded prams. The above section repeals all previous powers exercised by local authorities to make rules for bicycles. B. H.

[96796.] — **Marine Condenser.** — A suitable condenser for the size of querist's boiler would consist of about 6ft. of 1¾in. diam. copper pipe, made D section, and fitted alongside the keel of the boat outside, being attached to the skin by suitable ends. The cost would be about 20s. It will also be necessary to lead a jet of live steam into the funnel, to liven up the fire, and assist the draught. Fitting fresh water-tanks connected to the hot well, and using the water to make up the auxiliary feed, will add considerably to the life of the boiler, whilst a feed-water heater, something like sketch below, between the feed-pump and boiler check-valve, will also be found to be worth the expense. If "Old Colonial" can get a chance to thoroughly examine one of Messrs. Simpson Strickland's launches, he will see the above fitted in the most complete way, and be able to understand it. D. C. G.

[96778.]—**Barometer.**—The barometer is simply a measurer of the weight of the atmosphere, and is no sort of guide to the probable weather unless the local conditions are well understood. If a mercurial barometer has been screwed up to keep the column intact, it will be only necessary to release by unscrewing. The vacuum should remain intact, even if the bag of mercury has been screwed up. But what is the difficulty? A barometer is simply so many inches of mercury in a tube supported by the weight of the atmosphere, and the mercurial column falls or rises accordingly. M. T.

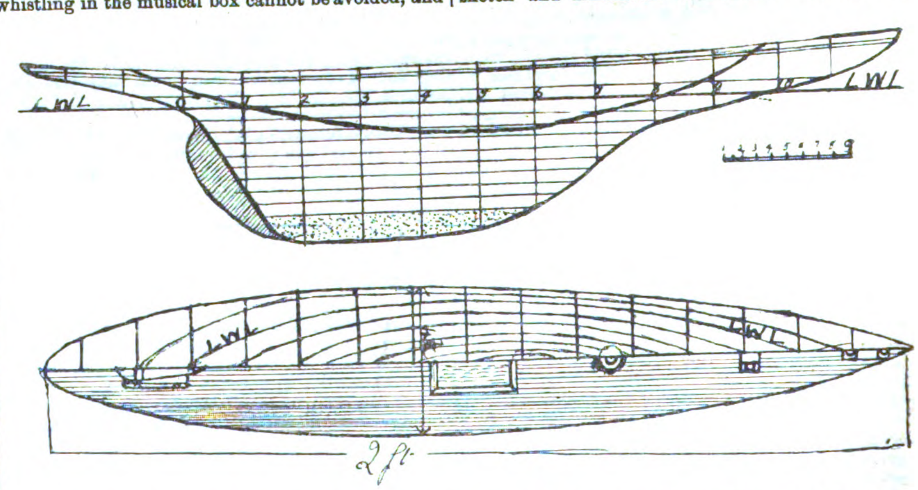
[96816.]—**Musical Box.**—The scratching and whistling in the musical box cannot be avoided, and is there when you buy it new, only then it is not so noticeable, on account of the cylinder moving faster than it does now. This scratching is caused by the reeds, which are set in vibration by pins and still continue to vibrate while other pins come up to chip them again, and in which they vibrate before the pins obtain a firm hold.

J. H. SCHUCHT.

[96840.]—**Microscope.**—For a microscope (compound) the lenses necessary are: (1) An objective of short focal length to form an enlarged image of object. (2) An eyepiece to receive and further amplify first image. If your convex lens ¼in. has a short focal length—e.g., anything below an inch, you could use it as an objective, which, however, ought to be plano-convex; you would not, of course, be able to have an achromatic combination. For eyepiece, you again want plano-convex glasses. If the 1in. or ½in. or $\frac{11}{20}$in. were such, they should be mounted as field-lenses with the ⅜in. as eye-lens. Read any book on elementary optics or on the microscope. OPTICIAN.

[96873.]—**Whole-Meal Bread.**—There is no such article as whole meal or whole-meal bread; the correct name is "entire wheat meal" or "entire wheat-meal bread." Thus wheat is a Triticum; wheat meal is no longer Triticum (wheat), but Triticum farina. As no doubt "D. W. G." requires his bread for domestic purposes, I need not here discuss the theory and practice of the various blends of wheat for the said purpose, as, from practical experience, I find that English wheat of this year's growth will produce a good loaf. The method of grinding is an important factor, as well as the sample of wheat. Doubtless you can obtain good wheat meal; if so, I give you two methods which I used nearly twenty years. Wheat meal being a variable absorbing product, proceed thus: Gradually heat four pints of milk (or water) to 80° Fahr.; then dissolve an ounce of distiller's yeast in same; then stir in 2oz. of moist (brown) sugar and 10oz. of your wheat meal. Do this in a medium-sized pail, or a similar-shaped vessel; cover over with a board and a cloth, and stand aside in a comfortable warm place until ready. This is the "ferment," and it will rise up the pail (sometimes more so than others), and then drop. When ferment has dropped—not before—dissolve not less than 1oz. nor more than 1¼oz. of salt in half a pint of hot water, 100° Fahr.; stir this into the ferment, and make a dough of a soft consistency. This can be done in the said pail to perfection by simply stirring in the wheat meal (with a strong wooden spatula) until you have a very stiff batter dough; it need not be touched by hand. Now scrape your "spat," and leave the dough in the pail in a fairly warm place until well risen—not more than double its volume. When risen, take your scales and a large spoon, or a smaller spatula, and weigh off 20oz. for each loaf, plus your tin. The last portion may be less than 20oz. That can be added in equal portion to the others with a palette knife. Your pail should be quite clean; no dry meal or scraps should be there. Stand tins in a comfortably warm place (not less than 65° Fahr.) until the dough has risen (in tins) to not more than twice its volume. You can, of course, go higher or lower. Bake in an oven of the temperature of not less than 400° Fahr.—no more than 450° Fahr.—for about forty minutes. Your loaves on top should be convex. Your fermentation is then correct. Second method: milk 4½ pints (or water); heat to 90° Fahr.; then dissolve in the same 1oz. of distiller's yeast; then add 2oz. of sugar and 1¼oz. of salt. Make the dough stiff; cover over pail, and stand all night on the kitchen table (this can stand from nine to twelve hours); in the morning give it a stir, and stand in a warm place an hour or so. Then proceed as above. RAGLUS.

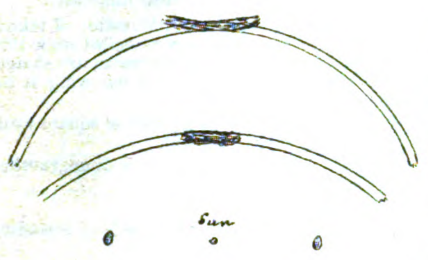
[96876.]—**Model Yacht.**—I trust the inclosed sketch and dimensions will enable "Harold" to make a good and efficient yacht. The design is very much after the lines of the *Shamrock*. The boat sits well on the water, and is about 17in. on the water-line. The boat should carry about 950sq.in.



of sail. If "Harold" would care to advertise his address in the Sale Column, I should be pleased to send him drawings of sails and mast, fittings, &c.

WOODHOUSE.

[96879.]—**Rainbow.**—The remarkable series of rainbows or solar haloes referred to by Mr. Harman as having been observed at Tunbridge Wells on the afternoon of Oct. 11, was also plainly visible in London on the same afternoon, although at an earlier hour, and possibly under somewhat modified conditions. Whilst passing through the City at about 2.30, my attention was attracted to a vivid streak of coloured light about 10° in length, resembling a portion of a rainbow, situated apparently about 45° above the place of the sun, and being curved slightly convex towards his position, as if forming the lower segment of a large circle reaching far beyond the zenith, of which, however, no other portion could be seen. Other features were then noticed, which I sketched on the spot, and now reproduce. The usual solar halo at 22½° distance



from the sun was not visible in its entirety; but two mock-suns appeared in their usual positions right and left, and a second rainbow streak at a similar distance over the sun, and, therefore, midway between it and the upper and more brilliant streak. The upper portions of two other haloes could also be plainly traced, the first being distant about 45° from the sun, and consequently touching the upper streak, the other being apparently of larger radius, the apex passing through the lower streak, consequently not having the sun in its centre, the curves on either side being prolonged to a distance nearly reaching the other halo, their tendency being apparently to intersect at points distant 45° on either side of the sun, thus giving it somewhat the appearance of a parabolic curve with the sun in its focus. This had all faded away by about three o'clock. In both streaks the lower colour was red.

W. T. N.

[96881.]—**Malting Wheat.**—If "Merchant" advertises his address, he can be put into communication with those who are ably acquainted with the above subject up to date.

ACROSPIRE.

[96882.]—**Vinegar Plant.**—The vinegar plant is a fungus which is used to convert alcoholic solutions into vinegar. The fungus is a bacterium called the Mycoderma aceti, and consists of short bacilli about 2 μ long, contracted in the middle, and resembling the figure 8. To develop the vinegar plant, plenty of oxygen and a fairly high temperature is required. It is firstly produced in the manufacture of vinegar as follows:—The malt or barley is mashed in hot water till all the soluble matter is extracted. The clear liquid is then run off into a vessel and yeast added. Fermentation then sets in. This liquid is pumped over piles of birch twigs, placed in high vats. The twigs become coated with the Mycoderma aceti, or vinegar plant. This plant, when placed in any warm alcoholic solution, sets up fermentation and converts it into vinegar. The vinegar plant can be kept for any length of time. To keep the plant, it is necessary to place it in a diluted solution of beer or any other solution containing alcohol. Care must be taken to change the liquor every ten days or so: otherwise the plant will die.

ERNEST N. W. HUME.

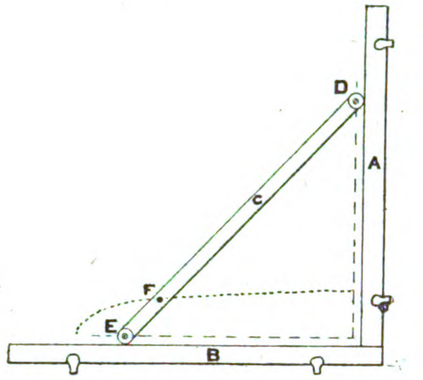
[96883.]—**Diamonds.**—Yes; 760° C.—i.e., 1,400° Fahr. Read Crookes' lecture on "Diamonds," delivered at Royal Institute, 1897.

M.

[96886.]—**French Verbs.**—The old spelling, hardly extinct in 1814, was with *ois, oit, oient*, where they now use *ais, ait, aient*. The sound became like *ai* more than a century ago.

E. L. G.

[96896.]—**Ellipse.**—Your correspondent "B. B. M." seems to have tried the common method by means of two pins and a cord, without getting the required exactness. The following is a modification of a very old method of drawing a quarter-ellipse:—Let A and B in the figure be two straightedges clamped at right angles to each other on a board. Prepare a flat ruler, C, exactly 11⅞in. long from the point D to E. At F, which must be 1⅞in. from E, let the pencil or steel scriber be fixed in a suitable hole. At D and E let circular pieces of metal (coins will do) be accurately fastened by screws through their centres to the ruler C. These discs need not revolve. The quarter-ellipse is drawn by sliding D along A while E slides along B. F will then describe a quarter-ellipse with an accuracy almost absolute if the apparatus has been carefully constructed and intelligently used. These quarter-ellipses may be cut with scissors from thin zinc or cardboard, and used as templates for drawing the whole ellipse by placing them in four different positions. The drawing pen must be dry

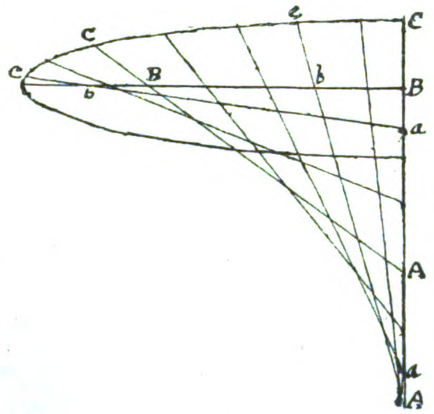


on the outside to avoid blotting. By varying the position of F, any elliptic curve can be drawn, the centre of C describing a circle, points near the end making very long ellipses, and those nearer the middle very round ones. D F must be half the long axis, and E F must be half the shorter one.

RICHARD INWARDS.

20, Bartholomew-villas, N.W.

[96896.]—**Drawing an Eccentric Ellipse.**—The use of foci and a string is a very bad way of drawing any ellipse. The principle of the trammel is always best. Having two lines accurately at



right angles, you have only to mark on a straight-edge the two semi-axes, A C the longest and B C the shortest; then keep the marks A and B on the two axes, and C is always on the ellipse.

E. L. G.

[96897.]—**Slade Micrometer.**—It is very easy to illuminate the Slade micrometer eyepiece of a small refractor. My telescope is a 2⅝in. refractor, and for some years I lit up the eyepiece in this way. A hole existed in the brass tube of telescope about the middle point, which was once used for attaching it to a brass pillar-and-claw stand—very soon done away with, by the way. I had this hole enlarged to about ½in. diameter. A small piece of white card, elliptical in shape, say ½in. or ⅜in. by ¼in. is attached to some fine brass wire—fine enough to be pliable and yet stiff enough to hold the cardboard in any desired position. This wire is made into a sort of letter Z shape, and the cardboard is then inserted in the tube, the wire being by trial bent or adjusted so that the cardboard is in about the centre of the tube, opposite to the circular hole, and inclined at angle of 45° or thereabouts to the axis of tube. This arrangement is secured in the tube by one or two turns of fine twine or cord lapped round outside of tube. A small wooden table may now be made to slide up and down one of the legs of the telescope tripod. The top of this should be secured by a screw in a washer, so that it revolves easily, and can be brought nearly up to the hole in the tube. A small candle lantern is then placed on the top, and with a very little adjustment the eyepiece can be graduated to the desired amount of light. Of course if it is too strong, the stars are obliterated, and if too weak the lines in reticule cannot be seen. Quite lately I have discarded lamp and table, which can only be used conveniently when an object is near the meridian, for a tiny electric lamp worked from a pocket dry battery. The lamp is just large enough to fit into the hole of tube, and is inclosed in a little brass cylinder open at one end only. A switch is provided which can be held in the hand, and the light turned on or off as desired. The light is secured into the hole by a turn or two of cord outside tube. In this way the light can be turned on when the telescope is in any position, even when the light is at the lower side of tube. I have found this useful in filling in sketch of stars surrounding a variable star. I may say that I prefer a Ramsden eyepiece with one thread parallel to Equator, and two others at an angle of 45° to the first, for general work, as fainter stars can be seen than with the Slade, the photographic film of which has a tendency to obliterate faint stars; but, for taking precise differences of R.A. and dec., the Slade is the more accurate perhaps. The dry battery and switch, with electric light, was provided by an electrician for 15s. With these comparatively simple appliances, I have had very much amusement and instruction from my telescope, which is mounted on a Wray equatorial stand without circles.

E. E. MARKWICK, Colonel.

Devonport, Oct. 23.

[96902.]—**Gas Explosions.**—An explosion of gases travels at a certain rate; that is to say, it takes a measurable interval of time for an explosion to travel from one point to another in the same gas mixture. In a mixture of air and H an explosion travels quicker than in one of air and coal-gas. Suppose two gasholders connected with jets, one containing an explosive mixture of air and H, and the other of air and coal-gas, it would require a greater pressure on the air and H gasholder to prevent the explosion travelling backwards. "L. L. L." will probably find a piece of gauze stretched across the inside of his "gas" burner; this, too, prevents a recurrent explosion in his gas-pipe. With a suitable pressure and such a gauze, "L. L. L." could "burn" his explosive mixture of air and H under perfect control.

M.

[96905.]—**Negatives of Diagrams.**—In all probability your developer did not contain sufficient bromide and pyro. Pin the diagrams so that the lighting is more from the side;—lighting from the front is apt to cause a want of contrast. Of course, the defects and irregularities of the paper are shown less by front lighting. Use slow plates—process plates, if possible, as these are more thickly coated than ordinary plates, although very fair results should be obtained with the latter. Focus carefully with a large stop, and stop down to about $f/32$, rather under- than over-expose, and use a pyro-soda developer, strong in pyro and bromide, and stop development the instant veiling commences. The wet-plate process is much to be preferred for this kind of work.

T. J. LENEY.

[96913.]—**Workshop Lamps.**—Our system of using paraffin-oil is the acme of lighting with paraffin oil. There is no filling of lamps every day, and there is no daily trimming of lamps, as the wick never requires cutting, only wiping off the sediment once a week, or even once in a fortnight, and the light is far superior to gas and the ordinary oil-lamp. It is always a pure white light, without smoke or smell, and no more trouble than gas. The system can be seen in use at Esher, Dorking, and Tulse Hill, London. Shall be pleased to show system to "Jasmine" at any time, and answer any questions through the post, being a regular subscriber to the ENGLISH MECHANIC.

THE ROYAL AUTOMATIC OIL-LIGHTING COMPANY.

Church-street, Esher, Surrey.

[The system appears to be one to supply paraffin-oil from a fixed tank, through pipes to burners. We cannot spare space for the circular sent, and the above reply is very much of the nature of a free advertisement.—ED.]

[96914.]—**Astronomical.**—"Novice," in requesting to be shown how to find in mean solar time the interval during which a star which, rising exactly in the East, remains above the horizon, introduces the simplest of all the cases of finding what is called the "semidiurnal arc." As the essential principles upon which depend our modes of reckoning time, and which are necessarily involved in this simple question, are by no means so clearly understood as one would suppose, I may be excused in answering the above query at greater length than might seem necessary. Two elementary facts may perhaps be taken as generally well enough understood—viz., first, that in the "right sphere" (the conditions at the Equator) all the heavenly bodies appear and disappear during equal times; second, that in the "oblique sphere," such as under our observing conditions, stars having North declination are *more than half* their revolution times above the horizon, while those having South declination are *less than half* their circuits above it. In fact, so much does this hold, that circumpolar stars never set, and stars with considerable South declination never rise here at all. Now, it is evident that just as a ring swivelled horizontally by a diameter has always just one-half of its circle above the plane of its swivels, however much or however little it be tilted, so must exactly one-half of the Celestial Equator be above the horizon in all latitudes. Therefore any body situated in that circle (the

Celestial Equator) must necessarily be exactly for one-half its period of revolution above the horizon, if its motion be uniform. (Of course, we remember that this diurnal motion is due in the star's case entirely to the earth's rotational motion on its axis). The above supposed star of no declination—i.e., Equatorially situated—will therefore rise exactly in the East and set exactly in the West, as these are the *only* points of the horizon where the Equator cuts it; and, further, it will remain above the horizon exactly one-half period of the earth's rotational time—just, in fact, as in solar time the sun does at the Equinoxes. Refraction and other causes prevent these facts from squaring precisely with the above simple conditions *observationally*. The point now is, What relation has our time reckoning to the earth's axial rotation? This rotation appears to be perfectly uniform—at least, to our experience, as uniform as any motion with which we can possibly become acquainted. How, therefore, do we derive *two* entirely different modes of time reckoning from it—*sidereal* and *solar* time? All depends upon the point of reference, from which to mark the rotation. Stars being for this purpose practically fixed, the time which elapses between two consecutive returns of the same star to the same position marks out the period of the earth's rotational time—the sidereal day. On the other hand, the sun moving, in respect to the earth, slowly in the *same* direction (conventionally we may correctly enough speak of this motion of the sun), it necessarily follows that given the sun as a point of reference for the diurnal rotation, the earth must make somewhat *more* than one complete turn, relative to space or to a star, before sun and earth can again be *relatively to each other* in precisely the same position they were yesterday. Hence, whatever units we care to employ, the solar day must be longer than the sidereal day; for, as Loomis points out, "an arc of the Equator, equal to 360° 59′ 8·33″, passes the meridian in a mean solar day, while only 360° pass in a sidereal day," making a difference of 3m. 56·5554s. of sidereal time between the mean solar and sidereal day. The conversion of sidereal into mean solar time, or vice versâ, depends entirely upon introducing the above proportion between them, and the practical conversion is usually done by tables, which are to be found in most works dealing with practical astronomy or navigation—e.g., the *Nautical Almanac*. For our present purpose we have merely to remember that the star supposed to rise exactly in the East must be seen to describe (discounting refraction) one-half the entire circle, or 180° of the Equator, while above the horizon; and that this angular interval in sidereal time is exactly half a sidereal day. Now twelve sidereal hours, by proportions already given, will be found to be 11h. 58m. 2·0453s. in mean solar time, so that for this interval as marked by a mean time clock (the usual article) will a star which rises due East, remain above the horizon. The following equivalents may interest those readers, who, in the absence of tables, may wish to work out "time conversions":—

1h. S.T. =		59m.	50·1704s. M.T.
1h. M.T. =	1h.	0m.	9·8565s. S.T.
1m. S.T. =			59·8362s. M.T.
1m. M.T. =		1m.	0·1643s. S.T.
1s. S.T. =			0·9973s. M.T.
1s. M.T. =			1·0027s. S.T.

Astronomical readers will observe that refinements required in finding a star's true R.A., and which rather interfere with the simple definition of sidereal time, are not introduced in the above. H.

[96918.]—**Scrap Arc-Lamp Carbons.**—The ends of arc-lamp carbons are always useful in making-up Leclanché cells, mixed with the manganese. Otherwise they will do to burn on the fire, being carbon. What possible use can they be? They are only carbon, and will provide fuel. M. T.

[96921.]—**Thin Sheet Steel.**—When the bits of sheet steel are bent into desired shape, drop them into water, and they will probably be as springy as wanted. If the pieces of steel are simply pressed into shape by the dies, they will probably be springy enough if passed into water after shaping. T. L.

[96922.]—**Stylographic Ink.**—Boil pulverised gall-nuts, 250 parts; gum, 125 parts; sulphuric acid, 125; distilled water, 4,000, add a few grains chloride of mercury; pyrogallic acid, 1 part; sifted gum arabic, 3 parts; neutral ammonium meta vandate, 3 parts. Rub together and well incorporate. REGENT'S PARK.

[96923.]—**Heating Tank.**—"Heat" does not state the length of time he has at his disposal in which to raise the temperature of the water to the desired degree. F.I.S.E.

[96924.]—**Artificial Diamonds.**—Pure rubbish—like many another paragraph of the same species. A diamond-like modification of boron may be obtained by heating together to prolonged white heat boric acid and aluminium, or amorphous boron and aluminium, in a crucible surrounded with powdered charcoal. The crystals have the composition $B_{48}C_2Al_3$. Fine diamonds of very inferior quality were artificially produced about twenty years ago by J. B. Hannay, of Glasgow, by prolonged heating together of paraffin spirit, bone-oil distillate, and metallic lithium, but the process was very perilous, and the cost of the artificial stone greater than that of the natural diamond. W. J. G. F.

[96925.]—**Panama Hats.**—The so-called Panama hats are made at a place called "Suasa," in Colombia, South America. They are made of the fibre of a small fan-palm known in the country as "Palmiche." They are not difficult to make when one has learnt to do it; but it is very tedious work, and requires good eyes to make the finer qualities. I have seen men, women, and girls making them. A common or coarse one can be made in about three days, and costs from 3dol. to 5dol. The finer ones take months to make, and may go to almost any price. The natives of Colombia pride themselves exceedingly on the quality of their "Suasa" hats, and look down on anyone wearing a common one. A Colombian would rather go without food than without a fine Suasa hat, and it is not an uncommon thing for natives of the lower classes to pay from 60dol. to 100dol. for one, and the upper classes more. I have not seen one quite as soft as silk, but they can be made exceedingly soft and pliable, and will fold and roll so as to go comfortably into a breast-pocket (I don't know about a waistcoat-pocket). There was one of exquisite fineness exhibited at the last Paris Exhibition, and was sold to a Yankee for £400. QUEX.

[96927.]—**Mercury Gilding.**—If I were that gilder I would change my trade. He will surely die soon if he goes on at it. G. A. HAIG.

[96927.]—**Mercury Gilding.**—G. B. Wood, M.D., &c., "Therapeutics," speaks of the use of the iodide of potassium as of great value in eliminating metallic poisonings, such as lead and mercury, forming double salts, which are soluble, taken up and excreted. Ordinary dose. 10 grains three times a day. Compound syrup of sarsaparilla is a convenient disguiser of the drug flavour. REGENT'S PARK.

[96928.]—**Electro-Magnet.**—The results of winding the two limbs of an electro-magnet for a motor in series with the armature is that the motor will not run at constant speed irrespective of the load, but it starts easier against a full load, whilst a shunt-wound motor will run at almost constant speed, but will not start against a load.

WEBSTER MICHELSON AND CO.,
Dudley. Electrical Engineers.

[96932.]—**Polycistina.**—If you cannot obtain at any naturalist who deals in aquaria, why, inquire of Thomas Bolton, 25, Balsall Heath, Birmingham, or Director, Biological Laboratory, Plymouth. REGENT'S PARK.

[96933.]—**Asbestos Fire.**—A stove fitted with a gas-fire would give out greater heat, per cubic foot of gas consumed into a room, than a gas-fire fitted into an existing coal-fire grate; the latter has the best appearance. The cost of the apparatus itself and the gas per hour will depend upon the dimensions of the room and also the temperature it is proposed to keep it at. The "first cost" would be lowest if the grate is used. A person fixing such apparatus should have experience in that work, else the best result is not obtained. For instance, it is not desirable to permit a large amount of heat to escape up the chimney, and firebrick cheeks should be employed as well as the ball fuel.

161, Albion-road, N. A. CLARKE.

[96937.]—**Electric Light.**—It depends entirely on the facilities you have for generating your electricity. Gas at 3s. 8d. per 1,000c.ft. is practically equal to electricity at 4d. per unit. 1,000,000c.ft. of good gas should give 3,200,000c.p., or say 2,200c.p. every day of four hours. A dynamo to do this work should give 140 amps. at 65 volts pressure;—will cost about £75 and take about 15H.P. to drive. A gas-engine would cost about £125; a steam-engine and boiler about £140. A set of accumulators about £60. With such a set, even burning gas, your electricity should not cost you more than 2d. per unit, which would save you about £54 a year on your gas-bill, so that, reckoning the outlay on plant at £400, and your interest at 5 per cent. = £20, you would be the gainer by £34 per annum. S. BOTTONE.

[96937.]—**Electric Light.**—If "Electric" will give me the following particulars, I will endeavour to give him a fair estimate. As the query now stands, there is no data to work upon:—(*a*) Number of burners? (*b*) How long in use (maximum and average number of hours per day)? (*c*) Has he steam or other power available? (*d*) What is the nature of area already lighted? Take, for example, "Electric" has 60 burners, each consuming 10c.ft. per hour, burning five hours per day, will make roughly the total amount he consumes per year; but the number may be considerably out. The above burners will consume 600c.ft. per hour = 2s. 2d. approx. To replace these burners with sixty 16c.p. lamps will require an engine giving 6B.H.P. If a reliable oil-engine is installed to do this work, the cost for oil will be from 4½d. to 6d. per hour, to which must be added interest, depreciation, &c. With ordinary surroundings, and conditions being equal, "Electric" will find electric light the most economical. If you care to give me the particulars asked for, I shall be most happy to help you, if you advertise your address in the usual column. F.I.S.E.

[96937.]—**Electric Light.**—You could have the electric light far cheaper than your gas-light, as you will see from the last page of our new catalogue (which we shall be glad to send you), where the saving on 100 16c.p. lights is £89 per annum. The figures are there worked out for the consumption of of 1,095,000c.ft. of gas at 3s. 9d. per 1,000. The cost of a good gas-engine and a reliable and efficient dynamo for 100 lights of 16c.p. would be about £80 and £55 respectively.

WEBSTER MICHELSON AND CO.
Dudley. Electrical Engineers.

[96939.]—**Question in Arithmetic.**—I take it that the field is bounded by a gravelled walk 13ft. in width, and that the other two walks are at right angles to each other. If so, the following is the solution—

4,840 × 2½ = 12,100 = number of square yards of ungravelled portion.

$\sqrt{12,100}$ = 110 = length of side of ungravelled portion.

Adding (13 × 3)—

110 + 39 = 149 = length of side of boundary wall.

Multiplying by 4—

149 × 4 = 596 = total length of boundary wall.

Cardiff. D. OWEN.

[96940.]—**Wireless Telegraphy.**—To MR. BOTTONE.—Let your pole be about 10ft. higher than the surroundings. It will be well to have it surrounded by a wall of wire netting, which should be well insulated from the pole, and from everything except one ball of the transmitter. For simply bell-ringing, the Wimshurst is far and away the cheaper and more effective. Of course, you will understand that you arrange the transmitter in circuit with the outside of the jars, and place the prime conductor bells at a distance proportionate to the distance between the transmitter balls. An inch spark gap should be ample for so short a distance. I do not know what facilities you have for making up your apparatus; but as a little guide as to price, it may be of service to you to know that we send out a complete set, with Wimshurst transmitter and receiver, with relay, coherer, decoherer, bell, and batteries for £5 complete. Should you care to write to me as below, I shall be pleased to send you working instructions.

Wallington. S. BOTTONE.

[96944.]—**Laminated Drum Armature.**—To MR. BOTTONE.—Wind the armature with about 2lb. No. 20 d.c.c. in 24 sections, using a twelve-part commutator. Wind the field-magnets with 12lb. No. 22 d.c.c., connecting up in shunt. If you use Manchester type fields, with good wrought-iron cores, about 1¼in. diam., 4in. long, you should get about five amperes at 50 to 55 volts pressure with ease. S. BOTTONE.

[96946.]—**Navy.**—Yes. A year in the engine-room, on the watch, is sufficient, when the candidate can show that he has had three years in a shop where marine engines are made. They need not be marine engines: the real requirement is service on board ship (in the engine-room, on watch). Full particulars can be found in back numbers, or direct from headquarters on application to the Board of Trade. The Government supplies all the information necessary, which can be had on application. Anyone can sit for the examination if he has had a year at sea in the engine-room "on the watch." See p. 256. W. T.

[96948.]—**Launch.**—The Colt Disc Marine Engine, Hartford, Conn., America, give for their make the following dimensions: Diameter pistons, 3in.; total weight, 500lb.; diam. cylinder with over castings, 15½in. Pipe connections—steam, 1in.; exhaust, 1½in. Boat—length, 35ft.; beam, 8ft.; draught, 30in. Propeller—diameter and pitch, two blades, 24in. by 24in. Prices (1887), including reversing gear, thrust-block, coupling, and automatic lubricator, 327dol. Engine occupies small space, runs at high speed, no dead centres, self-inclosed, has few wearing parts, uniform wear, made in best manner and materials, easily operated by one person. See C. F. Kunhardt, steam yachts and launches, effective H.P. at 120lb. 10 to 12H.P. Hurst and Lloyd, High Holborn, have in their window several oil 6H.P. engines adaptable for your purpose; weight from ¼ to ½cwt.; worked by petroleum; price, I understand, about £30 at shop. I do not note in W. S. Hutton's "Practical Engineer's Handbook" anything as to weight, except

as regards crank and half-length of connecting-rod next the crank-pin; but he gives for nominal H.P. with 150lb. pressure per square inch:—Let H P = diameter of high-pressure cylinder in inches; let M P = diameter of the intermediate cylinder in inches; let L P = diameter of the low-pressure cylinder in inches. Then nominal H.P. equals—

$$\frac{HP^2 + MP^2 + LP^2}{5 \cdot 5 \times x}$$

where x = the number of times the indicated horse-power is required to be greater than the nominal H.P., &c. REGENT'S PARK.

[96953.]—**Steam Exhaust.**—Why not put end of exhaust pipe into chimney? G. A. HAIG.

[96955.]—**Stage Thunder and Lightning.**—As regards lightning paper, perhaps this, from W. H. Browne's "Firework-Making for Amateurs" may be handy. He says the chief difficulty is to get rid of all traces of acid (oil of vitriol and nitric acid solution) in which the suitable paper is dipped: there is a liability of spontaneous combustion and explosion by detonation in a violent manner (40 vitriol, 5 fuming N. acid). One plan he advises is to use weak solution of sodium carbonate for last washing (if acid is used), and afterwards well wash to remove soda solution, as latter gives yellow tinge to flame of paper if not removed—a colour destructive to any other tint desired. Advises, if not particular to expense, to try soluble salt of lithia instead of strontium saturated solution for crimson, which he gives for colour. As to colour papers are to be when fired, each paper receives colour effect as follows:—Each sheet steeped for five minutes in warm saturated solution of strontium chlorate (crimson), barium chlorate (green), copper chlorate (blue), potassium nitrate (violet), afterwards hang up to dry. The chlorates may be made sufficiently pure by mixing warm solutions of chlorides of barium, strontium, or copper, with equivalent warm saturated solution of potassium chlorate. After drying small pellet, lighted at one point, thrown into the air, a flame of intense colour is produced. I believe thunder is produced by moving heavy weights about. REGENT'S PARK.

[96956.]—**Glass Silvering.**—Same way as gilding, but more isinglass used, as silver leaf is softer and requires a stronger agglutinant. Thus: Prepare size of 2oz. or more of isinglass in sufficient water to cover it; boil. When dissolved, add one quart of alcohol and dilute to two quarts with water, and filter. Flood surface of glass with size, lay leaf flat on it, scatter whiting previously warmed over whole. Should chalk form lumps in heating, rub fine; but dusting therewith must be delayed till leaf is dry. When leaf is dry dust over with a fine brush, and then back with copal or dammar lacquer. Before doing this last coat, repeat silvering once before. When backing is dry remove superfluous silver by rubbing with moistened finger. REGENT'S PARK.

[96957.]—**Quill Pens.**—Has "Old Subscriber" ever seen a small tool used for making the above? If not, doubtless any cutler will show him one. Mine is marked Rogers, Sheffield. It is in shape somewhat like a pocket-knife, and contains a small blade at one end, and the pen-cutter at the other, which is actuated by pressing down a small hinged lever. It trims and slits at the same time, and certainly does its work well. It is no new thing. To cut the slit in the ordinary way, having trimmed the pen to shape, lay it back down on a block of wood, use on the inside of quill the point of a knife having a thin keen edge, press the knife down on the quill, and at the same time draw the quill away from the knife. Cross-cut the tip after slitting. If you cannot get the slit central, trim the sides to the slit. T. J. LENEY.

[96957.]—**Quill Pens.**—Soak the quills in water until they are soft, and use a short, but sharp, blade to split them. Some years ago, in a shop window in Newgate-street, London, E.C., a man could be seen at work slitting the pens as fast as he could handle them. Not quite sure whether they (the quills) were soaked in water or placed in hot sand. Any way, the quills should be softened by heat, and then slit. Try putting the quills into warm water, and then slitting with a sharp knife. Do it easily by putting the quill into the mouth for a few seconds; but a short and sharp knife is the best tool. S. R.

[96957.]—**Quill Pens.**—Have years ago seen makers using a conical wood plug to form a base for splitting nibs on. REGENT'S PARK.

[96959.]—**Moulding Slag.**—The writer saw several walls in Llanelly, South Wales, a few days ago, with half-round slabs of slag for the coping. The writer will be in Llanelly again in the course of a week or so, and will ascertain, if possible, the information "Constant Reader" desires. F.I.S.E.

[96959.]—**Moulding Slag.**—If the ironworks would run their slag in the molten state into moulds like bricks, but a good bit larger, they would sell well for building, I should think. G. A. HAIG.

[96961.]—**Electrical.**—A zinc copper cell, excited by dilute sulphuric acid, had an E.M.F. of about 0·75 volt. Whether one or fifty couples be immersed in the same cell, the E.M.F. remains the same; but if the couples be placed in separate cells, and coupled in series, the volts increase as the number of cells. The zincs consume less to waste, if amalgamated. S. BOTTONE.

[96962.]—**Multiple Wimshurst.**—The trouble caused to "F. W." is probably due to the "knotting" which he uses to cement the smaller and the larger discs together. I do not know the composition of the knotting; but probably it is this which persistently holds the plates free from excitement by reason of its conductivity. The discs should be fully ⅛th thickness, and then they will be about sufficiently strong to resist bending when under electrical excitement. The cheap, black vulcanite is really more durable, and better for the purpose than is the high-priced brown vulcanite. In buying, I ask for the cheapest, because it is best for the purpose; but I always test it before using it. I have some now which is perhaps eight years old, and it is now as good as when new. A good-condition machine should excite itself with one-half turn of the handle. This in any atmosphere and without warming. J. W.

[96962.]—**Multiple Wimshurst.**—To MR. BOTTONE AND "J. W."—It is very difficult to locate the faults in a Wimshurst without examining and testing it. However, judging from your description, and always presuming that plates 1, 4, 5, and 8 are rotating in the one direction, while plates 2, 3, 6, and 7 are going in the opposite, and that the brushes have been so set as to allow for this (see "E. M." for July 7, '99, reply 96194, for illustration of current brush arrangement), I am under the impression that the fault lies with the "knotting" which has been used to stick down the 15in. discs. This is apparently still wet; and as the narrow ends of the sectors lie in contact with this, all the charge is quietly leaking away to the spindle. The sectors are, to my mind, too few, too large, and certainly too long. Remove the 15in. disc, if possible; clean them and the plates thoroughly with methylated spirits, followed by a polish off with magnesia carbonate cream. Then, replacing the smaller discs on the larger ones, make eight small equidistant holes around the edges of the 15in. discs, reaching through the larger discs, and stitch together with good silk twist, which you can varnish over outside with thick shellac varnish. This will probably set matters right. Provided the neutralising ends make good metallic contact with each other, it does not matter much how. I have tried all qualities of ebonite, and, except when old and perished, find little difference between the cheaper and more expensive kinds. The harder varieties are the best for Wimshursts. I allow 4in. between each pair. S. BOTTONE.

USEFUL AND SCIENTIFIC NOTES.

Largest Meteorite.—The largest meteorite of modern times fell on March 12 this year, close to Bergaa, on the Finnish Gulf. It has recently been recovered from the bottom of the sea, having made a hole in the ice 30ft. in diameter. The meteorite, on reaching the water, burst into a number of small pieces, and it is impossible to form any idea of its shape. The pieces recovered weigh 640lb., the largest having a weight of 140lb.

Monoliths.—Owing to the introduction of rock-drills and channelling machines, the cutting of such monoliths is now an exceedingly simple matter, and a number are now being prepared for the new cathedral of St. John the Divine at New York. These monoliths in their finished state will be 6ft. 3in. in diameter by 54ft. long. They are of granite, and the rough block cut at the quarry measures 64ft. long by 8ft. 6in. by 7ft., and weighs 310 tons. A gigantic lathe is being built to turn it down to its finished dimensions.

Cordite.—The ballistic power of cordite is very nearly four times as great as that of the black powder it has replaced. Thus, 1lb. of cordite fired in the 3in. 12-pounder field-gun is equivalent to the 4lb. of selected pebble powder which used to be the service charge. It has further to be noted that cordite charges cannot be exploded by being struck by bullets, so that there is no danger of the artillery limbers being blown up by hostile fire. A pressure of 120 tons per square inch can be obtained by firing cordite in a chamber which it fills completely, whilst with black powder, under similar conditions, a pressure of 43 tons only is reached. In practice a considerable void space is left in the powder chamber, with a view to keeping down this maximum pressure; and, in fact, a maximum pressure of 16 tons on the bore of the gun is what is aimed at under service conditions. The size of the cords used for guns of different calibres is such as to insure that the burning of the charge is completed in the same time as the projectile takes to travel down the bore.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Glatton" has replied to 96487, 96496, 96574, 96651, 96659.

96507. Lawn Tennis, p. 46.
96511. Brazing Lamp, 46.
96514. Dry Cleaning, 46.
96516. Heat Consumed in Mechanical Work, 46.
96517. Clarifying Methylated Spirits, 46.
96525. Phonograph Shaver, 46.
96527. Fish Plate, 47.
96532. Geometric Solution, 47.
96534. Dental Chair, 47.
96535. Flagstaff Stays, 47.
96548. Bent Timber, 47.

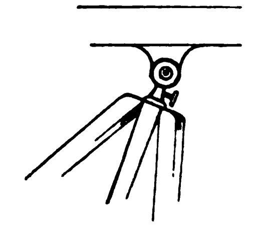
96682. Nibbling Machine, p. 144.
96684. Telescopes, 144.
96689. Cooling, 144.
96705. Jupiter, 144.
96710. Surface Tension, 144.
96712. Lantern Slides, 114.
96715. Quadruple Telephony, 114.

QUERIES.

[96963.]—**Gassner Dry Cells.**—Would some reader kindly give constructive details for the making of a Gassner dry cell? I cannot obtain gypsum. Would plaster of Paris do instead? What proportions should exist between plaster and zinc oxide cell to take a 6in. by 1½in. (or similar size) carbon plate?—VERITAS.

[96964.]—**Typewriter Ink Ribbons.**—Can any reader supply information regarding the method of making typewriter ribbons, and the composition of the ink, and method of applying same to ribbon.—TYPEWRITER.

[96965.]—**Equatorial.**—Inclosed is sketch of my 8in. achro. stand. I would like to mount an equatorial head on it. Unlike one mentioned by Mr. Ellison lately, it has



no screw motions. I would like to know if it is possible for an amateur to apply a driving-clock motion? I am in the clock line, and could easily get a movement driven by weights if I knew how to apply same to a telescope. I would be very glad of any help, and sketch if possible.—EQUATORIAL.

[96966.]—**Selenium.**—From what material and by what means is selenium produced? In using selenium (as in seeing by electricity), will not an induction coil be necessary to transmit the current to any distance? It seems to me that a current produced by this means must necessarily be feeble. What book can I get treating on selenium?—INVENTION.

[96967.]—**Grinding.**—Will someone kindly tell me what power gas-engine I should require to properly drive a 48in. grindstone for grinding new edge-tools after being forged? Also, sizes of driving-wheel and pulley-wheels on shafts and stone would be acceptable, and revolutions stone should make.—SIXTEEN-YEAR SUBSCRIBER.

[96968.]—**Liquid in Toys.**—Would any reader kindly inform me what red liquid is used in children's toys which boils by heat of the hand or mouth?—EXPERIMENT.

[96969.]—**Oscillations of Pendulum.**—Will some reader kindly help me with the following? If l is the length of a pendulum making 1 oscillation per second, and $l + c$ and $l - c$ the lengths of two other pendulums, where c is very small, prove that the sum of the number of oscillations of these two pendulums per day is very nearly $2 \times 60 \times 60 \times 24 \left(1 + \frac{3c^2}{8l^2}\right)$.—TRIP.

[96970.]—**Reversing Arrangement for Oil-Engine.**—Would some readers explain one or two of the best and easiest ways to make reversing arrangements for an oil launch-engine, about 1H.P., either for reversing screw, shaft, or engine? Also, which is the best place to get castings and forgings, and what book is there on making the above engines?—ROLANDO.

[96971.]—**Wind Motor.**—Could anyone give me particulars of a wind motor to drive small dynamo sufficient for lighting a small house? I am carpenter by trade, and understand sufficient of electricity to fit up dynamo and accumulators if the method of making motor is described. I should prefer it of wood, or most part. I live on a hill, and get plenty of wind.—H. BRAND.

[96972.]—**Motor Cycles.**—To "THE WRITER OF THE ARTICLES."—I intend constructing a light four-wheel car, after style of quadricycle described, but without the tricycle framing, sprocket, pedals, &c., the car to carry two persons. Would you kindly supplement your excellent articles with details of frame, steering and driving gears? I think it would interest a great many readers of "E.M." In any case, I would like information and sketch. Is motor sufficiently powerful for the above? Only moderate speed required.—M. H. B. C.

[96973.]—**Sand-Blast.**—Can any of "ours" give me particulars or any information of the sand-blast apparatus? I should like to know the pressure of air, and how produced, and if power is required.—M. A. P.

[96974.]—**Acetylene Gas Generator.**—Can any reader inform me how to make an acetylene gas generator? I am making a small motor, and am rather at a loss.—J. W. Drury.

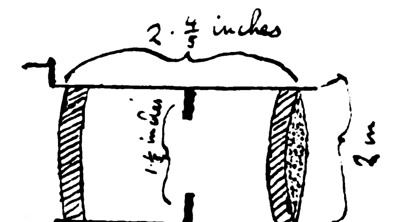
[96975.]—**Fishing Lines.**—Would be glad to learn of a good dressing for fishing lines.—Angler.

[96976.]—**Kieselguhr.**—Is there any preparation by which I could solidify or harden kieselguhr?—W. M.

[96977.]—**Varnishing Calico.**—Can any reader give me particulars for varnishing calico, for the purpose of making a small gas balloon?—W. M.

[96978.]—**Nervous Affliction.**—Can any reader advise a remedy? I am a young man, 25 years of age, with taste for study. When I was 15 I made study my only recreation, and this caused me a peculiar headache all day long, sometimes between the eyes, and at others at the back of the head and neck. This went on until I was 20, when the headaches left me, and in their place I was left with a very peculiar cramping seizure in the head, just as I was dozing off to sleep, and now I never go to bed but I have about 20 or 30 seizures, never lasting more than three to six seconds in duration. Muscularly speaking, I am as strong as a bull, and a model of strength and physical development, and I feel quite well and strong during the daytime—in fact, never feel the slightest weakness until I try to sleep; then I have these seizures, which render sleep impossible for about two hours every night. If I once get to sleep I never have another seizure on going to sleep a second time during the same night. About one night a month I sleep without seizures. Is it not a peculiar case? Can anyone advise?—W.

[96979.]—**Lens for Lantern.**—I have a portrait lens 8¾in. focal length to cover 5 × 4 plate. Can anyone tell



me (1) if it could be used with condensers for an ordinary-sized magic lantern, (2) the size of condensers, (3) the arrangement of lens and condensers, and shape and position of reflector, and (4) how to arrange two or three acetylene gas-burners in the lantern?—K. O. S.

[96980.]—**Turning Taper Rollers.**—Would some reader kindly inform me the best way to turn taper rollers 8ft. long 1½in. diam. at large end, to ⅝in. at small end?—H. D.

[96981.]—**Barometer.**—I am interested in your series of articles, "Some Meteorological Instruments and Their Uses," and would like to make a large barometer worked with oil. What would be the best to use—linseed-oil or glycerine? I thought of making the tube siphon-shape in lead tubing, and with the largest part of the bottom length of glass. Could you tell me how to fasten the glass tube to the lead tube, what length of tube I should need, and in what manner I could fill with oil or with glycerine so that I should get the top part free from air?—R. Weigley.

[96982.]—**Noisy Wimshurst.**—What is the reason of my Wimshurst machine making this peculiar noise? I find that after having revolved the plates round for about two minutes I hear a hissing noise at both jars.—E. G. Woodhouse.

[96983.]—**Steam Motor Waggon.**—I am desirous of making a waggon. I have a vertical engine and boiler, boiler works to 100lb., engine 3in. cyl., 4in. stroke, single, very compact. I should like to know how the mechanism is made for allowing the back wheels to turn corners, and how can I make a two-speed gear, two miles per hour and six miles per hour? Engine runs about 600 per minute, back wheels 3ft. diameter, chain drives. Also, how is the front lock worked in a heavy waggon, assuming the waggon to weigh, when complete, with water, oil, &c., 30cwt. about? What load could I take up gradients of one in six? If I compounded the engine, what extra load could I take up the same incline? I may say I have the facilities for doing all the work required. I should be pleased for the name of any books that would help me.—E. D. T.

[96984.]—**Plugging Holes in Steam Jackets.**—A cast-iron (1in. thick) steam jacket has some square holes, 1in. area, in same, and I propose driving from the inside of jacket some hard wood plugs to fill up the holes. The steam pressure will be, at the highest, 55lb. Will this be successful to stop the leakage? Plugs will be carefully dried.—Raglus.

[96985.]—**Condenser.**—I want information how to make a little condenser to suit a 20ft. steam launch, in order that salt water may never be required to enter the boiler. I understand that some steam must necessarily be wasted, but that the bulk of it can be easily condensed, and so used over and over again with the addition of a make-up supply of fresh water to be carried in a small tank. I think many other small launch owners, who have their boats on salt water would appreciate the information.—Old Colonial.

[96986.]—**To Mr. Reginald A. R. Bennett.**—I have made a phonograph, but cannot get it to act, so now I have converted it into the working on your principle. I got so far, but now I ask: Does the needle have any cutting edge, or is it like an ordinary-shaped needle? And I have a brass cylinder, upon which I make my covers (records), but I find they stick to the brass cylinder, and I have difficulty in removing them. Can you explain the reason, and is it necessary to have a zinc cylinder to leave a thin stratum in place of a brass cylinder? Could you give me a little information?—A Tryer.

[96987.]—**Series.**—Will some mathematical reader kindly sum the following infinite series?—

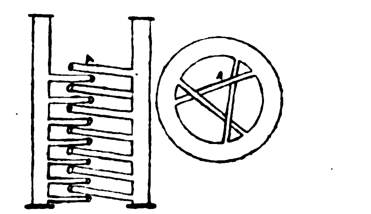
$$1 + x + \frac{x^2}{|\underline{2}\;|\underline{2}} + \frac{x^3}{|\underline{3}\;|\underline{3}} + \&c.$$

—Factorial.

[96988.]—**Zither Construction.**—Will any reader kindly give me information on the above subject, but more especially the best method of finding the correct position of the frets on the finger-board, the size and place for the sound-hole, and the position and number of the bridges inside the body of the instrument? In what way does the depth of the instrument affect the quality of the sound, and what is the best proportional depth?—Kohu Kohu, New Zealand.

[96989.]—**Polish for Brown Shoes.**—Recently some recipes were published for the above in the "E.M." I tried several of them. I tried for the tints annatto, phosphine, leather-brown, Bismarck-brown, alkanet-root, &c.; but I do not get a tint matching Propert's brown-boot polish. Can any reader inform me how to bring that colour? Also, how are the Universal creams (white) made for all kinds of leather?—Krishnalal Nanabhai.

[96990.]—**Boiler for Motor-Cars.**—Can someone kindly give an opinion of a boiler similar to sketch?



A, brass tubes slightly rising with the ends riveted to inner iron pipe, and so arranged to give most heat and strength.—A Cornishman.

[96991.]—**Cutting Mitre Wheels.**—I have to cut a pair of six greater diametral pitch wheels, with 21 teeth. I have the dia. 3⅝in. Will someone please tell me how to find the correct angles? Is there a formula for finding the width of space? I have a universal milling machine (Cincinatti No. 1½). How must I set it to cut taper on sides of teeth?—C. G.

[96992.]—**Petroleum Drinking.**—I have seen it asserted in print that petroleum drinking is at present prevalent in Paris. Can any reader of the English Mechanic give the information—(1) Why it is taken? (2) In what form is it used? (3) What are its effects?—W. A. D.

[96993.]—**Coil.**—Will Mr. Bottone kindly inform me the distance up to which a 2in., also a 6in., coil will work for wireless telegraphy? Also the height to which the vertical wire must be carried in each case? Is there any book treating on the subject suitable for an amateur?—C. H. K.

[96994.]—**Motor Cycles.**—Could "The Writer of the Articles," or some other well-informed reader, give us a definite answer with regard to the long cylinder bolts? I am about to start work on one, but would like to know about this first.—E. M. S.

[96995.]—**Great Central Newspaper Express.**—Can any correspondent give particulars of the actual running of the new early newspaper fast train to Manchester over the Great Central route? No need to waste a lot of space in useless details, as I only desire times of arrival at the stopping stations, and average speed between them.—A. S. L.

[96996.]—**Bone Bearings.**—Some time ago our friend "Jack of All Trades" advocated bone bearings for high-speed machinery. Will he kindly say what kind of bone, and how it should be prepared for, say, a 5in. lathe mandrel? Does he mean ivory?—Marrow Bone.

[96997.]—**Dynamo.**—I have a compound-wound dynamo, 110v. 16a., and when running the casts get hot and the voltage falls 10 volts in a very short time. I have tried running the dynamo with mains, pilot lamp, and voltmeter all disconnected, and it still gets hot. I should be glad if anyone would kindly explain the reason.—M. S.

[96998.]—**Accumulator.**—I have a small 6-volt accumulator which I charge from a 105-volt main, using a 100-volt 16c.p. lamp as a resistance. If I charge it for three or four hours and then light up a 6-volt lamp with it, the light only lasts about 15 minutes; but on giving it a rest, it will again light up, and so continue for about a week, a few minutes at a time. Will someone kindly say where I am at fault? Is the resistance I am using suitable?—M. S.

[96999.]—**To Mr. Bottone.**—In your "Guide to Electric Lighting" you describe a modified form of Bunsen battery, using a mixture of nitrate of soda and sulphuric acid in the carbon department. Please say the proportion of this mixture, and also the strength of the exciting fluid.—L.

[97000.]—**Armature.**—Will any electrical reader kindly say how I can find out the correct amount of wire and gauge output in amps. and volts for an armature 3¼in. long, 1⅞in. diam., armature 16-cog drum.—H. E. Woodhouse.

[97001.]—**Collodion Cotton.**—I have some collodion cotton that I want to dissolve into a gelatinous mass. I have tried camphor and methylated spirit, but without effect. I shall be thankful if any reader can inform me how to dissolve the cotton.—W. C.

[97002.]—**Nasmyth's Locomotives.**—In the life of James Nasmyth, the fact is recorded that he built engines for the Great Western, Bristol and Gloucester, and London and Southampton Railways. Can any of your readers give particulars of any of these, and say how many engines have been built at Partricroft works from 1838 to the present time?—Inquirer.

[97003.]—**Rothwell's Engines.**—According to several old railway books, it seems that in early years a firm of Rothwell made many locomotive engines. Can one of your readers oblige by giving the place where their works were situated, and also say when they began to build engines, and if the old firm exists now?—Inquirer.

[97004.]—**Wireless Telegraphy.**—To Mr. Bottone.—I have a 4in. coil and an exhausted Marconi coherer 1½in. by ⅛in. outside, gap 1/16, and two 2in. brass balls. (1) What distance should such a coil communicate, and is the coherer up to it? (2) What wire and core for the relay? (3) What sized Leclanché for this circuit? (4) Should wings be of thin brass, and what size should they be, and at what height for the greatest distance coil is capable of?—Dies.

[97005.]—**Physiology of the Brain.**—Can any reader give me the origin of the following paragraph, which I found in a paper that does not quote its authorities? "The more advanced of modern physiologists now claim that the back lobes of the brain are the seat of the highest intellectual faculties, a theory which is in direct opposition to that of the phrenologists and to popular opinion as well, the latter being that a high forehead is a proof of superior intelligence. An anthropologist of high repute points out that a man, of all creatures, has the most highly developed back lobes, and that the ablest men and races have them in the highest perfection. Idiots and confirmed lunatics, according to his investigations, have these imperfectly developed or in a very bad state."—T. P.

[97006.]—**Metallurgy.**—How was cast iron converted to wrought before the invention of puddling?—M. C.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1699.—By C. A. Gilberg.

Black. [8 pieces.

White. [7 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Nov. 13.*)

Solution of Problem No. 1697.—By A. F. Mackenzie.

Key-move, Kt-K 4.

NOTICES TO CORRESPONDENTS.

Problem No. 1697.—Correct solution has been received from Whin-Hurst ("Recent events must make the disappointment keener"), A. Tupman, J. E. Gore, T. Clarke, Rev. Dr. Quilter, Richard Inwards, A. E. Stokes, W. Peters, J. Mason, F. B. (Oldham).

The specific inductive capacity of guttapercha is 2·46, of rubber 2·34, of paper nearly unity. The average capacity of a telephone cable should be 0·080.

All standard Russian railways are required to equip their goods waggons and engines by January 1, 1903, with the Westinghouse air-brake. The order involves the equipment of 300,000 waggons, as well as a large number of locomotives, 60,000 of which are to be fitted with air-brakes, and 240,000 with air-pipes and couplings, inside of three years.

There is an outcry in Philadelphia against the extending use of bituminous coal, which is rendering the city "as sooty as any western soft-coal city." Previous to 1890 practically all this coal burned in Philadelphia was included in the 250,000 tons annually consumed in making gas. Ten years ago bituminous coal began to be used for other purposes, and in 1893 the total consumption rose to 900,000 tons; in 1897 and 1898 it was 1,600,000 and 1,450,000 tons respectively, according to the Government reports on mineral resources for these years. While the increase in the use of bituminous coal in Philadelphia has been 2,034,977 tons in the period 1893-98, the increased consumption of anthracite coal only amounts to 50,468 tons.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 10, 1899.

INLAYING.—V.

IN Fig. 96 is seen a flowing frieze ornament that can be adapted for single or duplicate uses, or with slight modification it forms an excellent centre-piece when used singly. By the addition of a centre at the right hand, and reversing the flow of the ornament, we gain a long frieze. Fig. 97 is similar to the above, but a trifle more difficult to execute; can be converted into a long frieze by adding a centre, as before stated. Fig. 98 can be repeated *ad lib.*, and will convey our meaning with respect to reversing the flow of the ornament.

The above can be cut in white holly in almost any ground colour; but if coloured ornaments are used, particular care should be bestowed to gain the desired effect without resorting to glaring contrasts. Judicious cutting up will permit of very effective shading. Or the same will look exceedingly well if the ornament is cut in German silver or brass; but silver is far superior, and when well engraved it will give satisfaction for the trouble taken. The metal will look well if the groundwork is rosewood, coromandel, or violet ebony.

The basket of flowers, as shown in Fig. 99, has a pleasing effect if cut in a rich mahogany. The addition of a spray at both sides tends to enhance the utility. A scroll ornament springing from the basket will not look out of place, providing the additional ornament is not too pronounced.

A few progressive studies of panels are given, as at Fig. 100 and Fig. 101. They will look well in almost all the grounds in vogue at the present time. They have a very pleasing effect, if the ornament is cut of dark mahogany, and the groundwork of satinwood, Hungarian ash, or bird's-eye maple.

The other panels (Figs. 102, 103, 104, and 105) illustrate the progressive stages of ornament. They will bear considerably enlarging, and can be cut in white holly or in coloured woods, as in the Pompeian style of ornament.

Our next stage will be the working together of brass and shell (tortoise), the latter being tinted. Different colours look and, not least, wear well.

The saws in use for metals should be purchased ready for use. A careful touch of the superfine file after a little use will prolong the life of the saw; but remember our warning: not to cut any one tooth lower than the other. It is fatal to the work and saw as well.

Figs. 106 and 107 are two friezes that can be cut in brass and tortoiseshell, silver and engraved, and in leather.

The brass used for our purposes should be the best annealed E metal. The German silver is also annealed, but still somewhat harder than brass. The tortoiseshell can be purchased ready split, but its future preparation has yet to be explained. There is also in the market a fairly colourable imitation made from the hoofs of animals, and this can be purchased in such substance as can well be employed for our purposes. Whether the imitation commands the taste of the reader matters not. We certainly prefer the natural shell, which looks what it is, and is far superior, whether coloured or not.

As the shell when purchased is invariably thicker in the middle, it must be reduced by scraping. A bent tool is the most convenient. A 1½in. plane-iron bent at right angles at the end of the slot is the best, but an ordinary piece of steel, hardened and tempered to the same degree as an ordinary cabinetmaker's scraper, will bear filing and setting in the same manner as the scraper.

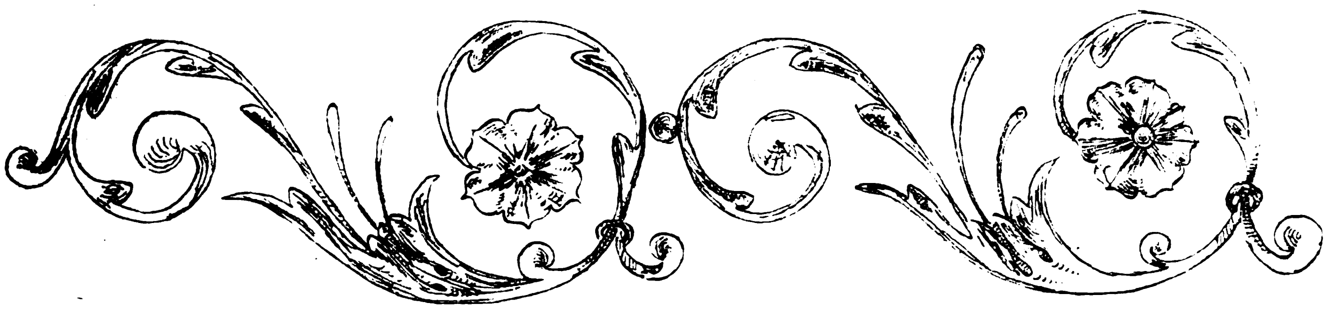


FIG. 96.

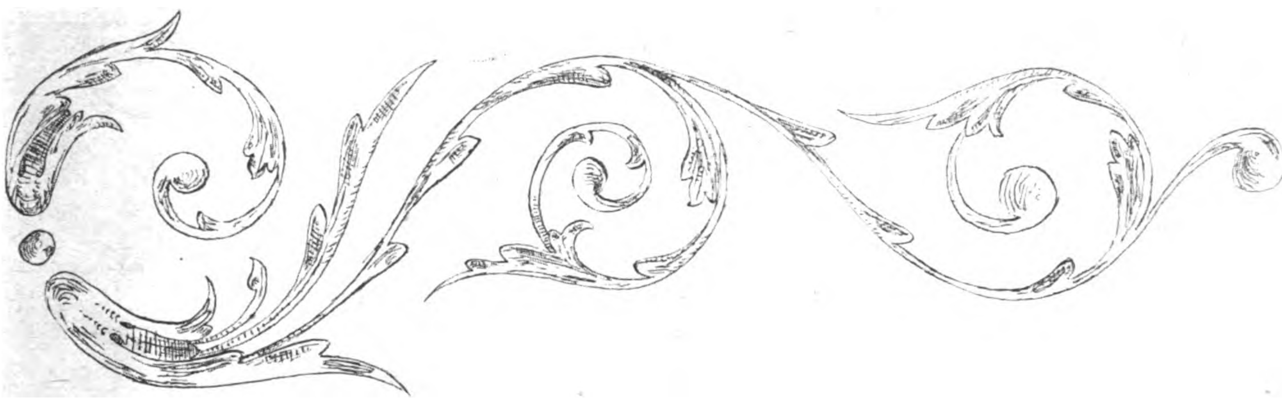


FIG. 97.

FIG. 98.

FIG. 99.

It being next to impossible to obtain a perfect equal thickness, as in the case of the metal, we have to pack up, so to speak, with paper *absolutely free from grease*, upon which we spread our colours. Vermilion is used for red reflections, arsenic for green; bright ultra-

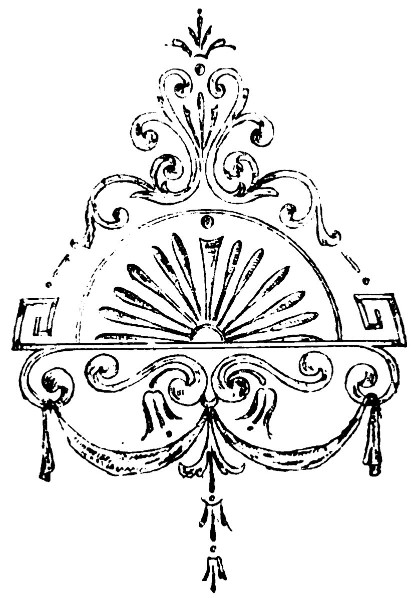


FIG. 100.

marine, gamboge, and carmine each for their respective colours.

An equal quantity of the best gelatine is added to the best Scotch glue in like proportion. When thoroughly mixed or "blended," the chosen colours are added

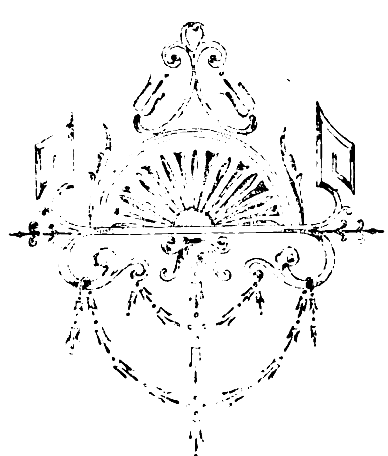


FIG. 101.

until a thick paste is obtained. The colours can be either brushed in or laid with an ordinary palette knife. The secret of success lies in having the paste well hot, and as consistently thin as will leave a good body of colour, free from lumps, and allowed to dry before a second or third coat is added if found necessary. We say necessary advisedly, because some pieces of shell may just possibly be very thin; consequently less opaque. They will show the colour up more—a fault that cannot well be remedied—but by judicious matching too glaring a contrast will be avoided.

Having chosen a sufficient number of pieces of shell for the object in view, they should be cleansed by scraping. The coloured paste will then adhere better, and the scraping tends to leave a fine surface free from blemish, where scratches or marks left in would reflect up and through the transparent portions of the shell, and thus mar the work beyond repair. The matching and piecing together is got by cutting with a pair of scissors, so that a number of irregular pieces when jointed together (and it matters not how or what form the pieces assume) will form one sheet of shell sufficiently large to cover our design, and of as near uniformity of colour as it is possible to obtain. Upon the outer face is glued the pounced design. The sheet of shell can now be tacked with fine pins, or glued upon the sheet of metal in use. If pins are used, they necessitate the drilling of the metal. A good plan is to bind the edges all round with brown paper. These directions apply particularly to work that will not take more than 6in. in width, as that is the general size the brass is rolled, although sheet-metal can be got almost any width, but it is an open question if the annealing is as perfect in the wider as in the narrow metal; but if found necessary to joint up the brass, a plan will be explained

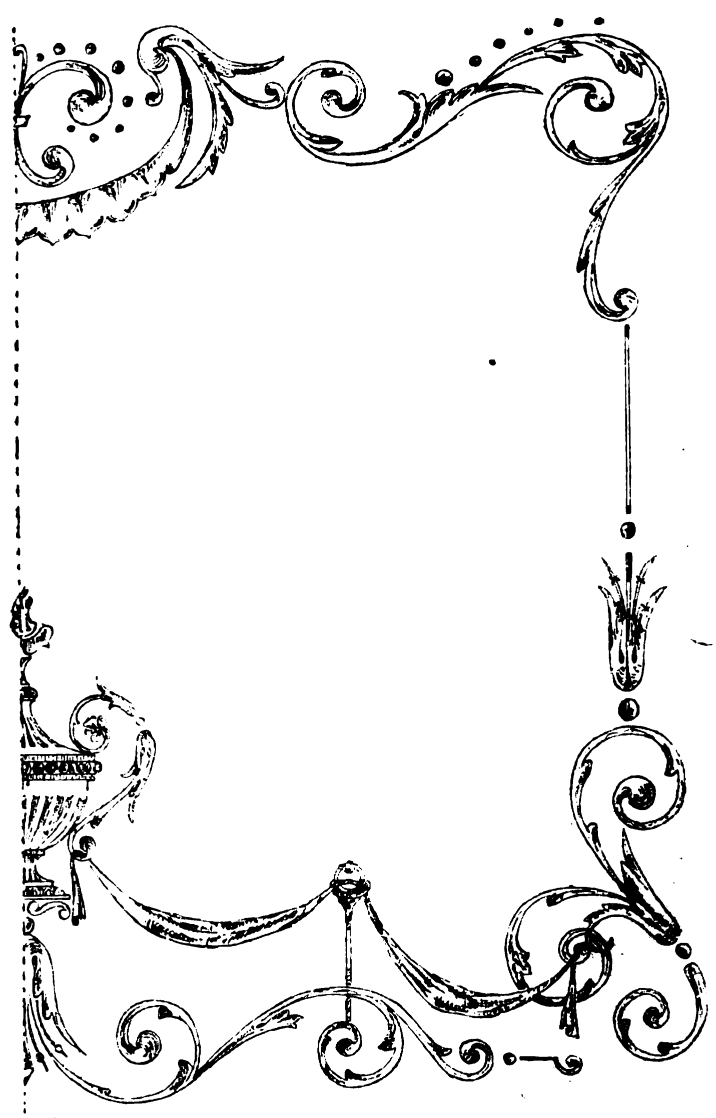


FIG. 103.

FIG. 102.

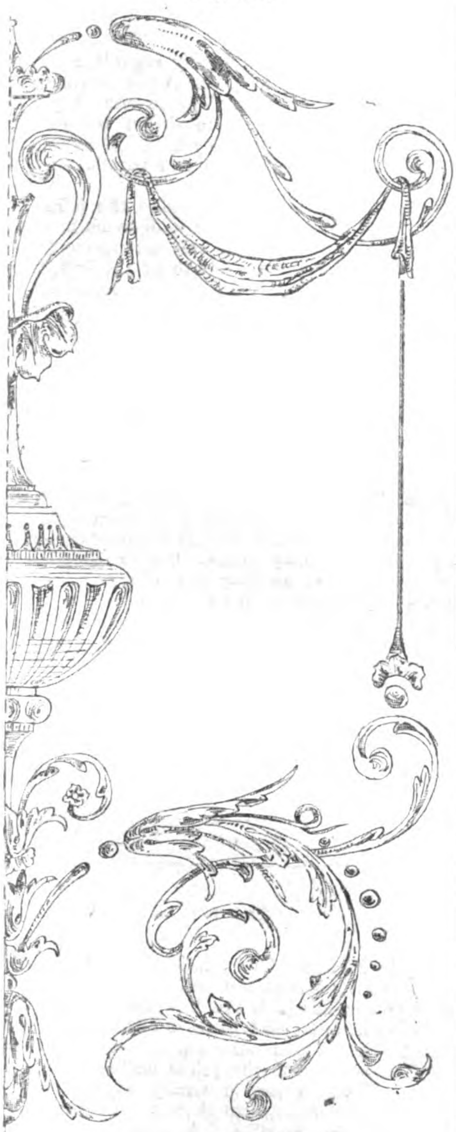


FIG. 104.

whereby the joint will not be so prominent or prone to show.

Another method is to joint up the shell on stiff brown paper (of course, after the reducing process is done), giving a touch of glue here and there to retain the whole

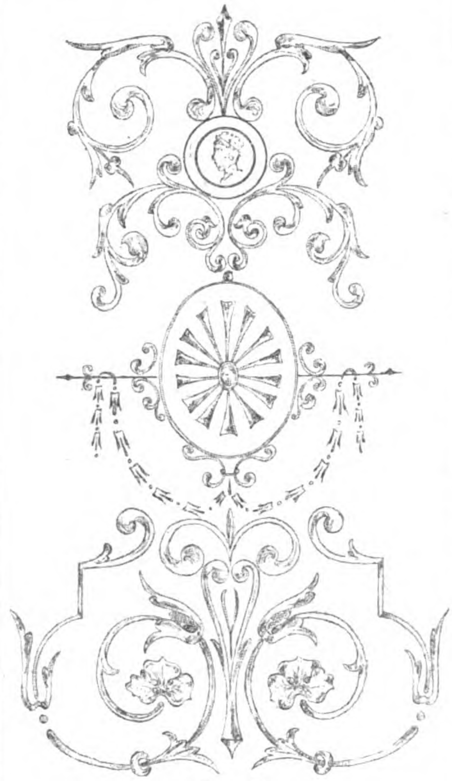


FIG. 105.

fairly firmly together. The colour can then be applied in thin coats, until the requisite density is obtained. When the coloured portion is thoroughly hard, the shell can be cut alone, using a backing of cheap stuff, as before explained. Cutting the brass by itself in either one or two thicknesses may be absolutely necessary, either because a large design demands it, or because a number of smaller pieces can be cut more economically. Again, by having four thicknesses of metal, a four-part design can be cut to great advantage, both in material and exact similarity of form.

Our work would be somewhat incomplete unless we gave means of laying our work after cutting. The difficulty lies not so much with woods that have fast dye colours, but with our work just touched upon. We therefore describe the process now.

Taking for granted the groundwork or body upon which it is intended to glue, veneer, or superimpose the cutting is ready, the first care is to tooth the face of the ground or body; next, to spread an even coat of glue, covering all parts. It should now remain for awhile; and then, when just tacky, the cutting can be laid gently, and in the exact position it is required to remain. To prevent any after-slipping, a few veneer pins should be driven in to fix it safely, but not into any light woods. Driving the pins on the edge of the cutting, and turning a portion over on to the veneer, will in many cases be sufficient. In no wise should holes be made in light wood; the result will be black spots.

The cutting being now in position, it remains to have in readiness a stout piece of mahogany about 1in. thick, named a "caul." The caul is gently heated, and should be of such heat as to cause a given quantity of glue to be exuded when even pressure is put upon the whole, allowing the work to remain under pressure until the remaining glue is thoroughly set. But, in the case of buhl-work, a slightly different course is pursued. It should have been stated that it is usual to have one or two thicknesses of ordinary paper between the cutting and the caul. We also want the paper in this instance, and a layer of some elastic material, such as a piece of felt carpet. Its uses are twofold. Firstly, when pressure is put upon the caul, the inequalities of the shell will have a better chance of being soundly glued to the groundwork or body. Secondly, it prevents the heat of the caul acting too directly. In gluing buhl-work, ever aim at gaining a good heat and no more. If the caul will permit the hand to be placed upon it, it will be about right.

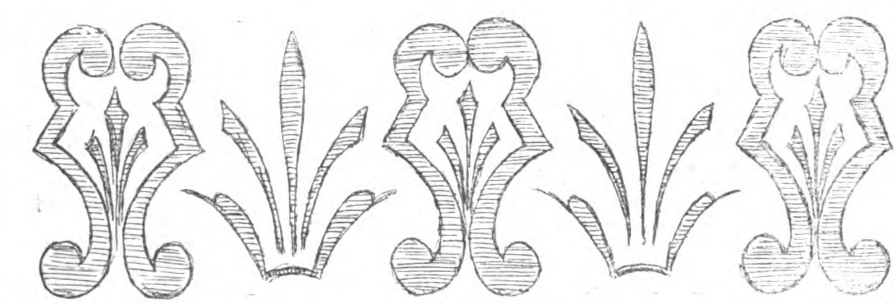


FIG. 106.

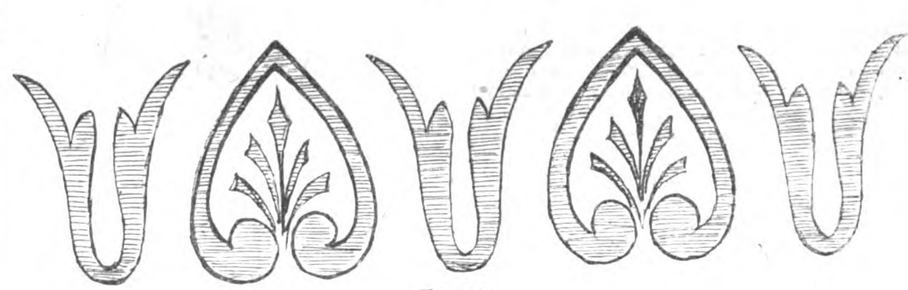


FIG. 107.

MILLWRIGHT'S WORK.—XVI.

THE fastenings of belts are very important details, because the joint is weaker than the solid material, and its strength depends upon the manner in which it is made. There seems scarcely a limit to the modes of jointing which have been adopted. Yet the old-fashioned lacing holds its own still, and is hard to beat. Though it seems to be used less than formerly, yet, when employed by a competent and experienced man, it is most efficient. The difficulty in its use is how best to arrange the lacing to obtain the maximum strength. Some slight projection, too, of the lace and of its ends is unavoidable, notwithstanding the free use of the mallet or roller. But this does not amount to

much in the hands of a neat strapper. Moreover, the process of lacing occupies some time, and must be done neatly if the belt is not to jump as it runs on the pulleys.

Metal fasteners have come largely into use of late years, and divide favour with laces. The objection to them is not non-efficiency, but that

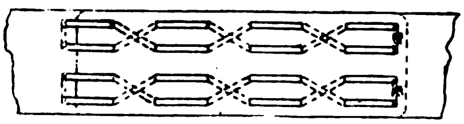


FIG. 87.

many are not flush on the outside, and caution has to be exercised lest the projections come in contact with anything, or lest the clothing of attendants should be caught by them. From this point of view the flush lacing has the advantage. Joints in which the ends stand up cannot be used with binder pulleys, neither can they be used on drives in which both surfaces come in contact with pulleys. Many of these fastenings, therefore, while efficient in holding power, do not fulfil an engineer's idea as to

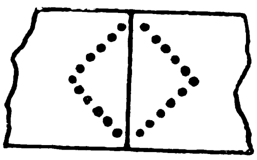


FIG. 88.

safety. All belts which are united in such a way that edges or fastenings stand up cannot be recommended for general use, though they are suitable for situations in which the belts are inclosed, or in which the duties of the attendant do not bring him into close proximity to them. A slight projection in a high-speed belt is liable to catch clothing, and for that reason should be discountenanced for general service.

All belts are built up by jointing short lengths of leather. This is done permanently by the manufacturers. Scarf joints are cut and cemented,

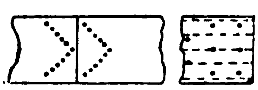


FIG. 89.

and lacing or riveting are added to make a permanent joint. In the shops the length of belting is usually connected in a temporary fashion, because joints have to be made afresh from time to time, in consequence of the inevitable stretching of the belts by the constant tension of service. Hence the joints made in the shops are not often cemented, because that takes longer in making than a temporary lacing. Tullis and Son, however, recommend, when possible to dispense with lacing in favour of cemented joints, and carry it out in their practice.

Belts are joined temporarily with butt, or

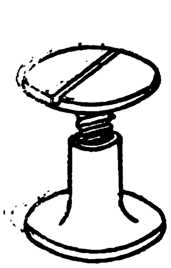


FIG. 90.

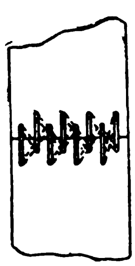


FIG. 91.

with scarfed ends. There are objections to both. The scarfed joint is probably the more common. If made neatly, it permits the belt to take the curves of the pulleys better than the ends of a butted joint. If badly made, it is open to the objection of being either too thin and weakened, or too thick and bunchy. In these details nearly everything depends on the strapper. For this reason none but a qualified man or men should be allowed to meddle with its.

A neat scarfed joint is made by shaving the leather as truly as possible off to a feather-edge, then punching holes with a hollow steel punch,

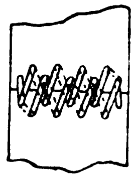


FIG. 92.

through which the laces will be thrust, and pulled taut.

Punching the holes weakens the strap by breaking its continuity. This cannot be helped,

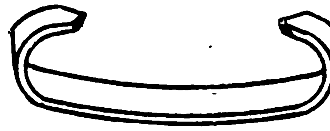


FIG. 93.

and therefore the strength of the belt is estimated across the weakened joint section. Though punching is usually adopted, yet in leather and in woven belting an awl can be used, in which case the material is not cut, but thrust aside, like the grain of wood by a bradawl. The degree of weakening of a belt, however, depends very much on the arrangement of the holes, which is the reason why so many devices are seen in belt-joints.

It is popularly believed that holes made by an

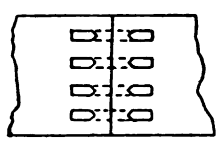


FIG. 94.

awl in leather permit of the full strength, or nearly the full strength, of the belt being retained. Experiments have proved that this is incorrect, and that leather is less liable to tear through when a clean hole is punched. This

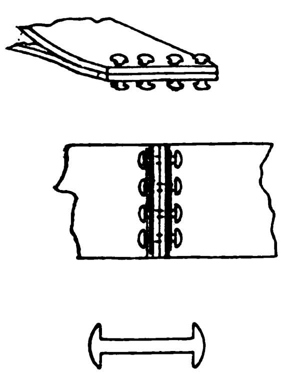


FIG. 95.

seems analogous with the fact that drilling a clean round hole at the ends of an incipient crack in a plate is the best means of preventing its extension. A hole bored with an awl makes a vee'd opening, which is more conducive to an extended

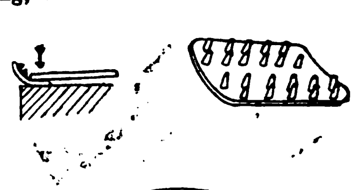


FIG. 96.

rent than a clean round hole. The leather then gives way first, the lace cutting it out.

The best form of hole is probably that which is punched with an *oval* punch, the long direction of the latter corresponding with the length-way of the belt. Another point which experiment has determined is, that there is little advantage in doubling the rows of holes in a butt joint. When

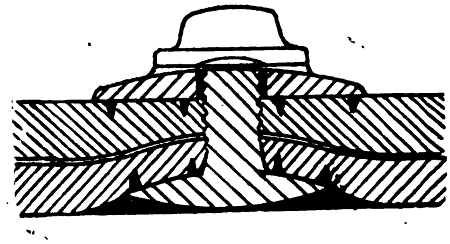


FIG. 97.

a single row of holes is exceeded, the lace holds and the belt fractures.

The common forms of permanent leather-scarfed joints made by the manufacturers are done in the first place by cementing. One type is then laced, the other riveted with copper rivets. I do not know that one is better than the other. The temporary fastenings of belts are so numerous

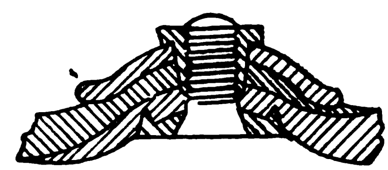


FIG. 98.

that one is often in a difficulty regarding which to select for a given purpose. A common method of temporary lacing, as done in the shops, is shown in Fig. 87, the side shown being that which goes against the pulley face. The straight portions of the lacing then run parallel on the pulley.

Tullis and Son prefer to make the joints of belts, when not cemented, in a diamond fashion (Figs. 88 and 89), because this arrangement retains nearly the whole strength of the belt, two holes only being in line across in any location.

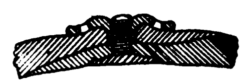


FIG. 99.

One drawback to splicing is the feather-edges of the splice, which are not kept down well by the laces. Herein lies one advantage of cementing even temporary joints. Copper clasps are used to assist in keeping such edges close, the clasps being driven in and riveted over.

For scarfed joints I think next, perhaps, to a good lacing, the steel screw fasteners (Fig. 90) are the best. It has been said that their edges cut the leather, but the fact is they wear themselves out first against the pulleys. They have the advantage of being quickly fitted, lie flush, and hold securely. A butt-joint fastening is

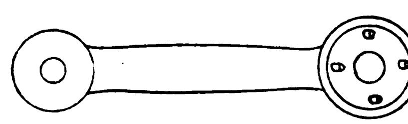


FIG. 100.

shown in Fig. 91. The parallel lines of lace are those which go next the pulley. Fig. 92 is an arrangement in which the lace does not cross on itself, with consequent increase of thickness, but runs in parallel diagonal lines.

We now come to the joints made with metal fasteners, which are generally applied more quickly than laces, and that is their chief advantage. The clip type of fastening is shown in Fig. 93, and the joint in Fig. 94. It is simple, and that is all. Holes are punched near the ends of a butt joint, the clips or hooks inserted, and turned over. Such a joint would fail under a light stress by tearing out of the belt holes, or by straightening of the clips, or by both. The joint

might be strengthened by staggering the hooks and inserting a larger number, which would be the best arrangement possible with this mode of fastening.

A common form of fastening for light belts is that shown in Fig. 95. The ends of the belts are laid face to face, the yellow metal hooks inserted in their holes, the belt straightened and flattened, leaving the ends standing up. Another form of fastener, Fig. 96, consists of a curved plate, with prongs. When applied, the belt is laid on one-half and hammered over the prongs, and turned over and riveted. Then the other end is closed similarly. When the belt and plate are straightened, the teeth bend over, inclining inwards, clipping the belt firmly to the plate.

There are several belt fasteners which are modified forms of the common belt screws; but they are used chiefly in the cotton and canvas

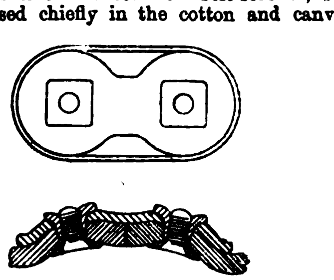


FIG. 101.

belting. Baxter's lock-nut belt fastener, Fig. 97, is a modified screw fastener, but much improved. The top face of the washer has a convex projection, over which the lock-nut fits, and is thereby prevented from slackening back. The head and the washer are well provided with prongs to stick into the belting. Jackson's patent fasteners are neat, the nuts being neatly dished and rounded. The nut sinks into the belt on both sides, its friction relieving the holes of strain. The nut is turned by means of a tommy-like key, which enters into holes in the nut. Fig. 98 shows the oval fastener, Fig. 99 the button fastener, Fig. 100 its key, and Fig. 101 the plate fastener for heavy belting. J. H.

COWPER-COLES SOUND LOCATOR AND PROJECTOR.

THIS instrument is for the purpose of readily locating sound, and for projecting sound long distances. The instrument consists of a reflector which is made entirely by electro-deposition mounted on an arm which can be readily turned on its centre, and depressed or elevated by the operator. When it is desired to ascertain the exact direction from which a sound emanates, the apparatus is turned on its axis, and as soon as the reflector is opposite the source of sound, it is heard much intensified in the receiver.

When it is desired to carry on a conversation between two distant ships or points, two instruments are used, so that the beam of sound is thrown from one reflector to the other, and focussed in the receiver of one instrument. One operator speaks into the flexible tube, while the operator working the other instrument places the tube attached to the receiver to his ear. Conversation can thus be carried on at long distances without unduly raising the voice.

Some experiments have recently been made at St. Margaret's Bay near Dover with this instrument. The ticking of a watch when placed in the focus could be distinctly heard 20ft. away, even with a strong breeze blowing across the line of direction of sound.

PEARL INDUSTRY OF NEW CALEDONIA.

THE pearl and oyster industry of New Caledonia is as yet in its infancy. To those who are familiar with these products, which have been supplied for the last half-century and more from the coral reefs of Torres Straits, Tahiti and Samoan groups, and, later still, from New Guinea, in all of which localities the trade in pearl-shell and pearls has obtained the distinction of a regular European market quotation, it may be surprising that the resources of the vast seaboard of New Caledonia and its dependencies have not ere this become known and seriously worked. Acting-Consul Erskine is of opinion that the oversight may be accounted for by the fact that the great mineral wealth of the colony has no doubt drawn off the attention of the commercial community; but since the advent of the present governor, great encouragement has been given to the development of the other industrial and commercial resources of the islands—hence large concessions having been granted by the French Government. Syndicates were formed for the working of pearls and pearl-shells on the coasts of New Caledonia and the adjacent islands, with the result that at the present moment extensive prospective operations are being carried out to determine the existence and locality of shell banks. There are now two separate parties of concessionaires. The syndicate occupying the whole of the east coast of the island as well as the Chesterfield, Wallis, and Belep groups, is busily engaged in exploring its concessions with the aid of a patent submarine apparatus, which is said to be capable of descending to the depth of 100 fathoms, although 40 or 50 fathoms will be all that is required for the present. This machine is carried by a small ketch of about 38 tons, and it appears from the reports received to be working admirably, and discovering large banks of shells, especially off the north end of the island. Some 12 banks of large extent have been discovered and chartered, one of them, according to Consul Erskine, being about four miles long by about 100 yards wide, at a depth of 25 fathoms. The company working the concessions on the West coast, whose headquarters are at Paris, is stated to be making valuable finds. From 1lb. weight of pearls and upwards are said to be exported monthly. Large numbers of these pearls are sometimes found in each shell, which is mostly of a small size, and called in New Caledonia the "Pontadine," and apparently of small value for trade purposes. The shell banks found on the north coast of the island lie principally in shallow waters, and the oyster is collected by the Loyalty Island boys, who are employed for this purpose by the company at a wage of 30 francs (24s.) a month and rations. It is, however, proposed to import native divers from Tahiti, as they are more experienced at the work than the natives of the Loyalty Islands. Very little export of pearls and shells has so far been made, though parcels of a few tons of shells are occasionally despatched to Europe, and fetch from £40 to £60 per ton. Some of the pearls are valued at from £20 to £120 each. The concessions already mentioned are granted for a period of ten years, with the option of a further extension of ten years to the concessionaires, who must be of French nationality. Consul Erskine says, "If my information can be relied upon, it seems likely that the pearl and pearl-shell industry of New Caledonia has a very successful future before it, and will, no doubt, establish a reputation equal to any of the celebrated pearl fisheries in these latitudes."

SULPHIDE ORES.

AT a meeting of the Society of Engineers, held at the Royal United Service Institution, Whitehall, on Monday evening, a paper was read by Mr. Sherard Cowper-Coles on the "Electrolytic Treatment of Complex Sulphide Ores."

In introducing his subject, the author gave particulars of the present concentration system adopted at Broken Hill, so as to produce an argentiferous lead concentrate sufficiently low in zinc to be available for the ordinary lead smelting furnace. He then proceeded to give some particulars and figures of the cost of distilling zinc from its ores, the cost of producing a single ton of zinc, including coal, labour, pottery, and stores being usually not less than 80s. He pointed out that the present process is primitive and very wasteful, about 16 per cent. of the metal being unextracted from the ore, and 10 tons of coal being required in many instances to produce one ton of zinc. Reference was made to experiments for producing zinc in a blast furnace.

The author then recounted some of the chief characteristics of sulphide ores, and gave analyses of various samples. A historical sketch of the investigations undertaken by various workers in this field then followed, and particulars were given of Watt's, Dieffenbach's, Ashcroft's, Siemens and Halske's, Hoepfner's, Mohr's, and Swinburne's processes. The author then described in detail a number of experiments he had made on a practical scale on sulphide ores, and enumerated the difficulties that had been encountered, and how they had been met. Information was given as to the crushing of the ore, the roasting, and details of the type of roasting furnace employed. The next operation described was the leaching out of the zinc with sulphuric acid, and purifying the zinc solution obtained by passing it through epuration tanks, the purified solution then being circulated through electrolysing cells, and the zinc deposited in a metallic form. The advantages of aluminium revolving cathodes were then considered, also the best material for the anodes.

The effect of impurities in the electrolyte was described, and an analysis given of a sample of zinc sponge, also particulars as to the cost of depositing zinc. A diagram was exhibited showing the actual weight of zinc deposited as compared with the

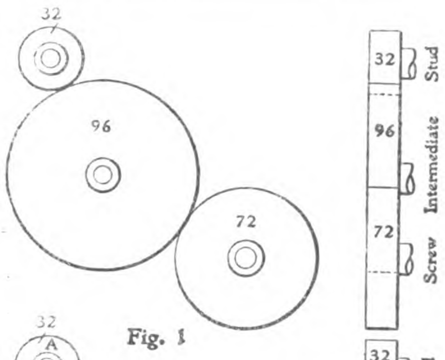


Fig. 1

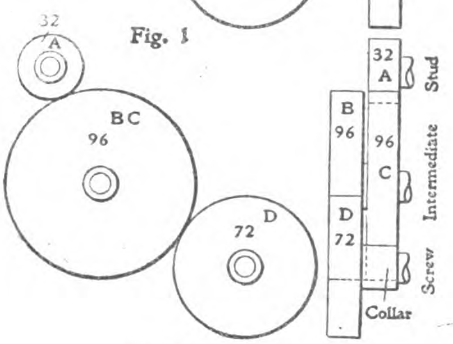


Fig. 2

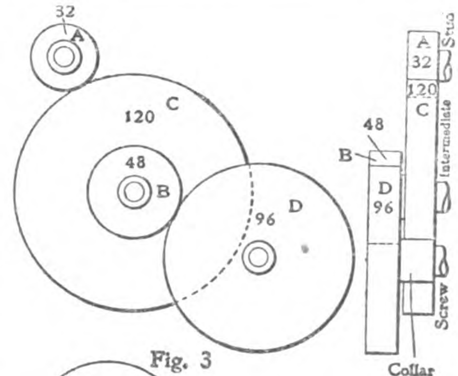


Fig. 3

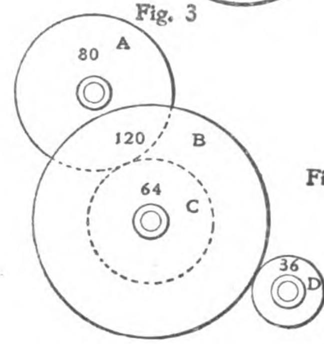


Fig. 4

theoretical, with varying current densities. The process of manufacturing zinc white and zinc sulphate from zinc-bearing ores, and the leaching out of the lead remaining in the ore after the zinc has been extracted were described in detail. The cost of electro-depositing the lead was also given, the cost being far less than that of zinc. The author stated that the current which would deposit one ton of zinc would deposit three tons of lead. The theoretical amount of electrical energy required to deposit one ton of lead was stated to be 263·5 kilowatts, which, at $\frac{1}{4}$d. per kilowatt, equals 11s. per ton of 2,240lb. of lead deposited. Particulars of a process for the manufacture of litharge and white lead direct from lead-bearing ores were also given. The author then described the final operation of leaching out the silver and depositing the same from a cyanide of potassium solution. The paper was illustrated by diagrams, and a large number of specimens of crude sulphide ores and their products were exhibited.

COMPUTING COMPOUND GEARS.

THE following remarks on the method of computing gears for cutting threads are extracted from an article in the *American Machinist*, by Mr. Morris Fulton, of Philadelphia:—Say that we have a screw-cutting engine lathe arranged for using the gears either simple or compound, with a lead-screw having a pitch of four to the inch, and the following list of gears: 24, 32, 36, 40, 48, 56, 60, 62, 64, 66, 69, 72, 78, 80, 84, 96, 120. This may not be the best possible selection of gear numbers, but they will answer our purpose. There are, of course, two gears alike for cutting the same pitch as the lead-screw, and there is also a gear for cutting $11\frac{1}{2}$ threads to the inch for wrought-iron pipe and fittings.

Fig. 1 shows one of the simplest cases of single or direct gearing. Assuming here that the stud turns at the same speed as the lathe-spindle, then if the gears on the stud and on the screw were of the same size, or had the same number of teeth, they would both turn at the same speed, and the thread cut by the tool would have the same pitch as the lead-screw. In this case, however, the driving-gear on the stud and the driven gear on the screw have not the same number of teeth. The number of teeth on the screw being the greater, the screw will, of course, turn slower than the stud or spindle, and the tool will cut a thread finer than the lead-screw, or will cut a greater number of threads to the inch. The ratio of the lead-screw pitch to the pitch of the screw that is cut will be the same as the ratio of the gear on the stud to that on the screw. To find, then, the number of threads to the inch that these gears will cut we have the simple proportion:—

$$32 : 72 :: 4 : 9.$$

Here, of course, the operation is $72 \times 4 \div 32 = 9$, or the number of teeth in the gear on the screw multiplied by the pitch of the screw, and the product divided by the number of teeth in the gear on the stud gives the number of threads to the inch that the gears will cut.

If, instead of this, we wished to cut a certain number of threads to the inch, we would first select some gear for the stud, remembering generally that if a fine thread is to be cut, a small gear will be required, while if a coarse thread is to be cut, a larger gear must be used. Say that we want to find the gears for cutting nine to the inch. We select 32 for the stud, and we have this simple proportion:—

$$4 : 9 :: 32 : 72.$$

That is, after selecting the stud gear, we multiply it by the pitch that we want to cut, and divide the product by the pitch of the lead-screw. If we had taken 40 for the stud, then the operation would have been:—

$$4 : 9 :: 40 : 90;$$

but as we have not a 90-tooth gear in our list, that would not do.

In simple or direct-connected gearing like this, the diameter, or the number of teeth in the intermediate gear, need not be considered, as the intermediate gear merely transmits the motion, tooth for tooth, from one gear to the other. In the compound gearing on the engine lathe there are two gears on the intermediate stud which revolve together, instead of the single gear. In the compound train shown in Fig. 2 these gears both have the same number of teeth, and it is evident, without computation, that the result is precisely the same as in Fig. 1. Compound gears are, however, frequently necessary, to enable us to cut either coarser or finer threads than would be possible with the simple gearing, and in some cases they enable us also to cut fractional threads that are not at either extreme as to pitch. In Fig. 3 the train shown is for cutting fine threads, and the train in Fig. 4 is for a coarser thread than the lead-screw.

In these trains the gears A and B are designated as drivers, and C and D as driven gears. The ratio of the pitch of the lead-screw to the pitch of the screw that is cut will be the same as that of the product of the drivers to that of the driven gears. To ascertain the number of threads to the inch that will be cut by the gears in Fig. 3, we have the proportion:—

$$32 \times 48 : 120 \times 95 :: 4 : 30.$$

That is, we multiply the driven gears together, and this product by the pitch of the lead-screw. We also multiply together the two drivers, and use this product as a divisor of the previous product, the quotient being the pitch required.

The pitch resulting from the combination shown in Fig. 4 is obtained by the following compound proportion:—

$$20 \times 120 : 64 \times 36 :: 4 : \frac{96}{100}, \text{ or } {\cdot}96.$$

This last result must not be misunderstood. The pitch of the thread is not $\frac{96}{100}$ths of an inch, but it means that $\frac{96}{100}$ths of one thread will be contained in one inch measured on a line parallel with the axis of the screw. The total measure of one thread along this line would be $1\frac{4}{96}$in. or $1\frac{1}{24}$in.

Returning to Fig. 3, say that we have to find the gears to cut 30 threads to the inch. The difficulty in the matter is that we here have to assume, or to "select at random," three of the four gears, when we may easily compute the fourth. It will generally happen that the gears first picked out will not do, and others must be selected and another computation made. In this case we know that, as the thread to be cut is a fine one, the drivers must be comparatively small and the driven gears large. We first take, then, say, the two smallest gears on the list for the drivers, and the largest gear on the list for one of the driven. Then, to find the other, we have this proportion:—

$$4 : 30 :: 24 \times 32 : 120 \times x.$$

Then $(24 \times 32 \times 30) \div (120 \times 4) = 48$, the other gear. That is, we multiply together the two drivers and the pitch of the thread to cut, and divide this product by the selected driven gear multiplied by the pitch of the lead-screw, the quotient being the number of teeth for the other driven gear. We now have the full set of gears for cutting the required thread; but when we try to connect them on the lathe we find that they will not reach. It is evidently necessary to use some larger gears, so we start again with 32 and 48 for drivers, as in Fig. 3, and 120 for one of the driven, as before, when the other driven gear is found to be 96, and these connect all right. In this case it was not necessary to restate the proportion and go through the whole computation again. We have simply taken one driver, 24, and one driven gear, 48, and multiplied each by 2, giving us 48 for a driver and 96 for the driven gear. A simple case that might be quite likely to come to us would be to cut a screw of one thread to the inch. In this case we know that we have to speed up the screw, so we take big gears for the drivers, and we have the proportion:—

$$4 : 1 :: 120 \times 96 : 32 \times x,$$

and we find that the other driven gear will be 90, making the complete series: drivers, 120 and 96; and driven gears, 32 and 90. When we come to connect these we find that they are too large, so we take the 120 driver and the 90 driven, and subtracting a third from each, we get, instead, 80 and 60, which have the same ratio as 120 and 90, and our set of gears is then: drivers, 80 and 96; and driven gears, 32 and 60. There is still an objectionable feature about these. The driven gear, 32, is too small, and will not drive as well as a larger one. We take 40 instead, and in making this larger we have to make the other driven gear smaller, to keep the product of the two the same, so we multiply together the driven gears, 32 and 60, and divide this by 40, and the quotient will be 48 for the other driven gear, and our set then becomes: drivers, 80 and 96; and driven gears, 40 and 48, which should be a satisfactory train for cutting one thread to the inch.

THE STEAM TURBINE.

AT a recent meeting of the Institution of Junior Engineers, the Hon. C. H. Parsons said he had been requested by the retiring president and the committee to deal with the subject of turbines, with which his work had been specially connected. The first engine deriving its motive power from fuel was recorded in the Pneumatics of Hero of Alexandria about 200 B.C. This engine was a crude form of steam turbine; but from that time the principle had been allowed to lie dormant until A.D. 1629, when it was suggested again by Bianca in another form. About 15 years ago he (Mr. Parsons) was led to investigate the subject of improving the steam turbine and its application to the propulsion of vessels. The first vessel fitted with steam turbine machinery was the *Turbinia*, begun in 1894 and completed in 1897. She was estimated to have attained a speed of $34\frac{1}{2}$ knots; she had been out in very rough weather, and was an excellent sea boat, and at all speeds there was an almost complete absence of vibration. The turbine principle was being applied successfully to torpedo-boat destroyers, and in regard to larger ships the conditions appeared to be more favourable in the case of the faster class of vessels, such as cross-Channel boats, liners, and cruisers. In such vessels the reduction in weight of machinery and economy in coal consumption per horse-power were especially important, and the absence of vibration was also a great advantage. A boat 270ft. long, 33ft. in beam, of 1,000 tons displacement and $8\frac{1}{2}$ft. draught, could be constructed with spacious accommodation for 600 passengers, and with machinery developing 18,000H.P. such a vessel would have a speed of about 30 knots, as compared to the speed of 19 to 22 knots of the present vessels of similar size and accommodation. It might be interesting to examine the possibilities of speed attainable in a special unarmoured cruiser—a magnified torpedo-boat destroyer of light build, with scanty accommodation for a large crew, but equipped with an armament of light guns and torpedoes. Assuming dimensions double those of the 30-knot destroyers, and plates of double thickness, specially strengthened, there would be two tiers of watertube boilers, and eight propellers of 9ft. diameter, revolving at about 400 revolutions per minute. The speed would be nearly 44 knots. She could carry coal for this speed for about eight hours, but she would be able to steam from 10 to 14 knots with a small section of the boilers more economically than other vessels of ordinary type and power.

THE total quantity of coal brought coastwise to the port of London last year was 7,378,000 tons.

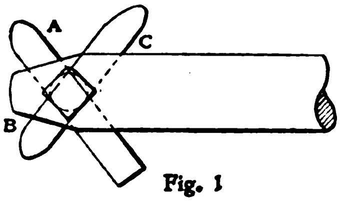


Fig. 1

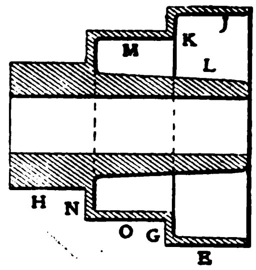


Fig. 3

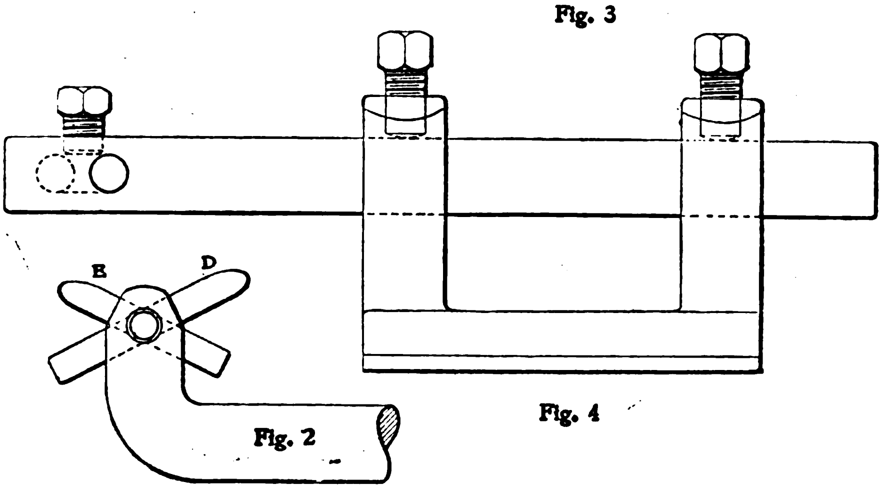


Fig. 4

Fig. 2

BORING-TOOLS.

HAVING read a number of articles of recent date on boring-tools of various descriptions, I would like to describe a tool of my own make, which I believe is original. At the time this tool came I was employed in a shop in the central part of Ohio. This shop at that time was building turret-lathes. It being a new venture, and the shop employing but few men, it could not support a blacksmith, and every machinist had access to the forge, where he did his own forging and tool-dressing. There was a portable forge in the basement, and a boy to do what striking was necessary.

Having been given the job of finishing the cones for these lathes, Fig. 3, which were turned all over, I placed one of them in a chuck and trued it ready for boring. My next job was to find a boring-tool long enough to bore through the cone, and, finding none, I proceeded to the basement and forged a tool, to the best of my ability. The tool was so long and slender I was unable to get below the scale on the casting. At last, giving up in despair, I went to the foreman and told him my troubles. He said he didn't see any reason why the tool would not work if it was properly ground, and tried it, to satisfy himself, but with the same result. I then approached him with the subject of making a tool and holder. I explained my idea to him, and told him I was sure such a tool would do. I could not convince him, but he at last consented to let me make the tool. I got a pattern made, and then the casting for the standard, Fig. 4. This I planed with a tongue on the bottom to fit the top of the rest, and secured it by a bolt in the centre. The hole for the tool I drilled near the size, and then bored true with a small bar on the centres, and put in the two $\frac{5}{8}$in. set-screws. I made two bars of 1in. round steel, one bent and the other straight, and of the right length. The nose was cut away taper on the two sides, and two $\frac{1}{4}$in. holes were drilled obliquely, as shown, and crossing each other in the centre, where I had a $\frac{1}{4}$in. set-screw to hold the little tools that did the cutting, and when I had these all lipped and ground I was ready for business.

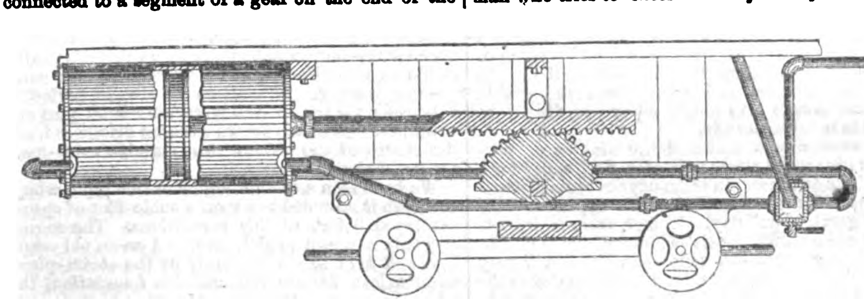
With the tool in the position B I did the boring, and that and turning the inside of the cone was all I had calculated to do with the tool. With the cutter in the same position I turned surfaces marked I and M, and faced K. I then changed the tool to A, and turned and faced the hub and turned the large step F. I then used the bent tool, Fig. 2, and with D I turned O and faced G, also that part of H that was not held in the chuck, and faced N.

I had thus finished the entire cone, except the small part in the chuck. I then went at the task of convincing the foreman that I had a good tool; but he would not be convinced. To give him his just dues, however, when I left there that was the only tool that he would allow to be used for turning cones.—A. F. HORTON, in *American Machinist.*

A VERY active programme of shipbuilding on the Great American Lakes is being inaugurated. The Carnegie Steel Company have ordered five steamers, each 475ft. long.

WELDING-MACHINE OPERATED BY AIR.

THE illustration shows an appliance which has been attached to the Debombourg welding and upsetting machine used in the Erie shops at Galion, Ohio. The machine was originally operated by a lever 7ft. long, and required from one to four men to operate it. It is now operated by the valve shown in sketch. The cylinder is 12in. by 27in., and has a rack on the end of piston-rod. This is connected to a segment of a gear on the end of the eccentric shaft. This appliance was gotten up by Mr. A. A. Arnold, machine foreman, under the supervision of Mr. A. W. Ball, master mechanic, and is one of the many air appliances used in the Erie shops at Galion, Ohio.—*Locomotive Engineering*, N.Y.



AN APPARATUS AND METHOD FOR PREPARING AGAR.

IN the April, 1898, number of the *Journal of Applied Microscopy*, Miss Marion H. Carter, of Cornell University, published a method for preparing agar for the cultivation of bacteria. Being impressed with its simplicity, I determined to give it a trial, inasmuch as it promised to save considerable labour. Repeated trials have proved that much of the drudgery connected with the preparation of this important medium may be avoided by employing Miss Carter's method. The object of the present article is to emphasise this fact, and to describe an apparatus which I have devised for employing the method. The apparatus consists mainly of an ordinary 9in. copper funnel, with an inch-wide perpendicular wall round the top, which may be obtained ready-made at the shops. To it are added a cover, and three legs having a spread equal to the greatest diameter of the funnel. The spout may be closed by means of a rubber stopper, or a cap may be soldered on. In the former case the funnel will be found useful in other directions. A funnel of this size will hold a gallon, and gives ample room for work.

If one litre of medium is wanted, place about 900cc. of bouillon in the funnel, 10 or 15grm. of pulverised agar, according as a 1 per cent. or a $1\frac{1}{2}$ per cent. solution is desired, to the other 100cc., and mix thoroughly by rubbing up in a mortar or a beaker. Place the mixture thus made in the funnel, and stir thoroughly. If the agar is in the stalk form, it may be put directly into the funnel after having been cut up. Now place the funnel with its contents in a 11in. by 13in. can, containing sufficient water to last for two hours, and boil. An Arnold steriliser may be used instead of the can, if desired. After boiling for an hour, turn off the gas, remove the covers, and stir the agar solution, especially that in the spout of the funnel. Replace the covers, and boil another hour. Turn off the gas, and allow the whole to cool, taking care not to disturb the solution at this time. After solidification has taken place, remove the funnel, invert it on a glass plate, and the agar will come away as a mould. That portion from the spout will be found made up of the insoluble materials which ordinarily interfere with filtration, and which usually amount to about 1 per cent. of the whole mass. It is to be sliced off and thrown away. The remaining portion will be sufficiently clear for ordinary purposes, and may at once be remelted, distributed, and sterilised. Should it not be sufficiently clear, it may be clarified by the usual method. Filtration may then be readily accomplished, since most of the foreign and insoluble matter has been removed by the sedimentation process. As might be supposed, the nutritive qualities of agar thus made are in no way interfered with. Over fifty different species of bacteria have been grown upon it with perfect success by the writer.—CHARLES F. DAWSON, M.D., Washington, D.C., in the *Journal of Applied Microscopy*, N.Y.

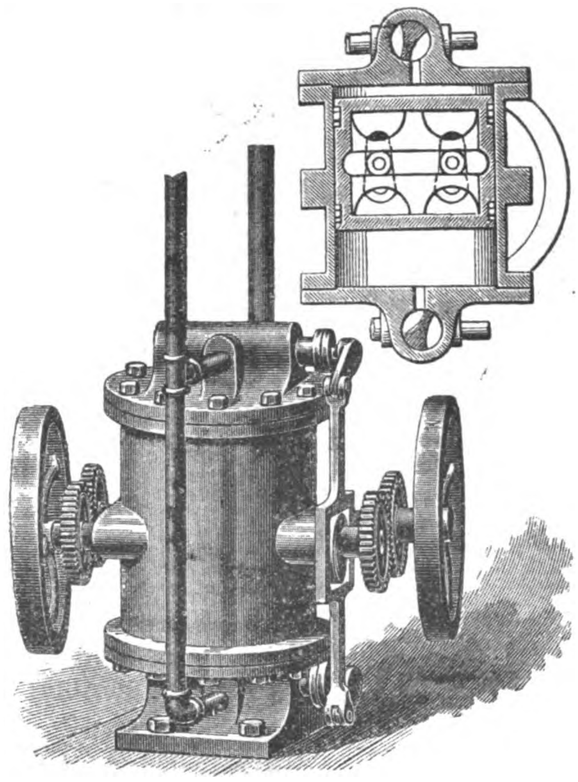
LANTERN SLIDE-MAKING FROM THE SPECIALIST'S POINT OF VIEW.

IN these days of high-pressure work, the truth of the proverb, "Jack of all trades, master of none," is more than ever apparent to everyone, and especially to photographers. When we see an amateur exposing on anything that comes in his way, be it landscape, architecture, animal or figure study, or what not, we generally class him in that wide and extensive species of beings known as "wasters." Whatever class of science or skilled work you take, you will see that the men whose works are looked on as standards of excellence are those who have struck out on some well-defined line and gone ahead solely in that direction. A man who tries to excel in every or any direction is bound, sooner or later, to have to give it up, and concentrate his energies on one particular class. So in photography. The men who are known as leaders in photographic circles are not all-round men, but those who have striven in one particular direction. Figure studies, landscape, sea studies, architecture, portraiture, and various other special classes of photography all have their leaders.

There is also another class of specialists. We find some workers devote all their energies to one particular printing process. It may be platinotype, or carbon, or it may be lantern slides. But these are not the kind of specialists which we are here considering. It is the first class of specialists which we are discussing.

It is obvious that an architectural photographer will work for a different result to a man who is making figure studies his *forté*. The architectural man will generally find that a black tone is one which suits his subject best, and therefore he must regulate his exposure and development in order that the colour of the deposit may be of an appropriate shade. As a general rule, he will have no need for the special tones which his *confrère* who goes in for landscape, portraits, or figure studies may often require. Different shades of greys and black will be the prodominating colours in his collection of slides.

In the case of the landscape photographer, however, the case is altered. Different atmospheric conditions, and various other things, will be found to be more accurately conveyed to the observer of the finished slides by means of a variety of tones, not only of different shades of reds and blacks, but even in some cases by a blue or green. It therefore behoves a photographer of this class to be able to obtain these various tones at will. He should be expert in toning to any of the colours



which he knows are of use in rendering his various subjects correctly, and in regulating the different processes through which the slide passes, in order that, when finished, it will express in the fullest possible degree the sentiments which it was intended it should convey to the observer. In this branch of photography perhaps I ought to mention one class of subject which seems to be particularly adapted for lantern slides. I refer to those views in which it is endeavoured to convey the idea of a moonlight or sunset scene. In my opinion, there is nothing which shows so well the artistic value of a lantern slide as a well-rendered moonlight scene or a sunset picture. Here we have a wide field open to the photographer and slide-maker, and one in which the results will amply repay you for all the trouble taken over a slide.

The worker who makes figure studies or portraiture his special study will also find a use for a large range of tones. In these days of sepia platinotype, the red tones for portraiture appear to have gained great popularity. In fact, from an inspection of some professionals' windows, one would be led to believe that this tone runs the black very close. To these workers, then, such plates as the Ilford Alpha and others of that description will be valuable tools, whilst, as I have said before, the specialist in some branches of the black art will hardly ever require them.

Seascapes and wave studies are also very suitable subjects for lantern-slides, and the photographers who devote themselves to these subjects will find plenty of work for the winter evenings, which should result in slides worthy of the title "pictures." The worker in this class will also find that he wants a long range of colours for his slides, and, therefore, he must be able, when the opportunity occurs, to produce a blue or a black or any other tone that will set off his slide to the best possible advantage.

These are only a few instances of how an amateur must work to secure results to fit in with his own special branch; but everyone will find that his slides will have some particular characteristics in accordance with the branch which he has adopted which would not be suitable for a slide of a different class of subject.—"ALEX," in the *Photographic News*.

HOYT'S HIGH-SPEED ENGINE.

A SIMPLE form of engine, which would occupy but little space, and which, nevertheless, would develop considerable power, has long been sought by manufacturers of automobiles and launches; for the motors at present in use are not only very bulky and heavy, but are often too complex in construction to be readily controlled. We have recently had the opportunity of inspecting a small high-speed engine, invented by a mechanical engineer, Mr. Gabriel P. B. Hoyt, of Jamaica, Borough of Queens, New York City, which will probably find its broadest field of usefulness in automobiles and launches, in which, as we have already remarked, high-power engines of small size are of the utmost importance.

The engine in question comprises essentially a cylinder in which a reciprocating piston is mounted, provided with a slot into which the wrist-pins of two crank-arms extend. The crank-arms are carried by shafts, which at their extremities are provided with gear-wheels meshing with each other. When steam or any other motive agent is admitted to the ends of the cylinder a continuous rotary motion is given to the shafts by the action of the slotted piston on the crank-arms and wrist-pins. The two shafts being geared together, a uniform rotary motion is obtained without vibration, especially when the piston starts on the return stroke, as the two shafts rotate in opposite directions by reason of the connecting gearing. The piston is always perfectly balanced; for the oppositely-turning wrist-pins are at all positions of the stroke at equal distances from the centre of the piston. Any suitable valve-gear can be employed.

We have seen a double engine of this type, which although it occupied less than a cubic foot of space, developed 6H.P. at 600 revolutions. The engine was only a rough model, mounted on an old soap-box, and held in place merely by the steam-pipe; nevertheless, despite the unstable foundation, the vibration was hardly perceptible either to the eye or touch.

By changing the construction of the valves the engine can be converted into a gas-engine, in which form it will probably be especially serviceable in launches. The lack of vibration, the large power which is condensed within a small space, and the simplicity of construction, in which the usual cross-heads and guides have been dispensed with, are the chief points of interest in this new engine.—*Scientific American*.

"THE HEAVENS AT A GLANCE" for 1900 is Mr. Mee's useful card almanac or celestial diary, which amateur observers have appreciated in former years. It is published by the author at Penhill, Cardiff.

ARTIFICIAL paving-stones are being successfully produced in Germany. The process of manufacture is to mix coal-tar with sulphur and warm thoroughly, and then add chlorate of lime. After cooling the mass is broken into small pieces, and mixed with glass or blast-furnace slag. This powder is then subjected to a pressure of 200 atmospheres, and reduced to the forms wanted. The resistance to wear and tear in use is fully half as great as that of Swedish granite.

SOME of the western railways of the United States have in use a weed-burning apparatus, one of which worked over 900 miles of road last year at a cost of less than 2½dol. per mile. The apparatus comprises a lamp using oil vapour. This vapour is kept close to the track by a shield over it. The intense heat burns the weeds between the rails. Once at work, the shield is lowered within 4in. of the rail, and when not in use it is raised to 18in. above the rail. The operation is somewhat slow, only about 1¼ mile an hour being covered.

SCIENTIFIC NEWS.

THE Leonid meteors are expected on the nights of Nov. 13 to 16, but the probable time is the early morning of Nov. 16, the middle of the shower, according to calculation, being about 6 a.m., Nov. 16. It is certain that many observers will be "on the watch," and it is to be hoped that they will not be disappointed, but it is possible that they may be—just as they were last year. Still, all who have the time and the desire to observe should look out for the meteors and record what they see, in their own words, but being particular as to the time, which should be G.M.T. if possible. It is possible that the shower will not be seen in its greatest display until 1900. For "astronomical" purposes the determination of the "radiant" from visual observations is the most important. This is a class of observation that requires practice and previous training, and an intimate knowledge of the sky. It is required to know not only the radiant point or radiant area for the entire shower, but also the position of the radiant at short intervals of time—at every half-hour, for instance. This is an observation of extreme importance, as from it can can be learnt if the radiant shifts during the progress of the storm, or, in other words, if the attraction of the earth influences the position of the swarm's orbit, and in what manner it does so. On this depends our power to predict the history of the shower in the future. Prof. E. C. Pickering, of Harvard College Observatory, has issued a circular giving directions for observing, and any notes of the meteors seen may be sent to Mr. W. F. Denning, the director of the Meteoric section of the British Astronomical Association.

The Leonid meteors are to be observed (if possible) from a balloon which will ascend near St. Denis on Nov. 14-15, and the following night. Probably the most successful observations last year were those made at Paris by means of a balloon when the city was covered by a fog or black cloud. Dr. Janssen, director of the Meudon Observatory, will make all the arrangements, and if the Leonids come in numbers over Paris and its environs, they will be certainly captured photographically.

The Gresham lectures on astronomy will be delivered by the Rev. Edmund Ledger, M.A., F.R.A.S., on Nov. 14, 15, 16, 17, commencing at 6 p.m., at Gresham College, Basinghall-street, E.C. The subject is "Sidereal Astronomy in Relation to the Constellations of Cygnus, Lyra, and Hercules."

A reproduction of one of Dr. Isaac Roberts's photographs of the stellar regions appears in *Knowledge* for this month. It is a photograph of the nebulæ surrounding D.M. 1848 Monocerotis, and is of especial interest, because it is new. Dr. Roberts says: "The surfaces of these nebulæ are strewn with numerous stars besides the nebulous condensations which are doubtless involved in the nebulosity; but it is probable that the stars are not involved, and are placed either behind or else in front between the earth and the nebulæ."

The Hampstead Astronomical and Scientific Society has a small observatory erected on the East Heath, in which the members can have an opportunity of using a reflector with a mirror of 10¼in. Mr. P. E. Vizard will commence a series of five lectures on Nov. 20 in connection with the society, to be continued on following Monday evenings.

It is stated that the following gentlemen will be nominated for election on the new council of the Royal Society at its anniversary meeting on the 30th instant: — President, Lord Lister; treasurer, Mr. Alfred Bray Kempe; secretaries, Sir Michael Foster and Prof. Rücker: foreign secretary, Dr. T. E. Thorpe. Other members—Mr. Horace Brown, Captain Creak, R.N., Prof. Dewar, Prof. E. B. Elliott, Dr. Gadow, Dr. Halliburton, Prof. W. A. Herdman, Sir John Murray, Sir Andrew Noble, Prof. Reinold, Dr. Stoney, Mr. C. J. Symons, Mr. Teall, Prof. J. J. Thomson, Dr. Tylor, and Sir Samuel Wilks, Bart.

Suggestions have from time to time been made that the British Association should occasionally go further afield than the United Kingdom for its annual meeting, and twice this great gathering of scientists has taken place in Canada. The council has recently received an invitation from Ceylon to fix an early date for a visit by the

Association to that island. It is, however, very improbable that the council will see its way to accepting the invitation. The time required for the double journey would be an obstacle to the attendance of many members, so that nothing like a full meeting could be expected, while the season at which the Association usually assembles is also a serious consideration in connection with a proposal for going to a Tropical climate. It is probable that a visit to Ireland may be arranged for the year 1902.

The session of the Royal Geographical Society commences on Monday, Nov. 13, when the president, Sir Clements Markham, will give a short opening address, which will be followed by a paper by Mr. W. Rickmer Rickmers on his "Travels in Bokhara." The paper at the following meeting, November 27, will be by Mr. Vaughan Cornish on "Desert Sand Dunes." At the December meeting, Colonel Sir John Farquharson will probably give an "Account of the Past Twelve Years' Work of the Ordnance Survey," from the directorship of which he has recently retired. Other papers expected to be given during the session are: "An Ascent of Mount Kenya," by Mr. H. J. Mackinder; "The Work of the Yermak Ice-Breaker in the Spitzbergen Seas," by Admiral Makaroff; "Travels in Central Asia," by Captain H. H. P. Deasy; "Travels in the Region of Lake Rudolf and the Sobat River," by Captain Wellby; "Travels in Abyssinia," by Mr. H. Weld Blundell; and "Anthropogeography of British New Guinea," by Prof. Haddon.

At the Royal Victoria Hall, Waterloo Bridge-road, on Nov. 14, Mr. W. J. Pope will deliver a lecture on the "Uses of Distillation." On Nov. 21 Dr. J. W. Waghorn will lecture on "Bad Contacts in Their Application to Telephones and Wireless Telegraphy"; and on Nov. 28 Mr. Michael Sadler will lecture on "A Brother of the Birds."

The Reader in Geography at Oxford University has returned from East Africa, and Mr. Mackinder has, it appears, accomplished the ascent of Mount Kenya. Mr. Mackinder's expedition included five Europeans besides himself, two of whom were Alpine guides from Courmayeur, two natural-history collectors, and Mr. C. B. Hansburg, a skilled amateur photographer. The journey to the lower slopes of Mount Kenya was full of interest, the route lying for some distance through one of the most thickly-populated and most highly-cultivated regions in Africa. According to the notes in the *Scotsman*, Mr. Mackinder established his base camp on the Sagana River, and then with his guides and his collectors set out for the exploration of Mount Kenya. He has succeeded almost beyond his expectations in mapping the entire mountain and its immediate neighbourhood, having not only ascended to its summit, but made a journey round the shoulders of the mountain just below the glacier level. He has thus been able to establish that there are no fewer than fifteen glaciers on Mount Kenya.

The death is reported of Dr. E. J. Petri, Professor of Geology and Ethnography in the University of St. Petersburg. He was formerly professor at Berne.

Mr. Frederick Wilkinson, the inventor of several useful appliances in connection with the machinery used in the textile industries, is dead. He invented the revolving-disc carding engines, and a few years ago devised a means of case-hardening the tips or carding points of card wire.

M. Berthelot has been making some investigations into the phenomena of hydration and oxidation at the expense of organic substances under the free influence of oxygen and light, and he concludes that such substances as the sugars, carbohydrates, glycerides, are affected by simultaneous hydration and oxidation—in nature. M. Berthelot's experiments were carried out on the slow oxidation of ether in the presence of air and water, and were presented in a memoir to the Paris Academy of Sciences.

Lyddite is one of the high explosives which are now in use by all the great Powers, and, in fact, by some of the minor States. It is so named from the experiments having been first made at Lydd, in Kent; but although there is some secrecy about its manufacture, it is well known that it is practically the same as Mélinite, écrasite, and other explosives. The base is picric acid, which is brought into a dense state by fusion, but when "fired" burns violently, and therefore "explodes" with terrific force. Picric acid has been used for many years in the dyeing industries, as, amongst other tints, it produces beautiful yellow dyes.

An invention that is much wanted is a "recording" instrument for the telephone, so that some evidence may be available as to what was actually said to the telephone. According to a technical serial an interesting invention has been made by a young Danish engineer, purporting to connect a phonograph of special construction with the telephone. In case the person for whom a telephonic communication is intended is absent, the phonograph will receive it in his place, and repeat it to him on his return. The phonograph is without a wax roller, and is based upon a system totally different to and decidedly less complicated than that of Edison's. A steel band is used instead, and from this a conversation can be wiped off as can a chalk drawing from a slate.

According to recent reports, the submarine boat *Holland* has made some very successful trials in New York harbour. The vessel ran a mile in nine minutes at a depth of 10ft. It would be interesting to learn how long the vessel can remain submerged.

USEFUL AND SCIENTIFIC NOTES.

Messrs. Green and Boulding, of Bunhill-row, E.C., have issued a neat catalogue, the principal feature of which is the Buffalo automatic injector, which takes either hot or cold water.

The construction of a light railway through the Isle of Sheppey will shortly be commenced. The starting-point will be at Queenborough, on the London, Chatham, and Dover Railway, and the terminal station at Leysdown, with intermediate stations at Fowler's Corner—near the halfway houses—Minster, and Eastchurch. The new line will, it is expected, be completed in twelve months.

The *National Geographic Magazine* states that various sites within a radius of twenty-five miles of Washington are being examined by parties under Dr. Bauer's direction for the determination of the best location for the Coast and Geodetic Survey Observatory. The examinations thus far made have disclosed some interesting regional disturbances, especially in the vicinity of Gaithersburg. In order to determine what influence such regional disturbances have upon the variations of the earth's magnetism—such as, for example, the diurnal variation or the secular variation—it is proposed to mount a sensitive Eschenhagen declinetograph at Gaithersburg, with the aid of which the variations of the most sensitive of the magnetic elements—the declination—will be continuously and automatically recorded.

Copper-coated Zinc Plates for Process Blocks.—Coppered zinc plates combine the advantages of copper and zinc plates. They can be made as follows:—An alkaline galvanic bath is first made containing distilled water 1,000cc. (1oz.), copper acetate 200gm. (88gr.), ammonia 100cc. (50 minims), potass. cyanide 500gm. (220gr.) The copper acetate is first dissolved, the ammonia added, and the precipitate which results dissolved in the potassium cyanide. An acid galvanic bath is likewise made by dissolving copper sulphate in water up to saturation. The zinc plate to be coated is cleaned thoroughly with a potash solution, and placed in the position of the cathode in the alkaline bath, a copper plate forming the anode. A current of about three ampères per square centimètre is used. After about five minutes the zinc plate is removed and polished with chalk. The copper image is not affected by this treatment, if conducted carefully. The zinc plates are next transferred to the acid bath, and submitted for about four minutes to the action of a current of about one ampère per square centimètre. If necessary, the plate, on coming from this second bath, is again polished. The sensitising solution contains: water 100cc. (1oz.), fish-glue 20gm. (88gr.), albumen 20gm. (88gr.), ammonium bichromate 3gm. (13gr.) The coating, drying, exposure, and development of the plates is carried out as usual. The back and edges are then coated with asphalte varnish, and the plate is ready for the etcher. The etching-bath is a 40 per cent. solution of ferric chloride, which is allowed to act for about two minutes—a sufficient time to lay bare the zinc. The plate is washed well, cleaned by a vigorous rubbing with a brush and pumice-powder. For the second etching a bath of three per cent. nitric acid is used for five minutes; this acts only on the exposed portions of the zinc. Should deeper etching be required, the plate must be inked in the usual way, powdered with asphalte, and heated. In this case the etching-bath may be five per cent., and the period of etching ten minutes.—*The Process Photogram.*

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, *332, Strand, W.C.*

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

VARIABLE STAR OBSERVATIONS, OCTOBER, 1899.

[42988.]—R Aurigæ is now below 13·0 magnitude, and beyond the reach of the Rousdon telescope. It was last looked for October 30, when no trace could be seen, though the air was very clear.

U Orionis has again come into a convenient position for observation, but it is very faint, being 11·8 magnitude October 28. The minimum will probably occur about the end of November, and by the beginning of 1900 it will be an easy object.

T Ursæ Majoris has fallen about six magnitudes in the last four months, and was a very minute point, 12 2 magnitude, October 30. The minimum will probably occur some time in December.

S Ursæ Majoris is now about minimum, and was a very faint point, 12·2 magnitude, October 30. The rise is sometimes very rapid, and observations during the next two months will be of great interest.

R Camelopardi passed a minimum, 13 6 magnitude, September 26, when it was a most unique point, barely seen with power 132, and about the limit of vision for this telescope. The interval since the previous minimum, January 6, 1899, is 296 days.

S Herculis passed a maximum, 6 4 magnitude, September 21, and has been a bright, well-defined yellow or pale orange star for the last six weeks, during which time the light has varied but little. It was observed 7·1 magnitude October 30.

Instrument in use 6·4in. equatorial refractor. Weather has been very favourable, and observations were made on 16 nights, on several of which the sky was remarkably clear. C. E. Peek.

Rousdon Observatory, Lyme Regis.

THE MOON AND THE WEATHER.

[42989.]—In the singular article by Prof. Hazen on this subject (p. 227), referred to by "F.R.A.S." in his letter last week, the writer, from certain *à priori* considerations, is led to say: "We see how absurd the notion is that the moon does influence our weather." He then sets himself to demolish the three ideas that the moon influences (1) pressure (appreciably), (2) cloud, and (3) temperature; all which, of course, ministers greatly to the satisfaction of "F.R.A.S.," who has so long maintained, in season and out of season, that the moon has nothing to do with the weather. Here is a high meteorological authority, whose dictum should effectually quiet the "lunatics."

Very good. But there is a little paragraph at the end of Prof. Hazen's paper which "F.R.A.S." seems to have overlooked, and which fairly takes one's breath away? "Just what influence," he says, "the moon may have upon the electrical condition of the atmosphere may be considered in doubt." Is it, then, possible, that one idea of the moon influencing weather may, after all, be rationally entertained and considered? The words seem to imply that there is some such (electrical) influence; we have only got to define it. But the professor is more explicit, for he presently remarks: "There seems good evidence to show that there are more thunderstorms during new than full moon." Here, truly, is a dilemma for us. It is absurd to think the moon affects weather; it is *not* absurd to think so. The moon has no influence on weather; the moon *has* an influence on thunderstorms. And one of the highest authorities saying both these things, almost in the same breath! Nor is it easy to see how the moon can affect the number of thunderstorms without affecting pressure, temperature, and other things. So that (I take it) the edifice built up by the professor, not very strong at the best, falls to pieces, as every incoherent and contradictory statement is bound to do. This idea of the sun having an influence on thunderstorms seems to be gaining force. Not only does Prof. Hazen accept it. Two eminent meteorologists, Ekholm and Archimus, have recently read a paper to the Swedish Academy, proving that both Polar lights and thunderstorms are under lunar influence. And not long ago, if I remember rightly, a paper connecting thunderstorms with the moon was read in the French Academy. Perhaps some faint ray

of this new light of science may even, in time, penetrate the bigotry (in meteorological matters) of "F.R.A.S." ! A. B. M.

o^1 CYGNI—15 CEPHEI, &c.

[42990.]—If Mr. Espin will refer to the "E. M." for June 21, 1878, he will find a diagram of o^1 Cygni by "S. W. B.," including more stars than his own sketch. The pair *d* is double on this diagram. Mr. Espin has misplaced the companion on sketch: it should be immediately preceding. The *comes* to o^1 is also on "S. W. B.'s" map; there is also a star *s.p.* A rather nearer than Mr. Espin's *a*, and a triple and pair betwixt A and C.

With regard to 15 Cephei, I am at a loss. Mr. Espin gives the old companion as at 200 6° 11″. Now I have repeatedly observed this star with 6½in. some years ago, and I have it as 295°, 300°, 297° at various times, but certainly never at 200°. Is there a misprint? Distance estimated at 10″ to 12″; easily seen with 4in. stop. Perhaps Mr. Espin will examine again. Possibly he may be right; but I think there is an error.

Mr. Burnham's sketch of *o* Cygni was made with the 18½in. refractor of the Dearborn observatory.

Can Mr. Espin tell me how to lay down additional azimuth curves on Peck's cover for his star-map? If they were drawn more closely, they would furnish a means of turning R.A. and D. into azimuth and altitude. What is the principle upon which these curves are drawn, and best means of drawing them?

A Member of the British Astronomical Association.

γ^2 ANDROMEDÆ.

[42991.]—The small companion to γ Andromedæ has constantly attracted attention since its duplicity was discovered by O Σ in 1842 down to even recent numbers of the "E. M." And, singularly enough, the discrepancies as to the colour of the components and as to angle and distance date from the discovery, and also continue at the present date. Observers are flatly contradictory as to which is the smaller star of the pair. Sm called them yellow and blue, De both blue, while Dawes seems to have fluctuated in his appreciations from "both blue" through "both green exactly alike," "green and deeper green," "pale yellow and blue" to "greenish yellow and bluish green." The only safe conclusion is that the colour ascribed depends on the colour corrections of the o.g. used in combination with slight variation in focussing, or is largely atmospheric, and so far as it is inherent is not very pronounced or distinct.

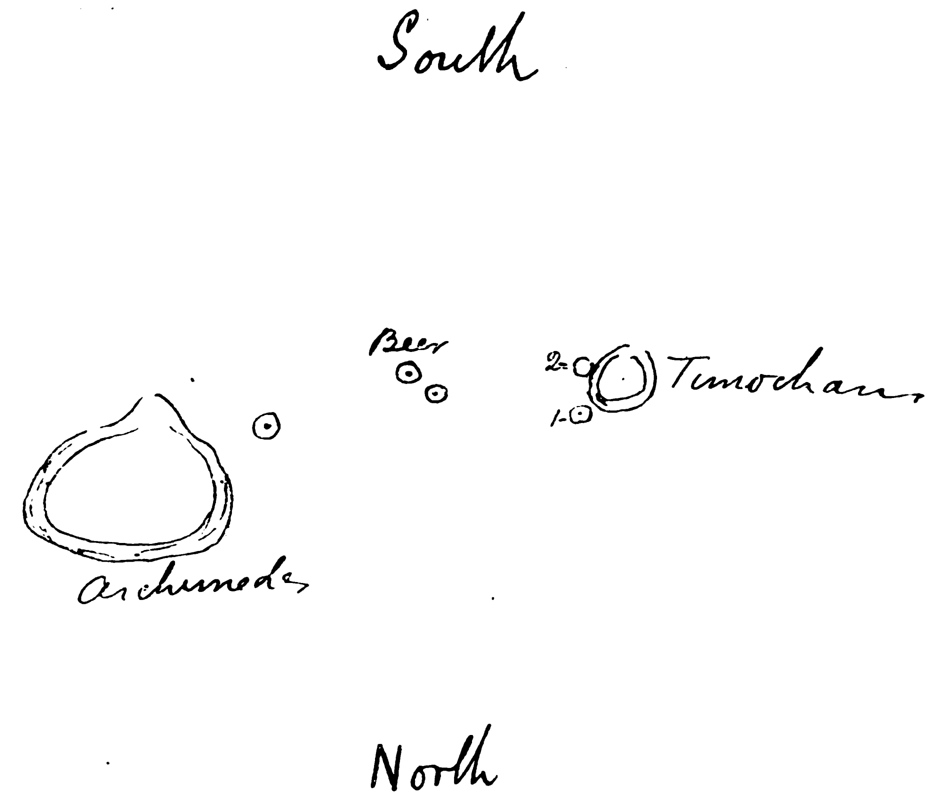
From 1842 to 1850 O Σ thought there was no change in angle or distance; but the evidence for either change or permanency rests on rather unsatisfactory grounds, since in the year 1842 the angle was measured both as 126·6° and 100 2°; and in 1847, as 111·3° and 117·9°; in 1873, 109·2° and 95·9°; while in the previous year it varied from 87·7° to 113·7°. The distance in 1842 is variously stated at 0·51″, 0·15″, and 0 31″, and in later years the variations are considerable, and point to nothing very satisfactory. We may conclude that the stars were too close for any real measures of either position or distance, and that they are no more than rough estimates, although made with micrometers.

The discrepancies continue in recent years. Burnham in 1889, found 98·2°, 0·09″. In 1890 he was doubtful of any elongation, and says "Decidedly less than 0·1″," and in 1891 found slight elongation only with 36in., and power of 2700, "Less than 0·05, and angle 312 6°." One admires the angle given to decimals of a degree with stars only suspected of being out of round. If the observations can be accepted, the stars occulted about 1890, and a considerable error in angle occurred on one or other occasion. But other observers with smaller, but probably more perfect, instruments claim to have completely divided this pair in recent years, although the angle assigned (in one case 113°) is quite irreconcilable with Mr. Burnham's estimate, as his estimates are with older observations. It does not appear that we have as yet any data accurate enough to serve as a basis for even an approximate orbit; but it seems very singular that only Gregorian reflectors have been able to divide, and Newtonians of 12in. and greater aperture, as well as refractors of 36in., have only spoken with uncertain voices.

A Member of the British Astronomical Association.

CRATER NEAR TIMOCHARIS.

[42992.]—I am obliged to "F.R.A.S." for his reply to my letter in your issue of 20th ult., and to "E. D." for his letter (42950). I do not think I made any error in orientation; but to make the matter plain, I send a small sketch showing the positions of the crater I see on the photo, lantern-slide, and of the one shown in Elger's map in his book on the Moon, which is not on the lantern-slide. The crater in Elger, and not on the lantern-slide, I have marked 1; the crater which I see on the slide, and is not shown by Elger, I have marked 2. It is much smaller than indicated in the sketch; but through a good magnifier quite clear and distinct. At the bottom of the plate there are the words "Lick Obs., Sept. 52, 1890, Moon's age 8d. 4h." The crater I refer to is rather to the south of an imaginary line drawn from Beer to the centre of Timocharis. R. P.



OBSERVING THE LEONIDS.

[42993.]—Although the paucity of Leonids observed last November and in November, 1897, does not lead us to expect anything like a record display this year, and though the brightness of the moon, so near the full, is unfortunate, it is none the less to be earnestly hoped that the greatest diligence should be employed in using to the greatest possible extent any opportunities for observing the meteors which may be afforded us on the present occasion, and the following simple hints may therefore be acceptable.

Dr. Johnstone Stoney and Dr. Downing give 6 a.m. on the morning of Thursday, Nov. 16, as the probable time of the centre of the shower. The radiant will then be nearly on the meridian, the moon will be low (near her setting), and the morning twilight will have commenced.

The experience of last year rather suggests that this is a late time to fix, and a watch should certainly be kept both on the nights of the 14th and 15th from 10h. 30m. in the evening until daybreak the following morning.

The observations to be made may be roughly classed under those which may be undertaken by persons unaccustomed to meteoric observation, and those which should be made by well trained meteor observers. The principal work to be done by members of the former class is meteor counting. A considerable portion of the sky should be chosen, either one of which the well-known radiant in the centre of the hook of the Sickle in the head of Leo is the centre, or one just bordering on the radiant. The area should not be too large to be easily held at a single view, and its corners should be marked by well-known stars. The counting should then be carried on as suggested by Prof. E. C. Pickering. "Once an hour, or better, once every half-hour, observe and record the time during which ten meteors appear. This is most easily done by noting the time by a watch, and at exactly the beginning of a minute looking at the sky, giving it undivided attention, and counting the meteors seen. If great numbers of meteors appear, it may be better to count a larger number, as twenty, or even fifty. If the interval between the meteors is long, the number to be counted may be reduced. These observations should be repeated until dawn, or over as long an interval as possible. Between these observations the observer may rest, or may make special observations of individual meteors. Thus, when a meteor is seen, record the hour and minute, the brightness on a scale of stellar magnitudes—2 equals the brightness of Jupiter or Sirius, 0 Arcturus or Vega, 2 the Pole Star, 4 the Pleiades, 6 the faintest star visible; the colour, B = blue, G = green, Y = yellow, W = white, and R = red; the class, L = Leonid, if the path prolonged would pass through the radiant point; N = other meteors. Thus, L 5 Y, 12h. 36m., indicates that a Leonid, magnitude 5, yellow in colour, was seen at 12h. 36m.

Observers who are accustomed to meteoric work should lay down on a star-map as accurately as possible the path of the meteors seen with respect to the stars. The time and duration of the appearances should be most carefully noted, and also the time of any special outburst or explosion that may occur to a particular meteor. From these there can subsequently be deduced the radiant positions for different intervals during the night. This class of observation is a most important one, as from it may be learnt, through the shift of the radiant, the influence of the earth's attraction on the swarm.

A third method of observation is by photography, and here again the work may be divided into two classes, according as the camera is either rigidly fixed, or else mounted equatorially and driven by hand or clockwork. In neither case should a long exposure be given, since the moon is so nearly full that it may fog the plates. Probably a quarter of an hour should not be exceeded, and the times of opening and closing should be most carefully noted. So also the observer should, as far as possible, watch the region of the sky covered by the camera, and note the time and direction of any bright meteor crossing it. The camera may be pointed on the radiant or on the zenith, or on some star conveniently placed between the two.

A portrait lens or rapid rectilinear lens should be used with a fixed camera; a wide-angle lens with one which is made to follow the stars. It will be much less necessary to note the time of the passage of the meteors in the latter case, since the stellar images would be dots on the plate, not trails, as with the fixed camera. Hence the direction of motion of a meteor can be determined without knowing the time of its passage.

Since the colour of the meteor streaks is usually of a greenish or bluish colour, it would be advisable to use a red lantern to illuminate the notebook and the face of the chronometer. Still more important is the need of securing accurate time. Both before and after the observations the error of the watch or chronometer used should be determined, and the correction applied to the observed time.

E. Walter Maunder.

Royal Observatory, Greenwich, S.E.

THE NUMBER OF STARS NOT INFINITE.

[42994.]—In the current number of *Knowledge* will be found an article in which I have stated very briefly the reasons which have led me (contrary to the current opinion) to believe that the number of fixed stars is finite. In the following letter I shall give my reasons in somewhat more detail.

The point from which I start is that the total amount of light received from the stars is a certain very small quantity, variously estimated, but cer-

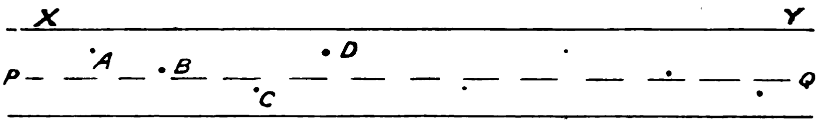


FIG. 1.

tainly not exceeding one-tenth of the light of the full moon, or 1-8,000,000th of the light of the sun; whereas if the number of stars were infinite, the whole of the sky would shine with a brilliancy comparable with that of the sun itself.

That this would be the case can be shown most easily from the theory of probability. Let X Y, Fig. 1, be a tube of uniform cross-section in which a number of objects, A, B, C, D, are scattered at random. The tube is supposed to be of infinite length; but the distance between any two adjacent objects is supposed to be finite, and the objects themselves to be of sensible size. Let an infinite straight line, P Q, be drawn through the tube.

Problem.—To determine the probability that the line P Q will ultimately intersect one of the objects.

Solution.—Let a be the area of the object A projected on a cross-section of the tube, b that of the object B, and so on. Also let s be the area of a cross-section of the tube. Then—

Probability that P Q will miss A is $\frac{s-a}{s}$

do. do. do. B is $\frac{s-b}{s}$

do. do. do. C is $\frac{s-c}{s}$

and so on. Hence we get the probability that P Q will miss A, B, *and* C

$$= \frac{(s-a)(s-b)(s-c)}{s^3}$$

$$= \left(1-\frac{a}{s}\right)\left(1-\frac{b}{s}\right)\left(1-\frac{c}{s}\right)$$

If there are n objects, we have a similar expression with n factors. Suppose, now, that the smallest of the n objects has an area q. The product of the n factors $\left(1-\frac{a}{s}\right)\left(1-\frac{b}{s}\right)$ &c., will be less than $\left(1-\frac{q}{s}\right)^n$ By hypothesis, q is finite; consequently $\left(1-\frac{q}{s}\right)^n = 0$, when n is infinite. In other words, the probability that P Q will ultimately meet one of the objects is a certainty. The above is a formal proof, but the conclusion appears to me sufficiently obvious without mathematics.

Now, let us apply the above to the stars. P is the eye of an observer looking through a telescope in the direction P Q. The objects A, B, C, D, &c., are stars. It follows that the line of sight will ultimately meet a star; at least, it will do so if we adopt the hypothesis that the stars are scattered indiscriminately at finite distances from each other. Since P Q will ultimately meet a star in whatever direction it is drawn from P, and since the superficial brightness of an object is independent of its distance, it follows that the brightness of the sky would equal that of an average star if the stars extended infinitely in all directions.

The above reasoning is clearly conclusive against the hypothesis that the stars are infinite in number and scattered throughout all space indiscriminately. We may, however, imagine that the stars might be distributed on some system which would render the conclusion invalid. We shall examine this supposition separately.

Let P, the eye of the observer, be the apex of an infinite cone having a small vertical angle (Fig. 2). Let this cone be divided into compartments by equidistant planes A, B, C, D. Let all the stars in the cone from P to A be projected on A from P as the point of projection. Let the total projected area be a. In the same manner let b, c, d, e be the projected areas for the stars in the other compartments, and let s be the area of the base of the cone P A; also let P A = r. Then the solid angles subtended by the stars in each compartment will be $\frac{a}{r'}, \frac{b}{4r'}, \frac{c}{9r'}, \frac{d}{16r'}, \frac{e}{25r'}$, &c. Now we know by observation that the sum of this series is finite, and much smaller than s. The number of terms must consequently either be finite or they must continually diminish, and become ultimately evanescent. Now it will be observed that each term in the series represents the density of the stars in the corresponding compartment, for the area of any plane D is

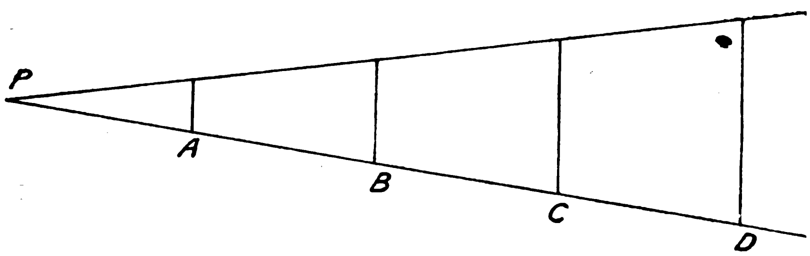


FIG. 2.

proportional to the square of its distance from P. Hence, if the number of terms is infinite, the density of stellar distribution becomes ultimately evanescent. I submit that this only differs mathematically, and not physically, from asserting that the number of terms is finite. Perhaps the matter may be put a little more clearly. Thus: The sum of the series must be greater than $n x$, where n is the number of terms and x the smallest term. Hence, if n = infinity, x = zero.

I see no escape from this conclusion. The method of distribution will not affect it. The result will be the same if we imagine the stars to be collected into systems, the distance of the stars apart in the system being small compared with the distance between the systems. To affect the result, the distance of the systems from each other would require to be infinite.

In the above, it has been taken for granted that there is no absorption of light in its journey through space. If there be a medium in space which intercepts light, the conclusion will no longer hold. Hence we have to consider the probability of the existence of an intercepting medium. I reserve this for another letter.

Gavin J. Burns, B.Sc.

"THE MENACING COMET."

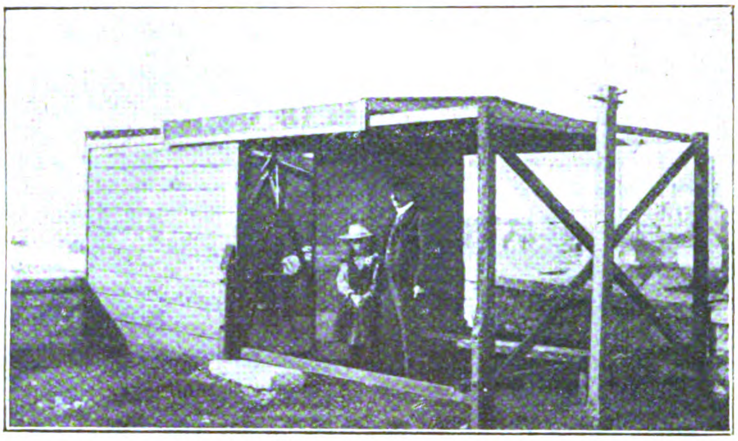
[42995.]—On the 1st inst., the *Daily Mail* may have startled the ignorant and those who fear to die by announcing, under the above heading, the return of Biela's comet.

"This announcement was all the more alarming, because Biela's comet has threatened the destruction of the globe before, and because Prof. Rudolf Falb foretold in 1897 that the end of the world would come 'on November 13, 1899, at nine minutes past three o'clock.'

"Yesterday, however, the Astronomer-Royal at Greenwich assured a representative of the *Daily Mail* that, as far as Biela's comet is concerned, the end of the world would not take place on either the 13th or the 28th of the present month."

It is now the 3rd inst., and the clock of terrestrial time is ticking on, measuring the same motion of the earth, at the same rate, as it has always done in the memory of man. By the time this is in type, we shall be close upon the fatal "nine minutes past three o'clock of the 13th inst., and the 28th," for there seems to be some discrepancy of calculation. In fact, Prof. Falb is slightly out in his figures and time. Only slightly, but sufficiently to remind one of the Byronic lines in one of miscellaneous poems, describing the red nose of the chancellor, which startled the devil into momentarily thinking it was the general conflagration. Of this we may be sure: the clock will sublimely tick on, and it will not be Biela's comet that will give the earth any such infernal jolt in its orbit round the sun. Now, I am far from imagining that celestial collisions may not take place, and that "such occurrences, though rare in time, may not be frequent in eternity." The whole thing was supremely absurd, put as the *Daily Mail* put it. If a comet's orbit so intersected that of the earth that it was certain to strike us, it is but reasonable to suppose that it would be visible for some time previously, and keep on getting bigger until it put us all in a sweat; unless it suddenly came round a corner in the heavens, and there are no corners in infinite space for any comet to play us such a joke. Having said this much, I now wish, with your kind permission, to submit to your many astronomic readers some ideas, the results of years of study, in relation to comets in general; and perhaps they will give additional interest to the comet, Biela's or whatever name it bears, which seems to be a part of, or involved with, the stream of Leonid meteors.

I will begin with the startling assumption that gravitation is caused by motion. I have studied Newton's "Principia" years ago, and in none of his works, not even in his "System of the World," have I been able to discover that this world-renowned philosopher explained of what gravitation consisted. Having, in the absence of any other explanation, assumed that the cause of the smaller body falling to, or towards, the larger body is because the larger one is in rapid motion, it naturally follows that no planetary body in infinite space can, properly speaking, have any such thing as weight. To suppose the earth in space has even the weight of a feather, is equivalent to supposing that something can be made out of nothing. It is as ridiculous as supposing that a thing can hold itself up. It may be safely assumed that the laws of motion which apply to one comet may be taken, in a sense, as applying to them all, although they may apparently not all be acting in the same manner. Hence, a little consideration of Halley's comet may help us to understand, perchance, something about the portentous threatening of Biela's. Halley's comet was a queer thing, upsetting all the schools of thought or systems of astronomy which were taken as accepted facts beyond question. So ruthlessly did this comet act in the provoking way in which it travelled in utter defiance of all preconceived ideas of motion, gravitation, and force, that it upset everything and made philosophers endeavour to account for it by supposing a palpable absurdity. Sir John Herschel had a suspicion that the phenomena of this comet did not cover the laws of the gravitation of matter as propounded by Newton. He saw and stated that "the comet's envelope and tail could not be a figure of equilibrium under the laws of gravitation." It must be borne in mind that the behaviour of the tails of comets is a phenomenon utterly incompatible with our ordinary notions of gravitating matter. If they are material, where is the force which can carry them round in the perihelion passage of the nucleus in a direction pointing continually from the sun, in contravention of all the laws of planetary power and motion? The "repelling force" which Herschel was constrained to imagine, if it exists, destroys *in toto* his own and Newton's gravitation theory. It did not dawn on his mind what Newton had left unexplained—viz., *the cause of the smaller body falling to the bigger one.* Herschel acknowledged that he could not in gravitation find the cause for the extravagant sweep of the tail of Halley's comet, which was far beyond the earth's orbit. The "repellent force" was an idea equivalent to making a wheel turn both ways at once and at the same time. The present popular idea that our world in infinite space has weight, the millions of trillions of tons of which are capable of being calculated, resolves itself into confusion worse confounded, and the wildest absurdity. What, then, is a comet? My answer is—it is unknown. The spectroscope gives us some information, but not much. The use of amateur instruments, such as are in the reach of mechanics, 3in. refractor or possibly a stray 5in. mirror, is disappointing, so much has to be left to imagination. The most important statement emanating from an observatory that I have read for some years, was that emanating from the St. Louis Observatory. It was stated that the astronomer fixed the telescope in such a position that a comet, which was so far off that none but a cyclopian instrument could see it, would pass the field of view at midnight. In place of the eyelens he put on a fine plate of selenium at the back of a spectroscope, which is a mineral highly sensitive to electrical action, to which he attached some fine electrical wires connected with a bell in his bedroom. The spectrum of a comet is unlike that of any other heavenly body, and the moment it passed over the selenite plate it violently rang the bell in the bedroom. I believe this was a true report, inasmuch as I never saw any contradiction. It was certainly one of the most marvellous things I ever remember reading, for a comet, countless millions of miles off, invisible to all but an immense refractor, had the power to excite or exert sufficient mechanical power to violently ring a bell. Of the nature of cosmic force we know next to nothing. The recent photographic discovery that the well-known spiral nebula is not spiral at all, but consists of consecutive rings of nebulous matter, would seem to show that rings of meteoric matter ultimately condense into planetary globes. The question arises whether the great band of Leonid meteors, of which Biela's comet appears to be a part, is of this nature. Probably if it is so, the erratic movements and broken-up condition of the nucleus may be accounted for by the repeated impact of the earth in rushing through the stream. Evidently this would, by its disturbing force, prevent its consolidation, without which it cannot assume its planetary orbit, but must remain

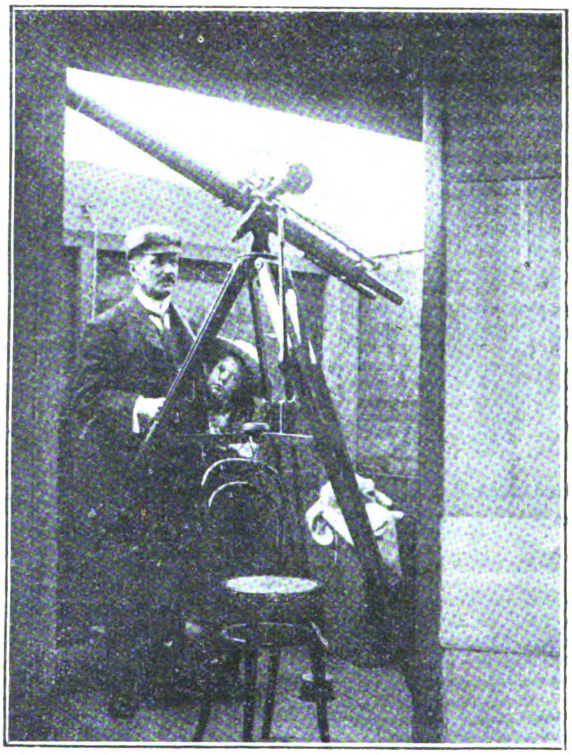


an ever-widening ellipse, ultimately becoming a comet detached from our Solar System, yet repeatedly visiting it by reason of the affinity of its elements and unknown laws of motion.

A Constant Subscriber.

AMATEUR'S OBSERVATORY.

[42996.]—I INCLOSE two photographs taken by my son of a little observing house I have lately put up which turns out very satisfactory in practice. The pictures (if they come out clearly on reproduction) more or less speak for themselves. The exterior



view shows the sliding roof (which is covered with canvas) half-way off. It runs on small brass rollers, and is slightly ridged to allow the rain to run off easily when the building is closed. A wooden plank will be observed in the middle of the area occupied by the skeleton frame exterior to the observatory. I walk along this when pushing the roof along. Without it the roof could not be moved so easily, owing to its height from the ground. The angle between two low walls was utilised as a site for the erection, which is firmly clamped to the former by two iron bands, the situation being high and exposed to all the winds that may blow. The post to the right with wooden pins has nothing whatever to do with the observatory, being occasionally used to suspend a line for drying clothes on.

The other picture shows the interior. A weather-board can be seen which can be lowered when required, giving a clear view just down to the horizon. The glass is a 2¾in. refractor on a Wray equatorial mounting without circles. The legs of the tripod rest on three iron pipes driven into the ground and filled with cement. Boards of floor cut round these, so that motions of observer cannot shake the glass.

I had the slow motion in declination brought down by a wooden handle to near eyepiece, which the picture shows. A small dry battery rests on the crosspieces of the tripod, and from it the wires run up to the electric lamp fitted in the tube on the opposite side to the counterweight.

One corner of the little house has a sloping desk for writing, and two shelves below for eyepieces and other paraphernalia.

The whole was put up to my general design by someone a little more skilled than the oft-quoted "village carpenter," but the latter could no doubt put up just as good a house under proper supervision. If anyone requires further details, I should be pleased to furnish them on application. The door, I should say, faces east, roughly. My little daughter is included in the photo.

E. E. Markwick, Colonel.

H.M. Gun Wharf, Devonport, Oct. 29.

REDUCING INTENSITY OF LIGHT—ASTRONOMY (?)

[42997.]—LET Mr. Ellison disabuse his mind of the notion that I had him in the least in my eye while writing letter 42816. I now apologise for having failed to acquaint myself of the fact that the "various devices" I reviewed (I can scarcely be said to have criticised them) had all been rediscovered by him, in this way making them, as he designates them, "*his*." Therefore would it be most unjust of me to accept his "duly grateful" thanks.

It will be found, I think, that as I indicated I should do, I added "my little quota"; but neither did I claim any originality for myself, nor deprive anyone, I hope, of the honour of their inventions, the authorities I named having long been known.

The question as to the relative amount of disturbance of vision caused by flat glasses of equal perfection placed so as to be influenced by reflection as compared with refraction, or placed in front of eyepiece lenses as compared with a position in the parallel rays of the convergent pencils behind them, is far too important to bear condensation here, but must lie over. But the very serious error made by the writer of 42948, when discussing a suggested improvement on "dark-glasses," makes it imperative that, emanating from so influential a source, its misleading effect upon less accomplished readers should be neutralised. In 42948, we are told that "it does not require much mathematics, after all." Certainly not; but all the same Mr. Ellison's plan is anything but an improvement on the plane glass if inserted in the position he advises. The suggestion is to make the surfaces of the dark glass of radii which have the central point of the image at the solar focus of the object-glass as the centre of both, thinking as he does, in fact stating, that "all rays from the o.g. would be perfectly normal to both surfaces, and would suffer no change whatever." The error here, which must be evident to the merest beginner in optics, and which is indeed of the same kind as that made some time ago by a learned contributor while discussing images formed by reflection, lies in fixing the attention solely upon the mathematical point which forms the axial part of the image. The slightest attention shows that while no doubt for the above point all rays from the o.g. would be normal, the conditions of the lateral rays passing to every part of the image other than the single axial point, are far different. No mere concentric arrangement of curves, watch-glass-like, can possibly prevent very considerable disturbance. Were this otherwise, many problems in practical optics would become very simple indeed, which theory and experience alike prove to the contrary. Indeed, in Mr. Ellison's suggested case, a glass curved as he advises would cause still *more* serious disturbance than a plane one, as the simplest projection of the conditions will demonstrate without any mathematical calculations whatever.

As is well known, such a dark-glass, if properly figured, would require to be made to suit each separate eyepiece, and even then there would be a margin of compromise. So much for the ultimate benefits of non-mathematical optical pottering. Fortunately, such a position for the dark-glass as Mr. Ellison suggests is not a necessity.

It is not my intention to advert, even shortly, to anything 42816 did not contain; but I may be excused in pointing out again that such "devices" as entire telescopes set apart for solar observations alone—e.g., Sir J. Herschel's reflector with unsilvered mirrors (the so-called helioscope), or even telescopes kept partly in that condition, formed, like the many complicated and expensive designs for like purposes, avowedly no part of my purpose in reviewing the various simple methods cited in my letter on this subject. On this account, keeping, as I said I should do, to such simple appliances as could cheaply and easily be used upon any telescope that should always be readily available for every kind of observation, I failed to see the bearing of certain criticisms made on my letter, because it did not happen to refer to methods I, on stated purpose, left out.

But, after all, perhaps my main object in bringing this subject forward again is to point out the fact that the writer of 42948 has, apart from the scientific error already alluded to (an error easily excusable in one unaccustomed to deal in such matters), made a literary mistake which might have been very easily avoided—a mistake which is particularly distasteful in destructive criticism—I mean the attributing of certain responsibilities to the wrong source.

I find I am credited with having led your telescopical amateur into the trial of methods which led to thorough disappointment—methods which gave results that might be said to be "magnificent," but which could not be called "astronomy." I suppose by a "perforated stop" (a term I do not remember having used) your correspondent means "perforated screen," and he states broadly enough that in the form in which he used it (a piece of perforated zinc, of hole size unknown) he followed my recommendation. Let me correct this upon three points. First, by looking again at 42816, *he* will find I merely go the length of saying "I can quite substantiate Mr. Dawes's opinion of the screen as already quoted second-hand in your pages from Chambers's 'Handbook,'" adding that "there Dawes is stated to have found this expedient to be capable of producing a sharpness of definition he considered to be very marked." Secondly, perforated zinc, which, personally, I have never found in hole, and especially in solid reticulum, so fine as the "'cardboard,' such as that employed in Berlin-wool work," which Dawes is said to have used, was not a fair trial material; and, thirdly, while "substantiating" Mr. Dawes in my letter, I took care to mention the fact that "my *own*-experience has been in favour of fine net," and further that different telescopes require different sizes of mesh, fine muslin being mentioned as having served well to bring out on some apertures, and under certain powers, the intense black zone

immediately surrounding the bright stellar point, or points, and in which zone faint or close companions were most favourably seen. In none of the above three particulars does Mr. Ellison's trial follow even the recommendation imputed to me, and in so far as the screen he did attempt to use (perforated zinc) is concerned, no one can tell whether or not its grade suited his telescope so as to be able to compare his results with those of Dawes. Indeed, the question becomes simply one of comparative proficiency in manipulative skill, in knowing what to look for, in sharpness of eye, and in general observing experience, between Mr. Ellison and Mr. Dawes, whose method he has followed much more closely than my modification of it. The latter has probably found a successor more famous than himself — but we are a "hard-hearted" and somewhat "unbelieving generation." The resplendent display of remote diffraction images of the star, which has attracted Mr. Ellison's attention so much in comparison with the dark inner zone, are just such phenomena as an experimentalist not very sure of what he was to see would fasten his eye upon. Of course, to observe the comparatively tame central phenomena of this diffraction spectacle, requires *rather* more skill than to write up a spectacular peroration upon the supposed failings of a brother contributor, who is no longer to fill, it would appear, the place of "guide, philosopher, and friend in matters astronomical" to your correspondent "any more."

Any more? Why, I have all along been in unhappy ignorance that I ever filled any of these posts to anyone—at any rate, there is now a vacancy.

But, after all, what astonishes me most is the fact that so learned a correspondent as the writer of 42948 should consider the subject matter of my letter (and his also, for that matter) as "astronomical" at all. To some amateurs, no doubt, these trifling physical and optical elements, along with the "fun," as some express it, of pottering among pieces of lacquered brass, or its humbler substitutes, may go a long way in standing for "astronomy," especially when backed up with occasional trials of sight as to who can see the faintest star with the most unsuitable means, or with occasional entries, in official-astronomer-like form, of such valuable details as "just glimpsed so-and-so," "good seeing at 11h. 50m.," &c. "Mere instrumentation" was a phrase several times heard by me, as expressive of the value placed upon the above style of "astronomy" by a late very high official in these matters.

Does one find almost anything of this species of "astronomy," or even the trace of some of its most popular developments, in such works as Airy's "Popular Astronomy," or in Herschel's "Outlines"? Let anyone who despises mathematics in such subjects read the latter's introduction, where is found the following:—"Admission to its sanctury (Astronomy) is only to be gained by one means—sound and sufficient knowledge of mathematics, the great instrument of all exact inquiry, without which no man can ever make such advances in this or any other of the higher departments of science as can entitle him to form an independent opinion on any subject of discussion within their range." (The dozen last words seem right.)

Regarding Vega, Webb says that as a test object the companion may be seen *in favourable weather* with a $3\frac{7}{10}$in. refractor, *sometimes*. He adds, with significant want of vigorous belief, "*it is said to have been* perceived with $2\frac{1}{8}$in." When I can afford time, I am going to run up to Dublin to experience the wonderfully favourable conditions there for seeing this star with still smaller an aperture than that so strongly doubted by Webb, but reported in 42948. H.

"IGNORANCE."

[42998.]—It is rather surprising to find so intelligent a correspondent as Mr. Schucht (p. 276) writing about a "grand and enjoyable hobby." Perpetual motion underwent post-mortem many years ago, as can be found in Dircks's "Perpetuum Mobile." and it is now past mention by passed mechanics, just as one o'clock is p.m. To us the motion of the heavenly bodies is perpetual; but that is the nearest we can get to it, for the vision of a machine of the kind is only a dream which comes at past midnight. P. M.

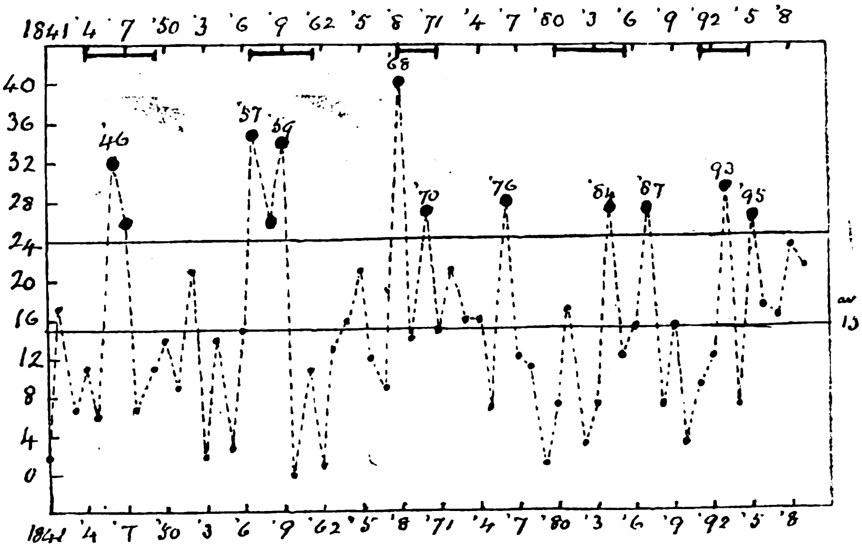
FIFTY-NINE LONDON SUMMERS.

[42999.]—A short time ago I gave, by your kind permission, a curve of London winters. Herewith I send you a curve of our summers for the same period—since 1841.

The item here considered is not, as in the former case, the mean temperature of a group of months, but the number of days in each year on which the temperature reached or exceeded 80° (at Greenwich). This number varies, it will be seen, from nothing in 1860 to 40 in 1868; the average is about 15.

I think it is worth noting (*pace* "F.R.A.S.") that nearly all the hottest summers in this period have occurred about the time of growth and maxima of the sunspots. Those with more than 24 of those hot days are marked with a bigger dot than the others; there are 12 of them. At the top of the diagram will be noticed five short horizontal lines. Each of these is drawn from the first year after a sunspot minimum to the first year after the next maximum. And it will be seen that 10 out of the 12 are in the time covered by those lines; the exceptions are 1876 and 1887.

Alex. B. MacDowall.



SELF-ACTING SURFACING.

[43000.]—I send you this suggestion for self-acting surfacing for a lathe fitted with overhead motion. I am about to fit it to my screw-cutting

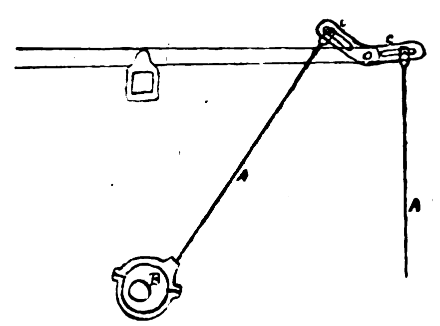


Fig. 1.

lathe, but would be pleased to hear criticisms or improvements on it first. It is the same kind of feed as is commonly fitted to shaping and milling machines, but I have not seen it applied to lathes before. The sketches, I hope, make it plain. In Fig. 1, A A are rods (about ¼ square Bessemer steel) to convey motion from eccentric B on overhead

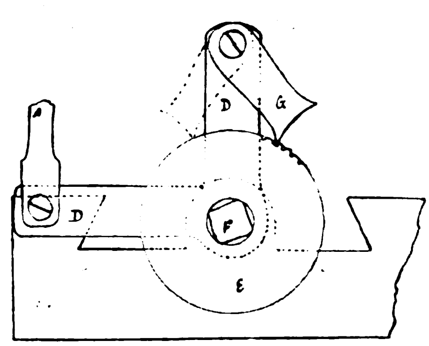


Fig. 2.

shaft to pawl on cross-feed screw. These rods are connected by means of the slotted plate C, fixed to tension shaft, which must be locked in position. In Fig. 2. shaft A moves plate D, which is free to turn on feed-screw F. On the square end is fitted a cogwheel, E, all in one with a winch-handle for hand feed (not shown). Pawl G moves wheel E, and direction can be reversed by turning G over to the other side, as shown by the dotted lines. The rate of feed can be altered by moving studs in the slotted frame C (Fig. 1). Fig. 2. is half-size.

H. W. Allingham.

PROF. BONNEY ON THE AGE OF THE EARTH.

[43001.]—Prof. Bonney has published a most wonderful "Story of Our Planet," near 600 pages, and in the index there is no such word as *comet*. It is true that by following the references given under "meteors," we find at p. 331 that "at intervals more rare the comet gleams like a pale torch among the brighter sparkles." At p. 335, "the comets, attenuated as is their substance . . . . consist apparently of hydrogen with various compounds of carbon—possibly chlorine and some other terrestrial substances." For the only visible bodies that can ever encounter "our planet," this pair of sentences out of 600 pages seem ridiculous. Comte, the Positivist philosopher, saw that the comets were simply the *only* bodies, besides sun and our satellite, that interest us terrestrials at all.

In discussing the "age of the earth," he fixes this at something between 100 and 500 million years. That would involve meeting or being overtaken by at least 400 to 2,000 comets, of which he has not a syllable but the above three lines!

Without hinting at the probability of the earth being older than the sun, he relates Laplace's Nebular Theory in such a way as to make the sun the last body to appear (p. 337), and supposes the earth to solidify while the sun was "possibly augmented in bulk by the matter which is now condensed into Mercury." As the said matter is not a forty-millionth of the sun's, this augmentation was hardly worth mention. I know of no reason for thinking the sun as old as the Permian strata.

We have witnessed in the Andromeda nebula the birth of an earth, but at no time that of a sun. We may venture to predict that if mankind ever witness such a birth, it will be in the same nebula. So, too, if an event like the destruction of Sodom is ever witnessed, it will be in the morning of some 15th of November, or in the next century 16th, and so on. E. L. Garbett.

OLD TIMES.

[43002.]—Seeing "Jack of All Trades" answering questions again takes one's thoughts back to the early days of the "E. M.," when Mr. Bottone taught us chemistry, and "Sigma" (Mr. Sprague) contributed his work on electricity; when "E. L. G.," with many adjectives, anathematised the decimal system, and introduced us to his pet Deluge and Watery Comet; when Mr. Hampden and "Parallax" would not be convinced that the earth was round, and Mr. "H." did not feel inclined to pay his wager; when W. Tonks told us all about small mechanical matters, and "Seconds Practical Watchmaker" taught us how to repair watches; when Thos. Fletcher, J. Lancaster, and R. A. Proctor were regular contributors, the latter with his column of Paradoxes; "The Harmonious Blacksmith" and "Fiddler" discoursed sweetly, and the letters of "Eos," from various Tropical places, were always such good reading (I wish they could be reissued in book form); when Fred Carre and "Frontiersman," "Saul Rymea" and "Todleben," "O. S." and "J. K. P.," and so many others gave us the benefit of their experience. When the illustrations were woodcuts, and the "Sixpenny" Column contained about a dozen advertisements; when in answer to an inquiry as to a machine for turning over the leaves of a book to be used by an engine-driver who had lost both arms, a subscriber built a machine, and sent it to him; when "Garrison Gunner" (Capt. Battersby) told us about the West Indies, and so many others who, alas! have joined the majority! There were giants in those days.

Talk about an encyclopædia—a set of the "E.M." is the only one that covers the ground in regard to

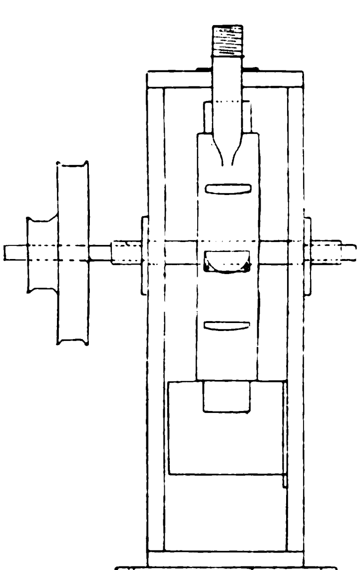


FIG 4

END ELEVATION

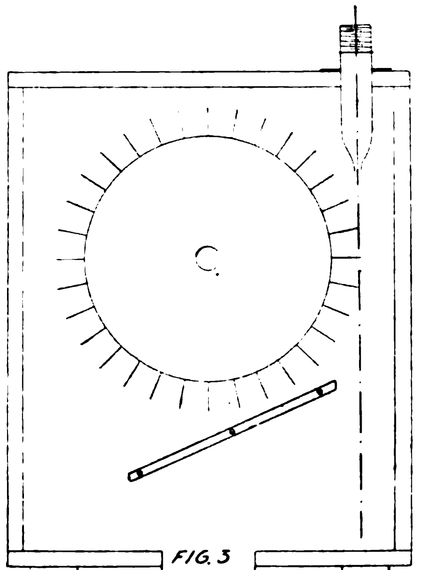
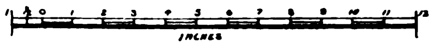
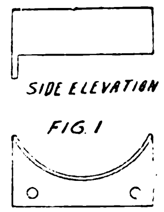


FIG. 3

SIDE ELEVATION



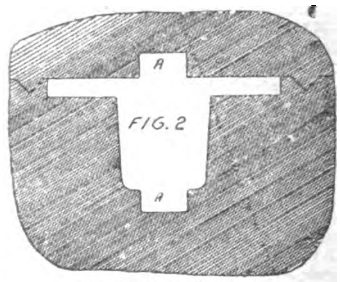
INCHES



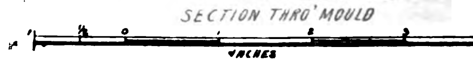
SIDE ELEVATION

FIG. 1

END ELEVATION



SECTION THRO' MOULD



INCHES

mechanics and applied science, and is a mine of information on almost every subject, and some very queer ones have appeared. We had our Medical Column, which was stopped on a point of etiquette, and the Legal Column ditto. When that interminable series of articles appeared on Organ-Building, which is, however, the most complete ever written on the subject, and Dr. Allinson taught us to drink hot water (and a very good thing it is) and eat whole-meal bread. Thirty years ago I bought a number of "E.M.," and never missed a week since. It is curious to notice how a certain lot of inquiries turn up at regular intervals, and how frequently perpetual motion is discovered. Perhaps the best series of articles were those on Zoology by the late Dr. Aveling. Would it not be possible to have another series in continuation to bring them up to the higher mammals? And why not a little human physiology?—surely there is no machine better worth describing than the human body.

West Didsbury. M. Cole.

A SIMPLE WATER MOTOR.

[43003.]—The following description of a simple water motor, which may be readily constructed with very few tools and little difficulty, may be of service to Mr. River (query 96845), and other readers of the "E.M." The motor is intended to operate off the ordinary house supply, and will give from one to two man-power, according to available pressure.

A glance at Figs. 3 and 4 will show at once the method of construction, and the principle on which the motor works. The first thing required is a wooden disc 8in. in diameter and 1¼in. broad, mounted upon a ⅝in. steel spindle. The central portion of the spindle is to be left of full diameter for a distance of 5in., each end being turned down to ½in. diameter. If the operator be not the possessor of a lathe, the nearest blacksmith will do the necessary turning for a few pence. Care must be taken to leave sufficient length at the side to admit of a pulley being afterwards attached. The wooden disc should now be firmly keyed on to the spindle, and if possible turned up true *in situ*. However, if carefully made otherwise, this is not an absolute necessity. Finally give the wood a good coat of tar. We now require thirty little buckets of the form shown in Fig. 1, 4in. by 4in. The simplest way to prepare these is to model one carefully in wax. Well oil a small sheet of glass and also the wax pattern, and place the latter hollow side downwards upon the glass. Mix up some plaster of Paris to a stiff cream and pour it carefully over the pattern, afterwards working it up carefully with a flat paper-knife or similar tool, taking care to leave a good margin round the pattern. Allow the plaster quarter of an hour to harden; then take it up, and, with a sharp penknife carefully cut away any plaster which may have found its way into the hollow face of the pattern. With the point of the penknife also bore three conical holes in the plaster margin. Again, well oil the face of the mould and pattern, and proceed to form a plaster-lid in the same manner as before. When the plaster has hardened this lid will be found to lift away quite readily from the body of the mould, whilst the three little conical pegs fitting into the conical holes serve as guides, and insure its being replaced in exact position. The wax pattern may now be removed from the mould. If necessary, it can be melted out, and the mould should be set aside in a warm place to dry thoroughly for a day or two. Across the face of the mould a bell-mouthed groove must be cut through which to pour the metal, and on each side of it a small groove to permit of the escape of air when pouring the castings. The castings may be made of an alloy of two parts of lead to one part of zinc, and the mould may be held together under gentle pressure in a vice whilst making each casting. After the required thirty have been cast, two small holes should be drilled or punched in each, as shown in Fig. 1, and the buckets fixed at equal distances round the periphery of the wooden wheel by means of long French nails.

To make the bearings, procure some mandrel-drawn brass tube ½in. internal diameter. Cut off a short piece about 1½in. long, and round it form the body of the pattern in wax, allowing about ¼in. of the tube to project at what will afterwards be the outer end of the bearing, and keeping the other end flush with the face of the flange. Place the oiled pattern and flange downwards on a sheet of oiled glass and form a plaster mould as before, first closing the ends of the tube with wax plugs to prevent the plaster entering.

When the plaster has hardened, turn the mould over, withdraw the brass tube about a quarter of an inch, and form a plaster cover as before. The mould will now show in section, as in Fig. 2, the prints A A being formed by the brass tube. When casting the bearings, well tin a short piece of the brass tubing with solder, place it within the mould as a core, and cast the body of the bearing round it in zinc-lead alloy. The result will be a bearing requiring no further treatment save the drilling of an oil-hole. Two bearings are required. The wooden case for the motor may be made from ½in. deal, the inside dimensions being 4in. by 12in. by 15in. high. In the bottom board must be cut a hole about 3in. in diameter to allow the waste water to escape, two straps being also secured to the bottom to raise it about an inch from the ground, and by means of which it may be firmly screwed or bolted down if required. The nozzle is formed from a short length of ⅝in. lead piping. One end is knocked up until the bore is reduced to about $\frac{3}{16}$in., and to the other is soldered the male screw of an ordinary hose junction. A lead flange by which it may be screwed in position should also be soldered on. When putting the machine together, care must be taken to get the bearings in perfect alignment. A slight tendency to bind may be corrected by sinking the bearing a little bit into the wood on one side or the other. The pulley may be roughed out and afterwards turned to shape with the machine running. Connection may be made with one of the house taps by means of an ordinary hose, and the motor either placed in the kitchen sink with a heavy weight on it to hold it steady, or fastened down over a grating. It will be found most useful for driving small dynamos and similar light work.

W. J. G. Foreman, C.E.

CALCIUM CARBIDE.

[43004.]—No one can keep more than 5lb. of calcium carbide on his premises without a license, and the railway companies treat the carbide as if it was an explosive, and have special rules and rates as in the case of cartridges, gunpowder, &c.

Everything that can possibly be done to kill a most promising industry by rules and rates is being done by the Board of Trade and the railway companies, and an industry *can* be most effectually killed by absurd and restrictive regulations, as witness the melancholy example of the motor-car. It is no exaggeration to say that the ridiculous regulations of the Board of Trade have lost this country many millions of pounds, and have strangled it in its birth the most promising new industry of modern times. The more free and enlightened French are miles ahead of us—the victims of a narrow, bigoted, and autocratic bureaucracy.

I have seen it stated that eighteen hundred townlets and villages in France are lighted by acetylene. In this Board-of-Trade-ridden country are there one hundredth as many? Lancastrian.

ELECTROID GAS.

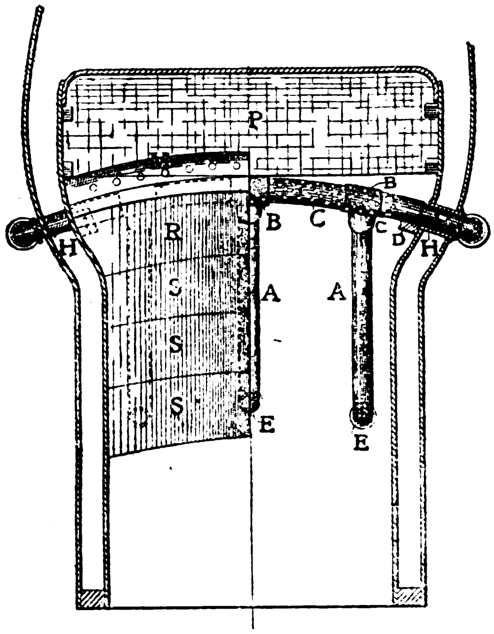
[43005.]—The name "Electroid" is a misnomer. I should say an ignorant and absurd misnomer. The gas is only our old friend Acetylene plus two volumes of atmospheric air. The acetylene generator used by this company is on a good principle, and makes a very pure gas, as is always the case when the carbide is thrown into a large excess of water, heating and polymerisation being thus avoided. By an automatic arrangement the carbide is thrown into water as required, and without interrupting the action of the apparatus. The gas passes to a purifier to remove phosphorus—the worst impurity—and then to a mixer, where it is automatically mixed with two volumes of atmospheric air. The resulting acetylene light is singularly white and beautiful. I have thoroughly inspected and investigated the apparatus, and its working, of the Electroid Gas Co., and believe it to be a most safe and excellent arrangement for the production and consumption of acetylene.

Wm. Hardman, M.B., &c.

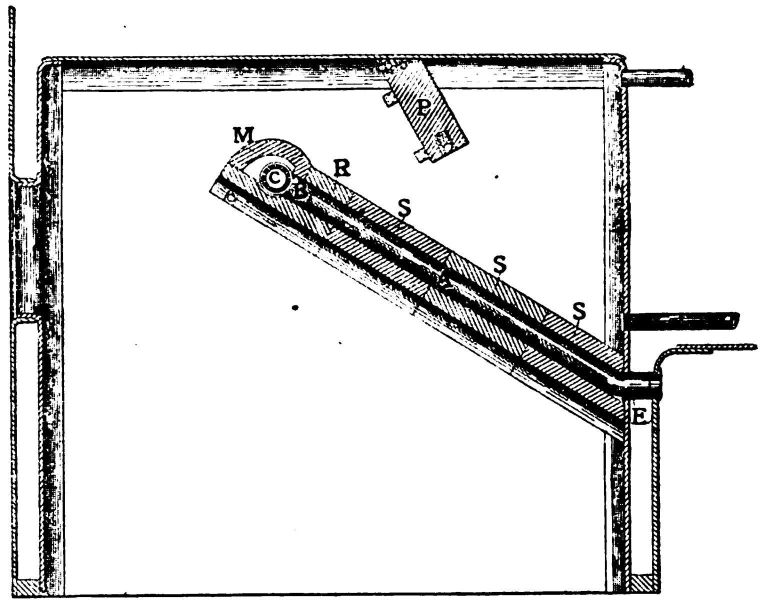
MORE PERPETUAL MOTION.

[43006.]—With regard to the letters by Mr. Baker and others *re* the above subject, I would like to have a few words with those interested, partly because having been through the mill myself, I can quite appreciate what Mr. Schucht says about its being a fascinating subject; but that is about the only fact in his letter with which I can agree.

Has it never occurred to Messrs. Baker and Schucht that the simplest perpetual-motion machine is embodied in a bicycle wheel with a heavy valve at one spot on the rim? If the wheel is placed free to revolve, and the valve just started from the top on its downward journey, it should gather enough energy during its downward movement to drive it right up the other side and over the top. But it will *not*, simply because the friction of the bearings and air (small as it is) absorbs exactly as much energy as would otherwise suffice to lift the valve the slight distance by which it falls short of a complete revolution. Any device introduced to obviate this must of necessity introduce more friction, and thereby defeat its own object. Mind you, this energy is not destroyed, but is converted into heat in



Cross Section.



Longitudinal Section.

the bearing (infinitesimal it is true, but it is just enough to upset the balance the wrong way).

Concerning the latter part of Mr. Schucht's letter, I think he has made a great mistake, in that a man striving after perpetual motion has not reached, let alone passed, the elementary stage of applied mechanics, because one of the very first maxims this involves, and upon which half the problems are based, states that: "Action and reaction are equal and opposite," and one does not get much further in it before he finds that by doubling the length of a lever you do *not* double the power, although you may halve the distance. What you do double is the stress at the further end, and it is just this failure to appreciate the difference between power and stress, energy and work, velocity and momentum, mass and weight, together with a lack of the faculty of seeing that "power" is but a measure of the *rate* of doing work, and not a measure of work itself, which accounts for such a large amount of deep thinking, which might be usefully applied to practical schemes, being wasted over this mirage of perpetual motion.

Mabel.

THE LIGHTNING FLASH.

[43007.]—Some statements of "Constant Subscriber" (letter 42985) in your issue of last week need, I think, some further explanation. Your correspondent considers that we are surrounded by an illimitable infinitude of liquid air, but goes on to assert that it must be "imponderable" and "unelemental." If it be imponderable and unelemental, it cannot be liquid air, nor, indeed, any material substance whatever, for as long as air exists its atoms and molecules must possess mass, and under the influence of gravitating forces, weight, and if the elemental nature of the constituent atoms could be destroyed, then the material would no longer exist as air. From the latter portion of "Constant Subscriber's" letter, and from the variation in the spelling, I conclude he does not set aside the wave-transmitting "all-pervading æther," but merely superimposes on it his liquid-air ether. Now would not the frictional resistance offered by such a material substance in space, however attenuated, have long ago, considering the infinitude of past time, reduced all celestial motions to a standstill. Moreover, would it be possible for wave motions such as those of light and heat to be transmitted over vast regions of space, as we know to be the case? Your correspondent does not discuss the causes which operate in breaking the continuity of the intra-terrestrial and outer liquid air—ether of space. In the instance given of the two persons killed by the flash, one of whom was reduced to ashes and the other unburnt, was there any evidence that both received the discharge in equal intensity? Might not one have perished from the disruptive action of the lightning, and his companion from the effects of shock? With regard to the difference in temperature in the blood of reptiles and the mammalia, it seems to me the fact is explained chemically on the ground of the comparative rate of oxidation, as effectually as on any magnetic hypothesis. Physiologists have shown that the nervous system is of epiblastic origin, whereas the blood vascular is mesoblastic. How, then, does "Constant Subscriber" consider the nerves to be "a continuation of the venal system."

C. S. H.

SMOKE FROM LOCOMOTIVES.

[43008.]—Referring to the letter of "Loco." on p. 277, I would say that surely he knows efforts have been made for many years to consume the smoke from locomotives, which is not considerable, as the steam "washes" it, and it is not much of a nuisance. It is a great nuisance on board steam-vessels, especially to those passengers who are "abaft the funnel," and there is no doubt the Admiralty would take up any useful device, for smoke betrays the position of war-vessels. Here, however, is a device for dealing with smoke in locomotives, taken from a recent number of *Locomotive Engineering*, a paper published in New York, which may interest your readers:—"In 1884, while master mechanic of the Eastern Railroad, Mr. A. Pilsbury, now superintendent of motive power of the Maine Central, got out a form of brick arch providing for air admission through the arch, coming out at the top. He took out a caveat for the invention, but never had it patented. The invention was applied to an engine on the Eastern Railroad, and gave excellent results, having been in service over a year. The matter was not carried further because Mr. Pilsbury left the road, and several official changes subsequently took place on the Eastern Railroad, and among them the device was neglected and afterwards forgotten; but its usefulness and utility were substantially established.

"We have received from Mr. Pilsbury a blue-print of the device, from which the annexed engravings were taken. It will interest some of our readers to know that Mr. A. M. Waitt, now superintendent of motive power of the New York Central Railroad, was chief draughtsman for Mr. Pilsbury when this form of arch was designed, and he made the drawing from which the blue-print referred to was taken.

"The brick arch is supported on lugs, D. There are three air-tubes, A, fitted into thimbles at the front end of the firebox at E, and terminating at the upper ends of the tubes in T fittings at B. The T's B and thimble E form slip joints, which admit of and provide for all the movement necessary and required by expansion.

"It will be noticed that the cross-pipes connecting the upper ends of the T's are perforated, and in turn covered by perforated curved firebrick, so that the air is delivered at the point and manner most suitable for aiding in consuming the gases. The deflecting arch P is not an essential part of the arrangement, and was not used in engine fitted with the device."

Your readers know that there is very little smoke (visible smoke) when a locomotive is running; but it is always desirable on the score of economy to consume smoke, and it is especially so on board steam-vessels for the benefit of the passengers—the sailors don't count. Anyone who could do away with it would make a handsome fortune.

S. R.

[43009.]—In the year 1845 Parliament passed an Act requiring locomotives to consume their own smoke; but it was known then and it is known now that it is impossible to avoid making *some* smoke, and consequently the law has remained practically a dead-letter.

Locomotives all have the brick arch, deflector, and blower, and I know of nothing better, but still all the smoke cannot be avoided. The London County Council did on Aug. 1 last decide to prosecute some railway company and its men in a police-court. However, the matter would not end there, as the companies have decided to carry such a case right up to the House of Lords, and the societies to which the drivers and firemen belong will defend their members up to the highest court.

Under these circumstances the County Council is very slow in putting its resolution into force. Indeed, it is already stated that probably nothing will be done beyond that the resolution of the Council will "go off in smoke."

Clement E. Stretton, C.E.

Saxe-Coburg House, Leicester, Nov. 4.

WHEN WERE YOU BORN?

[43010.]—I should be very pleased to thank Mr. R. A. Lawson for having shown an incorrection in the formulæ kindly published on p. 211, if I could indeed find anything incorrect in it. On the contrary, I feel obliged to answer that Mr. L. has misunderstood the whole thing.

In fact, the results of Mr. L.'s calculations ought precisely to be read: 2nd day of 2nd month of 54th year, and not, as he says, 20th day, &c.

Mr. L. has only failed to observe that, as the ordinal number of a month can happen to be expressed by two ciphers, two places must be left for them in the final number.

Thus, in Mr. L.'s example, 20254 should be read 2·02 54, just as in mine 30980 has been given by myself as 3 09·80.

I can neither thank Mr. L. for the two (out of six) easier solutions he proposes. If he wants to see how truly they are *scarcely correct*, I would invite him to follow me in the application of any one of the two to the case of a person born 2/10/54—

Day of the month	....	2
× 1,000	=	2,000
+ 10 × 100	=	3,000
− (45 + 1)	=	2,954
+ 100	=	3,054

which doesn't mean anything.

Mr. L.'s formulæ, if it had to improve mine (which, by the bye, is not mine at all), ought to be slightly modified by multiplying by 10,000 instead of 1,000 in the first operation: the result would then be the same as the one I have given.

But for that, should it be an improvement? Is rapidity, as the result of the employment of a smaller number of figures, to be much considered in a trick of this kind? I do not think so. It seems to me that the more you oblige the person asked to jumble his numbers, by successive operations, is the better, as it busies the mind of that person, and prevents him from knowing your little game.

Those two solutions of Mr. L. must anyhow be turned aside; but as he says that he has kept four others of them in store, we may hope that he will have the goodness of producing them, and that at least one out of the four shall be of some value.

Milano, Oct. 29. Hunot.

MOTOR CYCLES.

[43011.]—Referring to Mr. Sangster's letter (42960) in your issue of the 27th ult., I think that your readers would have had a much better grasp of his figures had they been given in English

measure and not in the metrical system, as this latter is not known to all. But mayhap this Mr. Sangster overlooked—inadvertently, I hope. His first quoted figures refer to no bearings in particular, and are therefore unintelligible to me, and I doubt not to other of your readers.

The rest of Mr. Sangster's letter is a personal attack that I fail to understand after his compliment on the "able" way in which I had criticised motors, both the De Dion and the Ariel—which, by the way, was not at first named by me in this journal. Mr. Sangster is perfectly right as to the authorship of "Monty's" letters; but that is no justification for a coarse personal attack, in which truth is distorted to suit his spleen. What interest can it possibly have for your readers to know Mr. Sangster's history of this writer? Being anonymous to them, though not to the Editor, they will not care one brass farthing so long as they get a *veracious* account from an English mechanic of motor-cycle work and its practice. And I claim that *I am* an English mechanic, one who has been through the whole curriculum — fitting-shop, drawing-office, and all—has served on shore and afloat, under others, and as his own master, during which time an inquiring mind and a ready hand have gained him an experience that Mr. Sangster has admitted in a letter that I hold.

But I must tell your readers that my descriptions of motors are not of prehistoric vehicles, but of the latest product of as late as August last. It might surprise Mr. Sangster to know that "Monty" has just been asked to inspect and test, on owner's behalf, a new motor tricycle, at present under construction by the Cycle Components Manufacturing Co., when he will then be able to note all the latest possible mechanical improvements on which Mr. Sangster has dwelt. The world is full of "possible mechanical improvements," and progress is always welcome, or should be; whilst, on the other hand, nothing is gained by a petty spirit when palpable faults are pointed out and remedies suggested.

I am *not* in the motor-tricycle business now, nor am I with a gentleman who is *wholly* engaged in the motor business. Mr. Sangster misquoted me.

Mr. Sangster knew my pseudonym; but I have written thereunder to this Journal for some years, and I prefer still to sign myself **Monty.**

[This must end the discussion so far as the personal element is concerned, which we think should not have been introduced by Mr. Sangster. —Ed.]

PHOTOGRAPHY—GELATINE PAPERS.

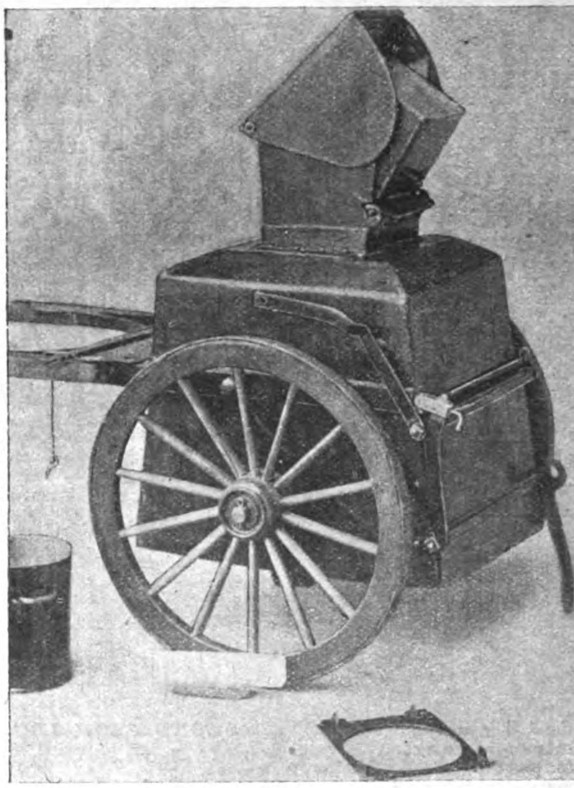
[43012.]—It will be admitted that the great drawback to the use of these papers is the troublesome amount of washing both before and after toning, which the makers seem to insist upon as a *sine quâ non* to successful working. Now, presuming alum is not used—and many experienced photographers find it unnecessary—there seems to be no theoretical reason for so much washing, or, indeed, any at all, and practice has in my hands confirmed this view, for I find that excellent results may be got by simply placing the prints dry, and, without any previous washing, to remove the free silver into the usual sulphocyanide bath. From thence, when of the required tone, they are removed direct to the fixing bath. In this way no washing is required until after the prints are fixed. In my own practice I have mostly used the Ilford paper, and the only modifications required are to print somewhat deeper than usual, and to use a rather weaker toning bath;—the Ilford formula, diluted witih one-third part of water, answers well. It is advisable to place each print into the toning bath separately, and to keep them constantly moving to insure even action. There is, of course, nothing new in the *modus operandi;* but from the amateur who has little time to spare for the practice of his favourite hobby, and who has wisely discarded the use of the uncertain combined bath, it will, I think, meet with due appreciation.

Whitstable. **H. C. Parlow.**

MODEL SANITARY DUST-CART.

[43013.]—The inclosed photo. was taken of a model sanitary dust-cart designed by me at the instigation of your paper. The principal features about the cart are that it can be loaded by one man from the ground, and that it will hold as much (60c.ft.) as an ordinary tip-cart. The shoot is arranged to prevent all dust from blowing about. As soon as a bucket is put up to the shoot, it opens a flap in front; the bucket is then pushed right in, lifting with it the hood, until it comes to a stop; the bucket is emptied, and brought back. All closes automatically by its own weight; no springs are used. The cart is a low tipping-cart with a door at the bottom, which, when unfastened, can be pulled open by a lever at the side, or, when tipped, will open itself. The shoot can be worked from the back or at the side. The stuff, owing to the shape of the cart, trims itself.

Being an employé of the London County Council, I cannot work this invention, but want the Council to take it up, and have asked them to have one built from my specification, which I doubt.



I have taken out the patent for the shoot (completed); the door, &c., is provisionally patented. I had to obtain permission for the shoot. The cart and door is as much the Council's property as it is mine, until they give me permission.

E. J. Hitchcox, Hydraulic Engineer.
South Pontoon, Woolwich Ferry, L.C.C.

THE ESSEX FUNGUS FORAY.

[43014.]—The following rather extraordinary account of the annual fungus foray in Epping Forest appeared in a halfpenny London morning paper:—"The members of the Essex Field Club made a successful week-end raid on the fungi of Epping Forest. In the woods the most striking objects were the clumps of the gaudy fly agaric, with tall white stalk and brilliant scarlet top. When incorporated in the humble 'catch-'em-alive,' as its name implies, it deals death to greedy insects. When taken in moderation by the human subject it causes a form of drunkenness that is indulged in by the people in the north of Russia, yet such are the ways of nature that the grubs of beetles may flourish on its substance. In the open grew the oak fungus that, as it ages, turns to a fluid once used for printing Bank of England notes. The blackness is due to the tiny spaes [?] that play the part of seeds, and under the microscope their absence from a note would show a forgery at once. Nor must the bracket-like form be forgotten that grows from trunks of birch-trees, and claims close kinship with the 'beefsteak fungus,' nor yet the 'candle snuff' that marks the spot where other trees have fallen. Nearly 140 kinds were distinguished by the experts, Dr. M. C. Cook and Mr. George Massee. It is to the former veteran fungologist that lovers of nature owe so much for his many delightful books on plants, while the latter is, perhaps, the greatest living authority on the minute forms of fungal life. Two species not hitherto found in the forest were recorded, and the experts characterised the collection exhibited as the best they had seen for ten years."

The "gaudy fly agaric" is the *Agaricus* (*Amanita*) *muscarius*, but it is news to learn that it has anything to do with the "humble 'catch-'em-alive.'" Dr. M. C. Cooke says: "It is found most commonly in birch woods, and not very plentifully in Britain. A decoction of this fungus has been employed as a fly-poison; whence its vulgar name," but that has nothing to do with "catch-'em-alive." It is perhaps the most handsome of all fungi, and it is possible that it is used in Russia, but it is doubtful whether it is the true Fly Agaric that is employed for producing intoxicating effects. As to the "oak fungus, that, as it ages, turns to a fluid once used for printing Bank of England notes," I fancy the reporter has developed his notes in a way not intended by his informant. *Coprinus comatus* and *C. atramentarius* both yield a fluid that may be used as ink (of a sort), but it is extremely doubtful that they were ever used to make ink for printing Bank of England notes. The word "spaes" is probably an error for spores, but the fact that it appears helps to show that the writer does not quite understand his subject; but why the "barber's wig" (*C. comatus*) should be called the oak fungus is a puzzle, as it grows in pastures and gardens. I have seen it on the Victoria Embankment when the soil for the garden beds was brought there some years ago. What is meant by the "bracket-like form" is also a puzzle; but presumably it is the Oyster mushroom, *A. ostreatus*, which is generally found as an "imbricated" mass. That may be an error again, though "bracket" is scarcely like imbricated in the most careless manuscript. But the mention of the "beefsteak fungus" leads to the suspicion that the "bracket" is *Polyporus squamosus* or *P. betulinus*, which is found on trees. Perhaps some of your correspondents will explain what is meant by "candle-snuff" that marks the spot where "other trees" have fallen. I cannot trust the paragraph above quoted, for even the name of Dr. M. C. Cooke is incorrectly printed, and I thought everyone who understood anything about fungi knew how to spell his name. **S. R.**

The "Practical Engineer Pocket-book" for 1900 has been issued by the Technical Publishing Company, Ltd., Manchester, and has been increased in size as well as recast, so as to facilitate reference.

The main line of the Orleans Railway Company into Paris is being prolonged into the Quai d'Orsay, a distance of $2\frac{1}{4}$ miles, nearly two miles of which will be in tunnel. Steam locomotives will continue to haul the trains to the Austerlitz Station, whence electric locomotives will be used. The three-phase current of 5,500 volts will be generated at a station over three miles distant from the Quai d'Orsay.

Briar Pipes.—In the course of an article in the *Windsor Magazine* on "The Making of a 'Briar' Pipe," one of the greatest authorities on the subject is stated to have said:—"It is strange, and yet it is a fact, that the English workman is of no use in the manufacture of pipes. The most skilful artisans are either the Austrians or the French. The pipemakers are a very select, small body, and observe every precaution to prevent their trade being learned by outsiders. They will have no apprentices, and if I introduced any boys into my factory I should have to pay them the Union minimum wage, which is two pounds a week. On the other hand, the workmen are clever, and they earn high wages." Speaking of the cost of a pipe, Mr. Weingott remarks:—"When the blocks arrive over here they are at once sorted. Out of one gross of blocks I rarely ever get more than three or four pieces of wood good enough for the very finest class of pipes, about a dozen good briars for fine quality pipes, and perhaps as many as four dozen pieces of wood for the ordinary everyday pipe. The remaining seven dozen pieces of wood are thrown into the furnace, and, I might mention, help considerably to generate the necessary steam power for the machinery."

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96511.]—**Brazing-Lamp (U.Q.)**—See sketch on p. 71, Vol. LXIV. of "Ours." GLATTON.

[96514.]—**Dry Cleaning (U.Q.)**—I have always understood that the articles are first soaked in benzoline in vessels specially constructed to prevent loss of vapour or risk of explosion, &c. This removes grease, oil, paint, and almost all the substances which usually cause the adherence of dirt. After this the clothes are dried, and the dirt, no longer cemented to the fabric, is easily beaten out as dust. I am not sure of the correctness of the above—perhaps someone will correct or supplement it? GLATTON.

[96516.]—**Heat Consumed in Mechanical Work (U.Q.)**—The temperature would fall on expanding into the atmosphere to a degree depending on its original pressure and temperature. The fall would be due to work done in displacing the atmosphere. Both in this and the first case every foot-pound of work done would use up 778 thermal units, causing a corresponding alteration of temperature depending on the pressure to which the air is expanded. GLATTON.

[96532.]—**Geometrical Solution (U.Q.)**—I suppose "J. S." has overlooked this query. His solution is, I think, very ingenious, and should not be difficult to understand. G O, G Q, G R are drawn in any convenient direction near where G X is expected to fall. They are merely used as a device for obtaining the short curve cutting E F at O, and their exact position is unimportant. E X F is a right-angled triangle, X O = B D by construction; and if it can be shown that the angle D B Z equals the angle E X O, no further proof is necessary. Being on the same base, and similar in the same circle, the angles E X G and E F G are necessarily equal; and as the latter is by construction equal D B Z, D B Z is also equal to it. GLATTON.

[96548.]—**Bent Timber (U.Q.)**—Surely this is a matter which can only be settled by trial with the particular timber you propose to use. GLATTON.

[96668.]—**Mirror-back Showcards.**—To "ESSAR."—Many thanks for reply; but there is something more wanted. There is no trouble to make bronze-powder stick to glass, but I cannot get the brilliant looking-glass appearance there is upon the mirror-back showcards to be seen in most tobacco shops. There must be some little trick about it—something after the hot-water trick to make gold leaf brilliant in sign painting. I hope someone of "Ours" will put me up to the method wanted. Does M. Cole know how to do it? SIGNWRITER.

[96689.]—**Cooling (U.Q.)**—Assuming adiabatic expansion, Peabody gives—

$$\frac{T_4}{T_3} = \left(\frac{p_4}{p_3}\right)^{\frac{K-K}{K}}$$

Where—

T_3 = absolute temperature at cut-off in the expanding cylinder (= 273·7 − 50 = 223·7° Centigrade)
T_4 = absolute temperature of exhaust
p_3 = pressure at cut-off (= 360 atm.)
p_4 = pressure of exhaust (= 36 atm.)
K = 1·405 with adiabatic expansion.

Hence— $\frac{K-1}{K} = \frac{\cdot 405}{1\cdot 405} = \cdot 288.$

$$\frac{T_4}{T_3} = \left(\frac{36}{360}\right)^{\cdot 288} = \left(\frac{1}{10}\right)^{\cdot 288} = \cdot 515$$

Hence— $T_4 = \cdot 515 \times 223\cdot 7$
= 115·25 absolute
273·7

= − 158·45 below zero Centigrade. GLATTON.

[96712.]—**Lantern Slides (U.Q.)**—Is there no one among your readers capable or willing to give advice *re* choice of a hand camera for this purpose? May I make another appeal for help? My query appeared on page 144. A. TESTER.

[96722.]—**Preservation of Indiarubber.**—This query refers to the preservation of vulcanised caoutchouc, and a definite answer would be valuable. As a matter of fact all vulcanised rubber goods soon go wrong, probably because the sulphur is worked out by the caoutchouc. Probably in the case given, smothering the "rubber" with flowers of sulphur is a good preventive of the rottenness that sets in, especially if the rubber is not used. Keeping under water is said to be useful, but much depends on the way in which the vulcanising has been done. Here is a remedy to prevent vulcanised rubber becoming hard or cracking, and it would do for cycle tires:—Dip in a bath of melted paraffin and dry in a temperature of about 212° Fahr. S. R.

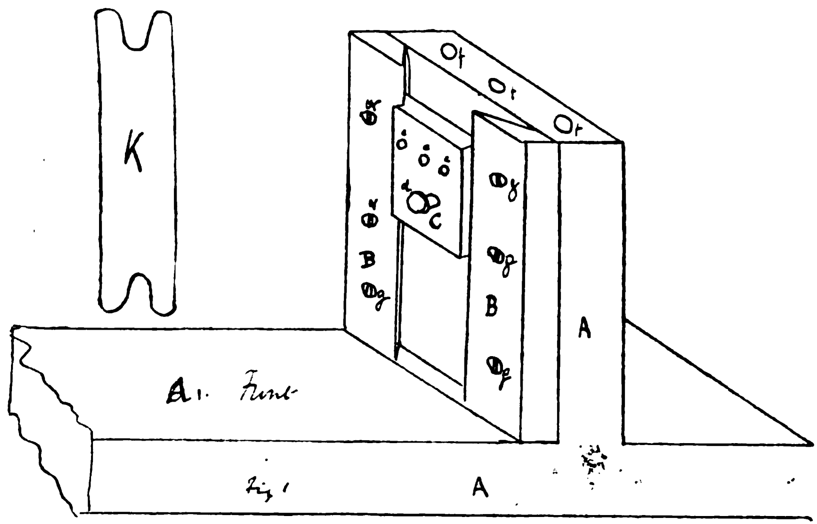


Fig. 1

[96737.]—**Chemical Balances.**—These appliances are amongst the most delicate of the scientific instruments. Directions for making can be found in back volumes; but I suspect that anyone capable of doing the requisite work would not need to ask for information. The idea of a "rough drawing showing dimensions and details of knife-edges and other important parts" is good. Surely the querist must see that a very exact drawing is necessary: otherwise the ordinary pictures of weighing scales in the cyclopædias would answer. M. T.

[96757.]—**French Polishing.**—If this powder is an advertised article, the querist probably knows where to find it; but I never heard of a "powder" to dispense with the process of spiriting-off. Where has "Rubber" heard of the "fine finish and the lasting properties of this powder," that he finds it necessary to ask for information? He surely must know more about it than those who have never heard of it, and I for one know nothing about a powder used instead of "finish." H. WALKER.

[96759.]—**Bikes and Prams.**—What "B. H." says on p. 278 is definite enough, but it does not answer the question. The query appears on p. 168, and was based on the fact that the chairman of a bench of magistrates, in the course of a case of wheeling a bike on the footpath, fined himself as well as the defendant, when he learnt from the clerk that "judgment" had been given that bikes must not be wheeled on the footpath. "R. R." said on p. 235 that it has been "decided in a court of law, &c.," and on p. 255 I said that what I wanted to know was "where and when it was decided." As "B. H." says that an Act "expressly enacts, &c.," there is "no necessity for a court of law to decide." I have heard something about even Acts of Parliament being indefinite until their provisions have been determined by the Courts. That is not the point, however. It has been asserted that the question has been decided—as "R. R." says, in a "court of law." I want to know where and when, because he reiterates the statement of the magistrates' clerk. The question about when is a carriage not a "carriage" is quite a side issue; but it is satisfactory to learn, as I gather, that the section referred to "repeals all previous powers exercised by local authorities." This happily is a free country, and while all good citizens obey the law (except some magistrates over the last Vaccination Act), we are at liberty to think what we like about the "law," and even to express an opinion about it. ROTA.

[96768.]—**Ironmould in Copper.**—If the querist has tried the recipe given on p. 191, it would be of interest if he gave his experience, and stated how the distemper of magnesite, or petrifite, answers. It seems to be useless to ask "Regent's Park" what he means; but as many people would like a remedy for ironmoulding through the zinc or tin becoming worn off so-called "coppers," perhaps some reader will try magnesite, or petrifite, and publish the result. It would be more useful than the rubbishy paragraphs from our friend, "R. P." LAUNDRY.

[96862.]—**Fret-Saw Machine.**—The beech upright, 14in. by 6in. by 2in., is strongly mortised into the sole-plate A_1. Two mahogany guide-pieces, B B, full length (14in.) of A, are screwed to it. C, of oak, thicker than B B, is fitted to slide freely, but without shake, between B B. An ordinary hand fret-saw is screwed to C by the wooden screws *e e e*. A 2½in. or 3in. lathe headstock is bolted to the front portion of A_1. This headstock should be fitted with a face-plate drilled with a series of holes varying from ½in. to 1½in. from centre, so as to allow of the stroke of saw being adjusted as necessary. These holes should be tapped and a pin fitted, together with a pitman rod. The pin *d* is fitted to C to take other end of rod. The platform H, of pine, 12in. by 12in. by ⅜in., is next temporarily screwed to A, the position of hole for saw found, and bored. It is then sawn down the centre, hinged at back, and the small

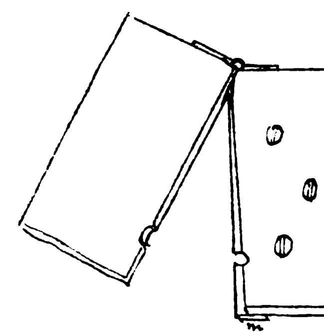
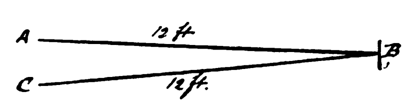


plate of brass, *m*, screwed on under the steady half, and a hook and eye fitted to front, and then firmly screwed to A_1, the screwheads being well countersunk. K is a piece of ½in. mahogany, cut to shape, and fitted between arms of saw-frame to decrease vibration when at high speeds. A good lubricant for the slide is a mixture of black-lead, olive-oil, and a few drops of petroleum, about as thick as very thin cream. This arrangement was originally adapted for a lathe, and is a really good and serviceable one. The split platform is an addition of my own to prevent much stooping when changing saws in dim light. GRAHAM.

[96871.]—**Image in Mirror.**—Where is the image formed? Proposition: The focal distance of the image of an object as seen in a reflector is equal to the distance of the object A from the reflector B, plus the distance of the observer C from the reflector. The distance of the object and



observer being each 12ft. from the mirror, the focal distance will be 12 + 12 = 24ft. The focal distance of the reflection of the sun is equal to the sun's distance from the reflector plus the distance of the observer from the reflector; the latter is a *quantité négligible*. And everyone who uses a sextant for the purpose of taking a distance realises that the focal distance of the sun's limb is also sharp focus for the bright limbs of the moon reflecting the sun's rays. Place a mirror on the ground in the sun's rays, and put on it a scrap of paper, or anything that can be focussed sharp; take up a position to receive the sun's reflected rays in a telescope or binocular, and first focus the paper; then direct the telescope to the sun's reflection, and you will find a blurred image. Now correct the focus to a sharp image, and you will find it in focus for the sun 92 million miles away. Evidently there is no image on the glass, or the focus for the paper would be right for it; so also there is no image behind the mirror, through 8,000 miles of solid earth, and millions of miles beyond, which, of course, is an absurdity, or the visual angle of the said image would be 16′ instead of 32′. To show that this absurdity is taught, I will quote from "Optics and Light" (Lommel), p. 30. "It [*sic*] sees *in*—that is to say, behind the mirror," &c. "In the same way, an image-point behind the mirror corre-

sponds," &c. Such teaching misleads the student, and gives him no insight into the actual phenomenon of reflection. Where, then, is the image formed? The answer is a reply in brief to the question, What is light? The sun, great centre of disturbance to his system, sends forth his energy in waves of exceeding smallness; some of these waves, moving in right lines, strike the surface of a reflector without affecting it in any visual manner; but being stopped by the solid body, a portion of them—less or more, according to the angle of incidence—is deflected at a like angle, unchanged, except as regards planes of vibration flying off from the reflector in right lines, whose direction is governed by the plane of incidence. If an optical apparatus, eye and brain, receives these deflected vibrations, they are modified into those luxuries of intelligence, the sensations of light, colour, and form. Let the student take a slip of paper, fold it in half, open it at any angle, and place the angle against the mirror. The two sides will represent the incident and reflected—i.e., equal angles—beam; and if he can also assimilate the fact that there is no light outside an eye, he will be in possession of the phenomenon of reflection. Again, let the distance A C be 12ft., and from position C mark the place B on the mirror where reflection occurs, A B C being equilateral, the angle consequently 60°; but if the reflected rays came from a point "as far behind the reflecting surface as this (the luminous point) is in front of it," the angle would be 30°. There is a strange propensity in writers on optics for going behind the mirror. Is not this an inheritance from remote ancestry? Place a monkey, for the first time, in front of a mirror, and he will immediately dart behind it in search of that other monkey; and we may take it for granted that the "missing link" would have done the same had it been placed before a mirror. But the monkey, after two or three attempts to find that other behind the mirror, finds out his mistake, and resigns itself to the fact as something no monkey can understand. Moral: There still remains unanswered, or perhaps we should say unproved, the question, Where does the modification take place? Is it possible to find proof with the help of the proposition which heads this paper? I suggest an experiment. An observer with telescope, a bright light by him, a pair of eyes about 10ft. or 12ft. away looking at the light. Now, if the observer can see the reflection of the light in the eyes opposite to him, and succeeds in getting a sharp focus, he will then examine the features of the face, and if he finds the focus correct for both, it will be good proof that the image is formed on the retina, and that there is the place where the modification of motion into light and colour takes place, and I suppose we shall have to concede intelligence to the retina. If, on the contrary, he finds that the focus of the reflection from the retina differs from that of the face, it will be proof that the image is not formed there, but that the retina receives the vibrations, a portion of them being reflected, whilst the remainder are conveyed by the optic nerve to the seat of intelligence, where they are modified into visual sensations. With the assistance of a friend, I have tried this experiment, not very satisfactorily, using a binocular, power 10.

FRED. H. EWER.

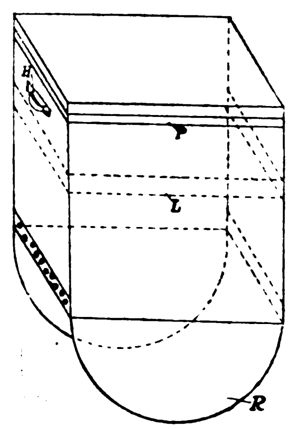
88, Victoria-road, St. Peter Port, Guernsey.

[96886.]—**French Verbs.**—If "W. B." is not actuated by mere passing curiosity, but has a genuine desire to understand the inner life of the French language, he cannot acquire this by a few lines in these columns, but must study such works as Raymonard's "Grammaire Comparée des Langues de l'Europe Latine," and Ampere's "Histoire de la Formation de la Langue Française." He will there find that during the transition from the "Langue Romane" into the "Langue Française" the termination *oie* of the two last conjugations came to replace exclusively the old termination *oue* of the first conjugation—see "Roman de la Rose" (12th century), "A la vie que tu menoies," &c. In the 16th century they suppressed the mute *e*, and wrote *oy* in place of *oi*, the *y* being substituted for no particular reason beyond that it was the fashion then, as witness such words as "roy," "loy," &c., in place of "roi," "loi." This remains still in such words as "envoyer," &c. Later on the useless *y* was dropped, and then the final *s*, adopted to distinguish the first person singular of the various tenses of the indicative, was similarly applied to the same persons of the imperfect and the conditional (which originally had the inflection *eie*, *oie*). We thus arrive at the termination *ois*, which naturally was pronounced as written (compare modern French "Danois"). This brings us to the end of the 18th and the beginning of the 19th century, when Voltaire, for apparently no end or reason, initiated the spelling *ais*, which is contrary to all etymology, the *a* not occurring at any period in the termination of the imperfect.

G.

[96904.]—**Ashes or Cinder Sifter.**—In reply to your correspondent "Hard Up," I have pleasure in giving you a rough sketch of a cinder sifter, which he can easily make himself at little cost, and which will be neat and tidy if painted, &c., and will do away with the cumbersome riddle and bag arrangement he speaks of, and I hope he will not now annoy the neighbours any longer. To make the same, first make an oblong box, any size according to the amount of cinders to be dealt with (see Fig. 1). On to this the rocker R is

FIG. 1.



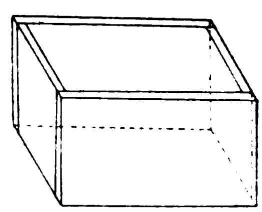


FIG. 2.

screwed, as shown (see R, Fig. 1), and the rocker can be made out of a piece of thin tough wood, bending it into position and screwing it against the bottom ends of the body. On to the box body, Fig. 1, put a plinth all round, to come within about 1in. of the top edge (see P, Fig. 1), and inside the box body, rather below the centre, screw ledges all round (see the dotted lines L, Fig. 1). Now make two boxes like Fig. 2, one rather less than the other, so that it will go into the box body to come up flush with the ledge pieces L, Fig. 1, and this box has a proper wooden bottom. Another box is now required which is made large enough to come up flush with the top edges of the box body, Fig. 1, and which, when in position, rests on the ledges L inside the box body, Fig. 1, and this box has some suitable wire gauze as the bottom, and a piece taken from an old riddle would answer the purpose well. Handles are screwed on each end of the cinder sifter, see H, Fig. 1, and a lid is made to fit over the whole and lie on the plinth P, Fig. 1, when the same is complete. The method of using same is simply as follows:—The box with the wooden bottom is first put into the body of Fig. 1, and rests on the bottom of same, then the box with the wire gauze on the bottom is put in, and filled with the cinders; the person then closes the lid, and then taking hold of one of the handles, rocks the apparatus to and fro until the cylinders are thoroughly sifted; then the cinders remaining in the top box are removed, and for this purpose the boxes should have some small handles attached, or the wood hollowed out for the fingers to grip hold of. The top box can then again be filled with cinders, and the ash sifted out, which goes into the bottom box, can be easily removed when full.

W. H. BLAND.

[96896.]—**Drawing an Eccentric Ellipse.**—With reference to the answer to "B. B. M.," on p. 274, by "F.R.A.S.," I beg to point out that the latest Moy's ellipsograph—of which I am maker—describes an ellipse whose major axis is 3¾in.

W. H. HARLING.

[96915.]—**Isle of Man Steamers.**—The mean speed of the *Mona's Queen* during her trial was 19 knots, the maximum being 19·4 knots. The ordinary seagoing speed of the *Peveril* was from about 13 to 14 knots. The *Duchess of Devonshire* was launched in January, '97 at Barrow. She is 300ft. long, 35ft. broad, and 15ft. deep to main deck; her gross register tonnage is 1,300 tons, and she is fitted with two sets of triple-expansion engines, and during her trials she made 19·47 knots under forced draught; being guaranteed for 19 knots. Now she has settled down, she makes 20 knots, performing the journey from Barrow to Douglas in 2½ hours, and from Barrow to Belfast in 6 hours. The distance from Peel to Belfast is 67 miles, from Douglas to Fleetwood 63, and Douglas to Ardrossan is 130 miles.

RED ADMIRAL.

[96918.]—**Scrap Arc-Lamp Carbon.**—I have never heard of these having been put to any practical use.

S. ELLIMAN.

[96923.]—**Heating Tank.**—The water in the tank should be able to be raised to the required temperature in about ten minutes, and maintained at that while in use.

HEAT.

[96938.]—**Question in Arithmetic.**—There are not sufficient data to answer this question. There would be four plots of land, each 55 yards square, divided by a path 13ft. wide; but we do not know how wide the gravel walk will be between them and the wall. Given that, it is easy to calculate the length of the wall.

NO SIRRAH.

[96955.]—**Stage Thunder.**—Stage thunder is usually produced by shaking a piece of sheet iron. To perform this, choose a piece about 3ft. square (that used for lining the inside of packing-cases suits admirably), hold it by the corner, and shake gently with a trembling kind of motion. A very good imitation of thunder is thus produced. Where greater realism is required, cannon-balls rolled backwards and forwards up in the flies produces a good effect, and is usually the method adopted in most large theatres. To imitate lightning, place some lycopodium powder in the bowl of a common clay-pipe. Blow through the stem, so as to force the powder through the flame of a spirit-lamp. If this be performed neatly, an instantaneous flash is the result. Of course, the stage should be darkened to produce a good effect.

VICTOR E. ARMSTRONG.

[96959.]—**Moulding Slag.**—I have to thank "F. I. S. E." for his answers to my queries, and will be pleased to have his further replies. I would also be glad to know what sort of a furnace is required for remelting slag.

CONSTANT READER.

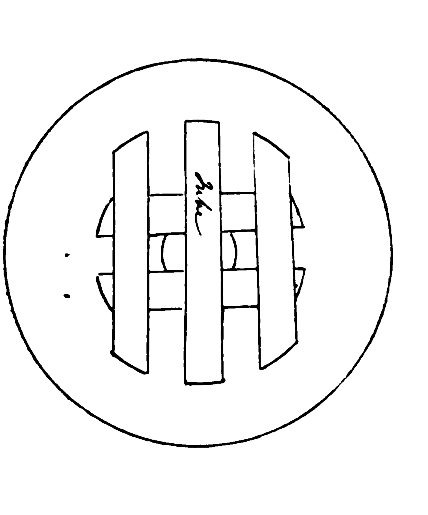
[96963.]—**Gassner Dry Cell.**—Its peculiarity consists in the zinc element forming the outside cell, in which the carbon is placed, separated from the zinc by a thick paste or jelly made of gypsum and oxide of zinc. The cell can be placed in any position, works as well on its side as upright, is not subject to creeping, has an E.M.F. up to about 1·5 volts with an internal resistance of only 0·25 ohm. in the round form, and 0·6 in the flat form. The Gassner dry battery polarises much less quickly than the ordinary Leclanché cell, the only defect at present noticeable is the fact that the outer cases, being metal, must be carefully guarded from touching one another. A very good composition for placing between the carbon and zinc of the Gassner dry cell is made as follows:—oxide of zinc ¼lb., plaster of Paris 1lb., chloride of zinc 2oz., glycerine 1oz., water 1½ pint. Mix the solids first, then add water and glycerine. One useful property of this battery is its capability of being renovated when it has lost power by having a current of electricity passed through it for a comparatively short space of time. This is effected precisely as an accumulator is charged—viz., by connecting up the + terminal of a battery or dynamo with the carbon of Gassner, while the − terminal is connected to the zinc. The charging current must have an E.M.F. of not less than two volts for each cell to be charged. A current of about two or three ampères for about three hours will be found to revivify a spent cell of one quart capacity.

SAB.

[96963.]—**Gassner Dry Cells.**—Gypsum is plaster of Paris. The recipe given by me in "Electric Bells" is reproduced from Gassner's original paper; and according to that the quantity of oxide of zinc and of plaster of Paris needed to make up a cell 3in. in diameter by 6in. high would be about 1oz. zinc oxide to 4oz. of plaster. But you will produce a much more satisfactory dry cell if you procure sufficient fine sawdust to half-fill your cell. Soak this for several days in a mixture made up of half a pint of water to which has been added 1oz. of chloride of zinc, 2oz. of salammoniac, and ½oz. of glycerine. Another paste must also be made up, consisting of about 1oz. coarsely-powdered gas carbon (graphite), ½oz. granular black oxide of manganese, 60 grains of rouge, with sufficient treacle added to make the whole into a very stiff paste. Take your carbon plate, and having put a slice of cork at the bottom of the cell to prevent the carbon touching the bottom, make a line along the top edge of the carbon about ⅜in. below the edge of the cell. Now coat the carbon plate up as far as this line with the treacle paste. Place the carbon plate in the centre of the cell, resting on the cork, and having squeezed out any excess of liquor from the prepared sawdust, ram it tightly round the inside of the cell between the zinc and the carbon, as far as the line on the carbon. Wipe the inside edge of zinc cell quite dry, and pour in sufficient melted pitch to fill up the cell flush with the rim. When the pitch is quite cold and set hard, make a hole with a hot knitting-needle right through the pitch to the sawdust. This will prevent the pitch bursting when gases are given off during work.

S. BOTTONE.

[96952.]—**Model Boiler.**—I send herewith sketch of one which will be suitable for "Amateur Engineer," and any tinsmith can make it; no rivets required; best made of sheet copper. The five cross-



tubes of ⅜in. copper add very greatly to the production of steam. Either Bunsen burner or spirit lamp can be used for heat, as may be found convenient. Total height 4in., diameter 3½in.

C. F. R.

[96963.]—**Gassner Dry Cell.** — If you can obtain "plaster of Paris" you can obtain gypsum—they are the same thing! You want a cylinder of zinc to contain your carbon plate about 6in. by 3in. high, with a bottom. Make a mixture, of the plaster 25 parts, ammonium chloride 10 parts, and water 55 parts. The interior of the cell is coated with this to the depth of about ¼in., the top being left uncovered to about the depth of 1in. When set almost hard, the carbon plate is put in the centre, and the space is filled rather tightly with the following mixture:—Powdered graphite 75 parts, black oxide of manganese 10 parts, chloride of zinc 5 parts, chloride of ammonium 10 parts, glycerine 2 parts. This is mixed with sufficient water to make a stiff paste, which is not to come higher than the top of the plaster. Fill up with pitch, and put terminals to zinc and carbon, as usual.

R. A. R. Bennett.

[96966.]—**Selenium.**—Selenium is an element, and can therefore not be produced. It is closely allied to sulphur in its general properties, and, like sulphur, is generally found in combination with metals, with which it forms "selenides." It occurs sparingly in combination with lead, cobalt, copper, and mercury in the Hartz, at Jilkerode; with copper and silver in Sweden, with tellurium and bismuth in Norway, &c., and along with sulphur in many iron and copper pyrites. It is procured from these ores by oxidising them with the aid of nitrate of potash, which converts the selenium into a soluble seleniate of potash; this is treated with hydrochloric acid, which liberates selenic acid, that in the presence of excess of hydrochloric acid is reduced to the state of selenious acid. Finally, the solution of this latter body is subjected to the action of a current of sulphurous anhydride, which abstracts its oxygen, and reduces to the state of pure selenium. I have never heard that a coil is necessary to overcome the resistance of the selenium cubes used in telephotography. The selenium must be in the condition it acquires after being melted at 217° C. Even then, in the dark it does not conduct electricity freely; but at the instant it is exposed to light, its resistance falls. Any good work on chemistry will give you information respecting selenium.

S. Bottone.

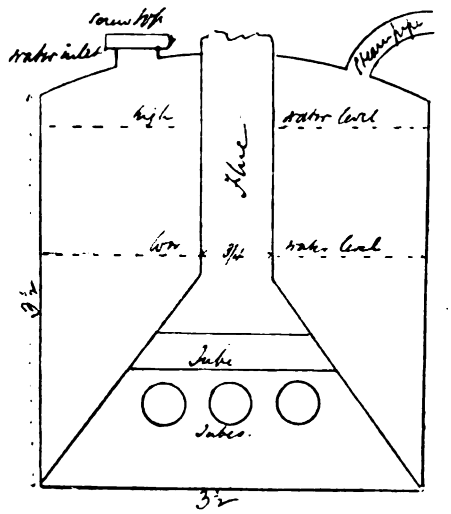
[96966.] — **Selenium.** — Rare element, closely allied to sulphur; found sparingly in free state, more commonly combined with metals or selenides. The Fahlun pyrites (Sweden) contains it, and was source when first obtained. The F.P. is used for making oil of vitriol, and in leaden chambers of apparatus a brownish (or reddish brown) deposit is found. Analysed by Berzelius in 1817, and found to contain new element. See Bloxam's "Chemistry," as to make, &c., and in "Electricity in Service of Man," for application of seleniun.

Regent's Park.

[96966.]—**Selenium.**—Selenium is an element allied to sulphur in its properties, and chiefly obtained from a double selenide of lead and copper found in the Hartz. Its resistance as a conductor of electricity is very sensitive to light, and this property has successfully been made use of in Graham Bell's "Photophone," where a beam of light takes the place of the usual line wire. "Seeing at a distance" had better be taken meantime *cum grano salis*.

W. J. G. Forman.

[96968.]—**Liquid in Toys.**—In good ones, the liquid is ether, coloured with alkanet or similar red colouring matter; the cheaper ones containing methylated spirits coloured. The boiling depends



on air having been thoroughly extracted from the tube, and with a good vacuum even water will boil at a comparatively low temperature.

S. Bottone.

[96968.]—**Liquid in Toys.**—Sulphuric ether, with a little colouring matter added.

W. J. G. Forman.

[96976.]—**Kieselguhr.**—I suppose "W. M." could "solidify or harden" kieselguhr by mixing it with lime, Portland or Roman cement, plaster of Paris, &c., or, if wanted, without too much foreign substance, with silicate of soda, alum-water, linseed oil, or varnish. If the querist had stated the object, a more definite reply would have been given; but he can find the information by searching through the back volumes. The substance named is used, I believe, for making dynamite, and also as a non-conducting composition to cover steam-pipes and boilers. For many purposes a thin mixture of plaster of Paris or a "cement wash" would answer.

S. R.

[96976.]—**Kieselguhr.**—Mix it with a sufficiency of soluble sodium silicate solution (water-glass) to make it into a stiff paste, and set it aside for some time to harden.

S. Bottone.

[96971.]—**Wind Motor.**—Some time ago I constructed a windmill for the purpose of driving a dynamo and pumping water; but I found considerable difficulty in the first place in getting sufficient data to work upon. America seems to have done most in this direction, and their type of wheel, as opposed to the old-fashioned English four-armed affair, is recognised as most efficient. It is very necessary to have speed as constant as possible, so the windmill must be governing to an extent. There are several methods by which this is effected, either by having the slats to open and shut, or by turning the whole wheel (which, in this case, has fixed slats) from the wind should it become too high. The simplest method, as far as I could ascertain, was by the latter method. In this a fixed vane stands out from the edge of wheel, and in the same plane. The rudder, which keeps the wheel facing the wind, is pivoted on an extension of the frame which carries the wheel, and is kept square by means of a weight. When the wind blows over a certain rate, the vane at side of wheel causes the wheel to turn slightly from the wind, and the rudder being pivoted allows this to be accomplished. In my design the wheel was 16ft. diam., with eight arms radiating from a cast-iron boss. Stays were fixed from arm to arm at a distance of 2ft. from centre; and, again, 6in. from the outer ends of arms, and on these stays the slats were screwed. The whole thing was designed with a view of easy manufacture; but a certain amount of metal-work is unavoidable. Should H. Brand think I could be of any service to him, if he will advertise his address, I shall be pleased to communicate with him, and give him full particulars.

Vent.

[96981.]—**Barometer.**—Mr. J. B. Jordan has written a pamphlet, published by Stanford, describing the methods and precautions he adopted when constructing his celebrated glycerine barometer, and anyone wishing to embark on the somewhat difficult enterprise of making a similar instrument may be recommended to obtain this little book.

A. H. B.

[96982.]—**Noisy Wimshurst.**—The machine will always "hiss" more or less. If very bad it is due to sharp points or edges on the conductors. It is caused by electrified air being driven off with some force from such points. Turn the machine in the dark, and you will soon see where the "hissing" comes from.

W. J. G. Forman.

[96982.]—**Noisy Wimshurst.**—Any Wimshurst, no matter how good the insulation, will, when the jars are fully charged, attempt to discharge these either through the air or along the nearest conductors, and in so doing produce a sizzling sound. Should, however, this sound be very loud, and especially if it is accompanied by poor working of the machine, it shows that there are some roughnesses or points at which the jars leak. Work the machine in the dark, and notice the spots which glow with brushes on or near the jars when the hissing is going on. On examining these spots with a strong light, you will be able to detect jagged edges or points. Smooth these and varnish over them.

S. Bottone.

[96982.]—**Noisy Wimshurst.** — The hissing noise is caused by the escape of electricity from the points on the conductor, not from the jars if they are properly made and have no points on them. Your query rather leads one to suppose that you think it is a fault in your machine. On the contrary, it proves that it is producing plenty of electricity.

R. A. R. Bennett.

[96983.]—**Steam Motor Waggon.**—The power required to propel 30cwt. up an incline of 1 in 6 on an ordinary road in fair condition, and at a speed of two miles per hour, would be 6·5H.P. Your engine would develop about 8I.H.P., so that you would have some power in hand for emergencies. You are compelled by the Locomotives on Highways Act to provide two independent brakes, and the vehicle must also be capable of travelling backwards as well as forward; therefore if your engine is not capable of being reversed, you will have to provide reversing gear as well as the two-speed gear. The best means of steering a vehicle of this weight is by the Ackerman system. It is simple, and obviates the use of a heavy fore-carriage. Differential gear will allow of the two rear driving wheels revolving at different speeds when turning a corner. If you drive each wheel separately by means of a chain, this will have to be placed on the intermediate shaft; but the proper place for the differential gear is on the driving axle or shaft, and it should be driven by a chain, or chains, from the intermediate shaft. I could provide working drawing of differential gear, steering gear, reversing gear, and speed gear, &c., if you care to advertise your address.

Auto-car Engineer.

[96986.]—**To Mr. Reginald A. R. Bennett.**—I do not quite understand this query. You talk about a "phonograph," but I have written no article in "Ours" on the subject of phonographs. I suppose you mean the grammaphone; if so, your needle must not have a "cutting edge," but simply a sharp point. In the phonograph an agate stylus is used. The latter part of your query I am still more at sea about, for you speak of "cylinders"; but the grammaphone uses no cylinders. You cannot use brass for making grammaphone records, as the acid would not act on it properly. If you are trying to make wax cylinders for a phonograph in the way that the protecting film is placed on the zinc grammaphone discs, I do not think you are likely to succeed, as the upper surface is sure to be too rough. I should recommend your greasing the cylinder or covering it with vaseline. Perhaps you can explain more clearly what it is you wish to do.

R. A. R. Bennett.

[96989.]—**Polish for Brown Shoes.**—Perhaps bookbinders' brown lacquer may apply. Paris brown lacquer:—Shellac 8¾oz., oil lavender ·525oz., gamboge 1·05oz., alcohol (98 per cent.) 2⅝lb. Dissolve, filter, and evaporate to a quarter of its bulk by distillation. Then add 1·4 bookbinders' brown lacquer, 1·4oz.; finally filter from sediment. B.B. lacquer made thus:—Brown shellac 4½oz., alcohol (84 per cent.) 3⅝lb.; dissolve shellac, filter, evaporate, as before, half the alcohol, add ¼oz. oil of lavender to remaining fluids. (H. C. Standage.)

Regent's Park.

[96991.]—**Cutting Mitre Wheels.**—As you have one of the Cincinnati universal-geared milling machines, is well shown in Paul Hasluck's "Milling Machines and Processes," of Crosby Lockwood and Co., and on the plate, Fig. 100, there seems to be dividing scales or index with graduated markings, and further on he gives, at page 337, he suggests for cutters from 4in. to 15in. in diameter

$$\sqrt{(\text{dia. in inches} \times 8)} \times \cdot 0625 = \text{pitch in inches},$$

or measure pitch in 30 seconds of an inch, and multiply it by the pitch in inches; products show required diameter of cutter. In Robert Grimshaw's "Shop Kinks," S. Low, Marston, and Co., speaking of gear teeth, they vary much both in make and material, and to a certain independent of the tooth outline. The pitch being 1, the depth to pitch-line may be 3-10, working depth 6-10, whole depth 7-10, thickness 5-11, breadth of space 6-11. One English proportion is pitch 100, depth 75, working depth 70, clearance 5, thickness 45, space 55, play 10, inside pitch-line 40, outside 35. Re gear-cutters (not gear-cutting machines), much is being done to unify practice as to outlines and dimensions of cut gears. Cutters of one or two large firms are alike, except a difference in bottom clearance; but of no consequence, being very trifling. The same proportions

best adhered to for teeth of circular as for diametral pitch. For the former working depth would be 0·64 the pitch (correctly 0·43662), and the bottom clearance 0·5p. In the matter of width of face of cut gearing, probably no standard would be possible or necessary; it so depends on circumstances. Three times the pitch, however, is by many considered a very satisfactory width. Small teeth require proportionately more clearance at the roof than large ones. In order to reduce to a minimum the cutting of a shoulder in flanks of epicycloid teeth, if flanks have excessive taper, thinning teeth for a distance of half the height of flank, measured from roof, &c. REGENT'S PARK.

[96993.]—Coil.—To Mr. Bottone.—1. A 2in. coil, with suitable relay and coherer, will work easily up to two or three miles. 2. The length of sky rod should be approximately 10ft. per mile over the surrounding objects. 3. A 6in. spark coil should work in similar circumstances to a distance of ten miles or more. 4. The only readable book on the subject at present is Kerr's "Wireless Telegraphy." I am at present engaged in writing a book on the subject, containing historical, theoretical, practical, and constructional details. S. BOTTONE.

[96997.]—Dynamo.—The trouble very evidently lies in the fact of the F.M. shunt coils being of too low a resistance. This can be avoided to a certain extent by inserting a variable resistance in series with the shunt coils and raising the speed of the dynamo to counteract the drop in volts resulting therefrom. There is no danger in the coils warming up as long as the insulation does not suffer, and the drop of potential may simply be due to undercompounding of the dynamo.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96997.]—Dynamo.—If you will kindly state (1) the type of machine, (2) the size of armature, (3) the gauge of wire on the armature and field-magnets, (4) whether armature is solid or laminated, and (5) what you mean by *casts*, I will try and help you. Has the machine ever run cool? Apparently there is a leak in the F.M. wires. S. BOTTONE.

[96997.]—Dynamo.—Must be a badly-designed machine, or is not wound for the output you are taking from it. Disconnecting from the mains would tend to aggravate the coil by sending all the more current through the shunt coils. The trouble might possibly be somewhat lessened by inserting a resistance in the shunt circuit. Fill a trough-shaped vessel with water, disconnect the shunt coils, and remake the connection through two sheet-iron plates in the water. Then try and get your output with the plates as far apart as possible, and see if it helps matters. If so, find out how much resistance you have in, and insert an equal resistance permanently. W. J. G. FORMAN.

[96997.]—Dynamo.—By casts getting hot we suppose you mean cast-iron pole-pieces. If these get hot without the copper wire coils it shows they are of too small a section for the magnetism induced, or that eddy currents are circulating in the iron. Running dynamo, with heads, &c., disconnected, makes no difference as to the heating. If the coils get hot there is not sufficient wire in them to prevent an excess of current flowing through them: hence they are carrying a greater current than they should do. Increase the quantity of wire, thereby increasing the resistance to the passage of current. This will stop heating of coils.

WEBSTER MICHELSON AND Co.,
Dudley. Electrical Engineers.

[96998.]—Accumulator.—The resistance is unsuitable. The back E.M.F. of the cell, when fully charged, would be about 8 volts, whereas you are cutting down 100 volts on your 105-volt mains, thus leaving only 5 volts charging pressure, which is not sufficient to effect anything like a full charge. A 97-volt lamp would be the correct thing, or even a 95-volt lamp, and a small extra resistance in series with it. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[96998.]—Accumulator.—Probably not enough current goes through, so that the accumulator is not fully charged. Put two, or even three, lamps in parallel, so as to let two or three ampères go through. S. BOTTONE.

[96999.]—Nitrate of Soda in Bunsen Cell.—To Mr. BOTTONE.—In porous cell, along with carbon, use: Nitrate of soda, 3oz.; water, 1 pint; oil of vitriol, 4oz. S. BOTTONE.

[97000.]—Armature.—A full reply would take too much space, covering, as it does, one of the most important parts of dynamo designing. If the querist can refer to Thomson's "Dynamo-Electric Machinery," or even to the "A B C of Dynamo Design," by myself in the pages of the *Model Engineer*, he will gain the desired information. An armature to the dimensions given should be capable of generating 100 watts. The gauge of wire depends on the voltage required, on the speed, and also on the magnetic flux.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97000.]—Armature.—By reading carefully my book, "The Dynamo: How Made and How Used." S. BOTTONE.

[97001.]—Collodion Cotton.—Make a mixture of 1 part of alcohol (sp.gr. ·825) and 7 parts of ether. This will dissolve it readily. Or, dissolve it directly in amyl acetate. S. BOTTONE.

[97001.]—Collodion Cotton.—Soluble in a mixture of ether, with $\frac{1}{7}$th of alcohol, yielding a viscous solution, which leaves the transparent collodion film when evaporated. It is much less combustible than pyroxilin. REGENT'S PARK.

[97001.]—Collodion Cotton.—Try gun cotton. Use sulphuric ether only.

WEBSTER MICHELSON AND Co.

[97002.]—Nasmyth's Locomotives.—The first locomotive engine built by Nasmyth and Co., at the Bridgewater Foundry, near Manchester, was named "Hawk," and was delivered to the London and Southampton Railway Company in 1839. It was a six-wheeled passenger engine, having cylinders 12in. diameter, 18in. stroke, and "single" driving-wheels of 5ft. 6in. diameter. The locomotive business is still carried on by Messrs. Nasmyth, Wilson, and Co. I have the complete list of the locomotives built by the firm, but to give this would take far too much space. CLEMENT E. STRETTON.

[97003.]—Rothwell's Engines.—Messrs. Rothwell, Hick, and Rothwell built the Union Foundry, Bolton, and completed their first locomotive engine in 1831. It was a four-wheeled passenger engine, named "Union," for the Bolton and Leigh Railway. After the year 1860 the business began to be unsuccessful financially, and ultimately the works were closed, and so they remained until about seventeen years ago, when the Bolton Iron and Steel Company purchased the Union Foundry, and added it to its own large establishment. A list of the engines built by Rothwell will be found in the railway collection at the free library at Liverpool.

CLEMENT E. STRETTON.

[97003.]—Rothwell's Engines.—I think at Bristol, but no doubt extinct. Have you looked at back volumes of the *Transactions* of Civil and Mechanical Engineers, locomotive magazines or journals, &c., at Patent Office?

REGENT'S PARK.

[97004.]—Wireless Telegraphy.—To Mr. BOTTONE.—1. About four or five miles. 2. If no air has got in the coherer, yes. 2. Core, a bundle of soft-iron wire $1\frac{1}{4}$in. long, $\frac{3}{8}$in. diam.; wire, 1oz. No. 36 silk-covered copper. 3. Two quart cells should be ample. 4. The wing to earth may be any wire, say No. 16 copper; the sky rods should be stout iron rods, surmounted by a pretty large roll of galvanised wire netting, and insulated from all except the coherer. A similar rod should be placed on the + side of transmitter balls. Allow 10ft. per mile. In reply 96940, for "a *wall* of wire netting," read "a *roll* of wire netting." S. BOTTONE.

[97006.]—Metallurgy.—The late C. Tomlinson, in his "Cyclopædia," has several pages on iron and manufacture. Wood or charcoal chiefly used before coal. Dud Dudley used coal; this was 1619, or so on. The making of coal into coke was known in England in the same century, and described by Dr. Plot in his "History of Staffordshire," &c.

REGENT'S PARK.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Glatton" has replied to 96511, 96514, 96515, 96534, 96548, 96689; A. Tester, 96712.

96560. Electrical work in Australia, p. 74.
96570. Wheat Roots, 74.
96577. Seltzogene, 74.
96580. Speculum polishing, 74.
96583. Tips, 74.
96586. Liquid Air and Magnetism, 74.
96591. Black Enamelling Small Metal Articles, 74.
96593. New Storage Battery, 74.
96597. Paint for Hot-Water Cistern, 74.

96727. Elementary Optics, p. 168.
96730. Curl in Photo. Films, 168.
96731. Power of Boiler, 168.
96740. Efficiency of Small Gas-Engine, 168.
96747. Retouching Negatives, 168.
96748. Boilers for Motor-Cars, 168.
96751. Diving, 168.
96752. Motor-Carriage, 168.
96760. Model Loco, 168.
96765. Bagatelle, 168.
96766. New Lawson Biunial Saturator, 168.
96769. Search-Light, 169.
96775. Boiler for Marine Engine, 169.

OWING, it is stated, to the high price of copper, the imperial German postal authorities purpose to replace this metal for telephonic purposes with aluminium wire or iron wire coated with copper.

QUERIES.

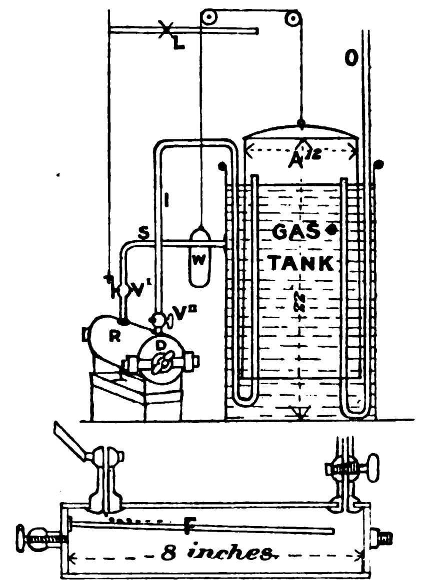
[97007.]—Boat.—Would any reader kindly inform me as to the kind and section of wood which would most suitably do for a small boat 12ft. long, 3ft. beam, 1ft. 6in. deep?—NOVICE.

[97008.]—Motor Cycle.—Will any reader kindly oblige with particulars of induction-coil, sizes, and quantities of wire, &c.; also explain why the valve-spindle in carburettor is made of German silver?—SENLAC.

[97009.]—Cleaning Paper.—Could any kind reader give me a recipe for cleaning paper without damage. I have some valuable music which has got rather dirty by use?—MUSICIAN.

[97010.]—Spectroscope.—Will some reader kindly give me information on the following? I have a table spectroscope by Browning, a few parts of which are missing, and which I could replace if I knew what was required. The collimator tube has at one end an adjustable slit, at about 3in. from this a lens, next follows a series of two sets of five prisms; then, at the end of the tube, a thread is cut, but the filling is missing. If a lens is required, of what kind and focus should this be? The diameter of collimator tube is $1\frac{5}{8}$in bare, while the mounting on stand has an aperture of $1\frac{5}{8}$in. Particulars of the adapter to use would oblige. In the collimator tube at farther end from slit there is a slot $\frac{5}{16}$in. by $\frac{13}{16}$in. What is this for?—E. S.

[97011.]—Acetylene.—The diagram is the plan of an acetylene apparatus that I have made; but before starting I would like all defects pointed out. A is the usual gas-holder, O outlet, I inlet from generator, W



weight for holder, L lever for automatically controlling water supply by shutting valve V'; valve V'' is for shutting off gas when charging R. Generator is a piece of 3in. steam-pipe 8in. in length with rubber-faced ends. F is a piece of flat iron for distributing water in generator. Will I need a purifier between generator and holder?—FRASER.

[97012.]—Accumulators.—In the cells there are three positive plates of about 10in. to 10in. What current ought each cell to discharge, and how long, after being charged to milkiness? What specific gravity of dilute acid should be put into cells that have been cleaned out, and some of the acid thrown away? If the acid is of wrong specific gravity will the cells work?—ATTENDANT.

[97013.]—Ice Storage.—What is the best form of an icehouse (that is, a house to store ice frozen in winter to keep till summer), and the method of packing the ice?—J. R. F.

[97014.]—Sledge.—Would some reader kindly give design of a well-built strong sledge to carry, say, four people, and materials used?—J. R. F.

[97015.]—Sidereal Time Indicator.—Has anything been devised to simplify the process of converting Sidereal to Mean Time when taking transits, something more accurate than the device figured in "Chambers' Astronomy"? Also say if the Transit Tables formerly issued by Latimer Clark are still published, and by whom?—J. BENTLEY.

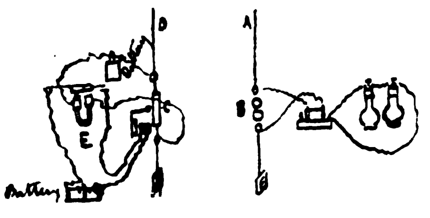
[97016.]—Electro-Gilding Solution.—Having a very good electro-gilding solution which has accidentally had added to it an excess of cyanide, can anyone who knows give an efficient way of getting rid of this excess without adding fresh gold?—ELECTRO.

[97017.]—Gas v. Steam.—Which would be the cheapest to work, all things considered—a steam-engine of 8H.P. (coal 18s. per ton, including cartage) or gas-engine of same power with gas at 4s. 2d. per 1,000ft.? Would be worked about eight hours per day, sometimes less.—OPTICAL L.

[97018.]—Electric Bath.—I have a very fine medical battery, with primary and induced currents, very strong or very weak if necessary. Can you kindly tell me the proper way to connect the current to water for an electric bath, and also what material should bath be made of? I only have an ordinary painted metal bath. Is there any handbook by a medical electrician that I could get? I wonder if any of your readers have benefited in health by taking a course of electric baths? I have hay fever in its most violent form for six or eight weeks every year—have had all my life; have tried about every known

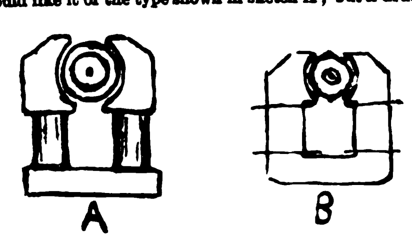
remedy, and could write a volume about it; have to give up work for several weeks. I am thinking about persevering with electric baths next year, and want to get all the information I can about them.—Perseverance.

[97019.]—**Wireless Telegraphy.**—To Mr. Bottone.—Please tell me what size induction coil I must



use to work a wireless telegraph for about half a mile? There are about eight houses in the way. Also how can I make a coherer out of a piece of glass tube, and must the air be exhausted, and is a battery placed in the same circuit between the coherer and relay? Please say if sketch is correct, and give the dimensions for the lettering?—Chase.

[97020.]—**Dynamo.**—To Mr. Bottone.—Please tell me what size to make a dynamo to give 6 or 8 volts at 2 ampères of current, with either a ring or drum armature. H armature will not suit. If a ring armature is best, I would like it of the type shown in sketch A; but if drum,



as sketch B. I want to keep the shaft low, and to use as little wire as possible. Also, how much wire must I use?—Chase.

[97021.]—**Bromide Printing.**—Attempting to produce prints by this process, have been troubled by a thick fog all over the print, including that part of paper protected by rebate of printing frame. Use ferrous-oxalate developer with subsequent clearing bath according to maker's formula, and have tried hydroquinone, with same result. Image is a long time appearing, and is very "hard" when complete. Safe ruby light used. Fog appears during development. Am suspicious that paper has been stocked a long time by dealer. Would stale paper show fog like this?—Faineant.

[97022.]—**Metric System.**—Would any of your correspondents inform me how to calculate the area of a triangle in mètres, &c.? The sides of the triangle are 1,660, 1,454, and 1,372 links respectively.—Enquirer.

[97023.]—**Engraving Tools.**—Can I get some information as to the sharpening and tempering of engraving tools? I want them for inscription and monogram work on gold and silver.—Jeweller.

[97024.]—**Horse-power.**—Will some reader let me know what indicated horse-power I should expect out of two cylinders, 2¼in. diam., 5in. stroke; cut-off, ¾ stroke; boiler pressure, 30lb.; revolutions 300 per minute? And what may I expect with 60lb. in boiler; also 120lb.?—Nottingham.

[97025.]—**Punts.**—Will any reader kindly give me the dimensions for above, such as length, breadth, and depth, and also how to make the shapes?—A. B. C.

[97026.]—**To "F.R.A.S."**—Will you kindly name a few standard books—up to date, but not too expensive—on modern field and siege artillery, path of projectiles, and explosives? Young, in his "General Astronomy," refers to "Astronomisches Nachrichten," No. 1426, for a proof of a formula for orbital velocity. The proof is in German, and therefore beyond my reach; but I hope it would not be asking too much to ask for a translation?—Second Differential.

[97027.]—**To "M.I.C.E."**—Please name an easy book on the calculus of variations. What is the calculus of operations, and what is the curve of sines?—Second Differential.

[97028.]—**Honey.**—I should like to know the analysis of honey.—Merchant.

[97029.]—**Pumping Boiling Water.**—Will an ordinary lift-pump with leathers pump boiling water out of a farmyard boiler? How long would leathers stand?—M. S.

[97030.]—**Dry Cell.**—What is the best dry cell to use in connection with wireless telegraphy? What is the construction of the Obach dry cell?—No Sirrah.

[97031.]—**Enamelling Oven.**—1. What thickness of sheet iron would I require for making enamelling oven to hold two or three cycle frames? 2. Where to fix burners, and how many would I require? 3. What kind of burners are best for gas? 4. At what heat would I have to keep it? Any other particulars would greatly oblige.—J. Green.

[97032.]—**Ink for Recording Instruments.**—Can anyone give me a recipe for ink for recording instruments?—A Subscriber from the First Number.

[97033.]—**Acetylene Container.**—Would any of our kind contributors give advice in the following circumstances? I have got an "Incanto" generator capable of containing 1lb. of carbide. Could I connect this machine with a home-made container in such a way as to utilise several charges one after another, until the container is full, and then use the stored gas to light the house? Would the gas deteriorate, and is there any danger in this method? I thought of using an ordinary oil-cask as the outer vessel of the container, and a zinc vessel for the inner.—Thelma.

[97034.]—**Trellis.**—I bought recently a piece of ready-made trellis, which, when closed, becomes proximately a flat board, but expanded becomes an open trellis 12ft. by 6ft. Suppose this set up vertically in an open space exposed to the wind. Is the wind pressure against it the same whether it is closed or open—the actual surface exposed being the same?—O. J. L.

[97035.]—**Paint for Baths.**—Can anyone give me a recipe for a paint absolutely unaffected by hot water? There is such a paint in which copperas plays an important part, and it will resist even hot water and soda. A workman was going to give me the details but I have left the place, and forgot to obtain them.—O. J. L.

[97036.]—**The Planets.**—Will some reader of the "E M." please inform me how I can find the position of the planets at any given time within the last 40 years?—Neptune.

[97037.]—**Copying Drawings.**—Can any reader give me a method of copying drawings or diagrams when placed in the horizontal position?—Optical L.

[97038.]—**Colouring Oil.**—Can any reader inform me how to colour paraffin oil, either red, black, blue, or green? I have made one or two attempts, but failed to get them to mingle, the colouring either remaining at the bottom and the oil above, or vice versa? What I wish is some harmless ingredient or non-poisonous chemical that will assimilate without elaboration.—Keemo.

[97039.]—**Clark Cell Method of Measuring Volts.**—Will any reader kindly give me a clear explanation of this method, using a bridge and known resistance? 1. Volts higher than Clark cell. 2. Volts lower than Clark cell.—Van Wang.

[97040.]—**Solio Paper.**—I have a quantity of solio paper prints, printed much too dark. What is the best thing I can do with them? Is there any process I can put them through to make them all right?—Watty.

[97041.]—**Motor Bicycle.**—To "Monty" and "The Writer of the Articles."—I am desirous of fitting a small motor to an ordinary safety bicycle, something after the fashion of the Armand-Garreau machine, capable of travelling at about 17 or 18 miles per hour along the level road (illustrated some time ago in these pages), the motor being fitted to the bottom bracket. So far as I can see, no definite information has yet been given with regard to making such a motor, although asked for several times; neither have I seen the necessary castings advertised. Will not the above gentlemen or others help us out of our difficulty, and give us the required information? I am sure drawings would be greatly welcomed by most of our cycling readers, including—Motor.

[97042.]—**Shoe Jobbing.**—Will any kind reader who is in the habit of doing this sort of work kindly give me a little information, more particularly on the tapping of shoes? Please name tools and materials required. Is there a handbook published on the subject?—Cobbler.

[97043.]—**Flue-tubes of Steam Boilers.**—Will someone tell me the cause and how to prevent steel flue-tubes from eating into little holes, and blistering same as little cinders stuck on? The water I use is rain-water. I always filter it through a rag before using. The boiler stands cold and idle more than used. It is only twelve months since I got it retubed. The old tubes were very rough, and full of little holes, and these are starting the same trick. Size of boiler (vertical) is 4ft. high, 1ft. 8in. wide, with six vertical 2in. steel flue-tubes.—H. N.

[97044.]—**Accumulators.**—I should like to know through "Ours" how to make accumulators for storage? Having a small engine and dynamo for lighting twelve lights, what metals and chemicals, and sizes, should I require to prevent always running engine when lighting up?—H. Cooper.

[97045.]—**Imitation Watered Silk Paper.**—Can any reader tell me the ingredients of the black colour that is put on paper called imitation watered silk paper?—S. J. B.

[97046.]—**Steam Exhaust.**—As I cannot run exhaust-pipe into chimney, is there any other way of condensing steam from exhaust of 3H.P. engine by any kind of fitting or arrangement I can fix on pipe so that no steam will be seen?—N. N.

[97047.]—**X-Ray.**—To Mr. Bottone or Others.—I have made a Wimshurst machine, which gives intermittent sparks of 5in. with jars, and continuous sparks of 2in. without jars. What kind of tube should I get for same? Would a tube for 3in. spark be suitable? Also cost of tubes for 3in. to 6in. spark? Would a 3in. tube be suitable for the thicker part of man's leg?—Novice.

[97048.]—**Fluorescent Screen.**—Will some kind reader of "Ours" please instruct me how to make a fluorescent screen?—Novice.

[97049.]—**Ohm's Law and the Decrease of Voltage.**—I was reading a book on electricity the other day, and it mentioned that the drop of potential in mains was considerable in some instances. Now, according to Ohm's law the potential always remains the same, and the ampères suffer diminution.

$$\text{Ohm's Law, } C = \frac{E}{R}.$$

Now, if Ohm's law is correct, how is it possible for the voltage to decrease? The voltage would remain the same if the current was transmitted one thousand miles or only transmitted one mile. I certainly think there should be a thorough investigation on this point, and have it settled. It is rather annoying for a student to grasp the principles of Ohm's law, and then to read that the voltage decreases according to the distance the current is transmitted. If some competent reader would give his opinion on this subject, I should consider it a great favour?—J. Brown.

[97050.]—**Electric Lighting.**—Has the old-fashioned atmospheric gas-engine advertised in these pages many years ago ever been used to drive dynamos? If so, with what results?—A.I.E.E.

[97051.]—**Metalised Bearings for Dynamos.**—Have these bearings, once advertised so much for dynamos by A. H. Bateman, of Greenwich, ever been used for this purpose? If not, why?—A.I.E.E.

[97052.]—**Atmospheric Engine.**—Can any of "ours" give a section of Lownes' atmospheric engine?—A.I.E.E.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 8, and unacknowledged elsewhere:—

Induction.—Young Engineer.—Meteor.—Rook Rifle.—J. M. de Havilland.—J. F. Sefton.—W. J. Shaw.—A Fellow of the Royal Astronomical Society.—Arithmos.—R. D. Hall.

W. H. B.—Yes, we pay for articles; not, of course, for replies or letters. We are open to suggestions as regards subjects.

T. R. Clapham.—This is really a matter Fellows must discuss with the Royal Astronomical Society itself. That Society apparently does not desire publicity for its meetings; besides, the point you discuss is of no interest at all to the great majority of our readers.

X. P. L. T.—Thanks; we have often thought of it, but are pretty full now. You probably have little idea how slowly such books sell!

No Sirrah.—We always adopt your gardener's plan ourselves.

W. G. Shaw.—You must kindly excuse us from offering an opinion. That is entirely a question for a lawyer. Our only obligation to readers and advertisers is to try and prevent frauds, or help them to redress where fraud has been consummated. In all cases where dispute is simply about quality of goods, or breach of agreement to supply, readers must seek the ordinary remedy and ordinary advice from their lawyers.

Alan.—1. Any of the large booksellers could supply you with works on hypnotism, mesmerism, &c. See also the back volumes for many notes on the subject. 2. Do not know the work mentioned. 3. All particulars can be obtained from the secretary of the society. The address is, we think, Dean's-yard, Westminster, S.W.

Sorrowing Annie.—The cause of the eyelashes falling must be ascertained. Perhaps there is some inflammation of the eyelids. A medical man should be consulted.

Redbun.—It is scarcely likely that the book can be restored if it has been saturated with oil. It could be done by treating each leaf separately; but that would be rather costly in time, if not for the detergent.

Anxious.—No one can give any useful information without examining the patient. Possibly bathing the part with hot water would be sufficient to give relief.

Institute.—When information is required as to the "rules and regulations" of institutes and societies the best plan is to apply to the secretary. Your particular question has been answered many times. You must enter as a Stud. Inst. C.E., and to do that you must be articled to a member of the Institute. But apply to the secretary for the rules.

T. M. C.—If you can tell us what the subject was, probably the article can be found. Nothing of the name mentioned in the Vols. for '95 and '96. Have you given the correct name?

W. G. H.—See Hints to Correspondents above, No. 4. Any of our advertisers who deal in electrical or physical apparatus can supply selenium. One firm in your city, for example.

Constant Reader, W.B.—See the back volumes for many articles on the subject, and refer to the works mentioned in the answer to A. Adams, last week.

Desirable.—First question beyond our purpose; as for the second, better see some of the kilns used in the district.

W. E. C.—Presumably you mean talc. It is not manufactured, but is a natural product, and is split into thin sheets. Mica is also used, and, like talc, is a silicate of magnesia.

W. Collinge.—Probably of the secretary of the Sanitary Institute. The query is inadmissible.

N. D. P.—1. Various remedies have been suggested, but the cause must be discovered before a satisfactory remedy can be found. 2. The "cement" generally used is a solution of caoutchouc in mineral naphtha, sold at most shops where they supply leather, &c., for shoemakers.

Anxious (Hammersmith).—That is a question that only

a medical man can answer, after a personal interview. We believe ourselves that the effects of mercury as a medicine are much more permanent than the majority of doctors think; and often more pernicious than the maladies it is supposed to cure.

ANXIOUS (Redditch).—We should be inclined to try massage. Write Dr. Allinson, 4, Spanish-place, Manchester Square, W., and ask his advice.

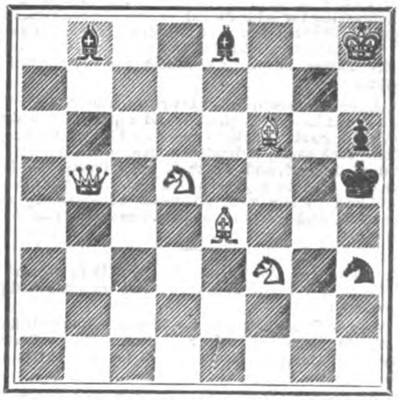
ARBOR.—Not exactly common, but by no means unfrequent in mild autumns. We have a laburnum tree that often flowers on the second growth late in the year.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1700.—By H. V. GOTTSCHALL.

Black. [5 pieces.



White. [6 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Nov. 20.*)

Solution of PROBLEM No. 1698.—By F. SCHINDLER.

Key-move, Q-Q 3.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1698.—Correct solution has been received from Richard Inwards, F. B. (Oldham), Quizco, J. Mason, W. Peters, Rev. Dr. Quilter, J. E. Gore ("Pretty").

M., J. W. HOOD.—The solution should not have proved too difficult. (See above.)

A. T.—You give Q-K 3. Above is correct.

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

For advertisements on inside pages, except page facing leader, for ess than a quarter-page; per inch single column—

1	6	13	26	52 insertions.
7s. 0d. ..	6s. 6d. ..	6s. 0d. ..	5s. 6d. ..	5s. 0d. each.

Per Column.—

1	6	13	26	52 insertions
£3 0s. ..	£2 15s. ..	£2 10s. ..	£2 5s. ..	£2 0s. each.

	1	6	13	26	52 insertions.	
	£ s.	£ s.	£ s.	£ s.	£ s.	
Per Page....	8 8 ..	7 0 ..	6 0 ..	5 5 ..	5 0	each.
Half-page ..	4 10 ..	3 15 ..	3 10 ..	3 0 ..	2 10	"
Quarter-page	2 10 ..	2 5 ..	2 0 ..	1 15 ..	1 10	"

Back Page, £10 10s. A few dates open during 1899.

ORDINARY ADVERTISEMENTS.

	£ s.
Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the ENGLISH MECHANIC Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to THE STRAND NEWSPAPER COMPANY, LIMITED, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK WRAPPER, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

Wanted, **Motor Tricycle**, condition no object; exchange Gas-Engine, 3in. Screw-cutting Lathe.—G. GOUDE, Whittlesea.

"**English Mechanic**," 10 years, exchange for Gas Stocks and Dies, Drilling Machine, or offers in Tools or Bicycle. —PALMER, General Smith, High-street, Fareham.

Dynamo, about 2-horse, partly finished; exchange anything useful.—SKINNER, Engineer, Whittlesea.

"**Sirius**" **Equatorial Head**, nearly new, 16s., or exchange.—A., 33, Fernhead-road, Paddington.

Printing Press and Type, outfit complete, value 50s. Offers, cash or exchange.—Apply ADAMS BROS., Daventry.

High-speed ½H.P. **Steam-Engine**, castings nearly finished, 35s.—GEO. MORGAN, Merthyr. See "Wanted" column.

"**Imperial Journal Arts and Sciences**," two volumes, 1,600 pages, cost 52s., sell 15s., or exchange below.

Wanted, **Flywheel and Crank**, suitable for bench lathe.—SMITH, 66, Woodland-terrace, Old Charlton, Kent.

Lady's Pneumatic, splendid machine, honestly worth £10, take £6. Also Smith's Oil Brazing Blowpipe, take 14s.

Will Exchange Above for Gas or Oil-Engine, Boiler, or anything useful.—HIND Thorne, Yorkshire.

Lathe, treadle motion, for 3½ centres, complete. What offers, exchange?—WILLIS, 50, Glenparke-road, Forest Gate.

Smith **Paraffin Brazing Lamps** for cycle work, 12s., or exchange.—ROBERTS, 4, Manette-street, Soho.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of **Screws, Bolts, and** NUTS for model work, drawn to actual size, sent on receipt of stamp. —MORRIS COHEN, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—CLEGG, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—JARRATT, Queen-street, Leicester.

Books.—All out-of-print books speedily procured, any subject. State wants.—BAKER'S GREAT BOOKSHOP, Birmingham.

Rubber Outer Covers, 8s. 6d. Prepared Canvas, 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—PEMBERTON.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—PEMBERTON.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—PEMBERTON.

Detachable Outer Covers (Licensed), 12s. 6d. each; all cycle accessories and cycle rubber goods stocked.—PEMBERTON and Co., 1, Cardwell-place, Blackburn.

50,000 Choicest Microscopical Objects.—Bargains. Catalogues free. Microscopes, cabinets. Collections purchased.—SUTER, 10, Highweek-road, Tottenham.

Nuts and Bolts for Model Work. Illustrated List, 2,800 varieties, 3d.—BUTLER BROS., Haggerston, London.

Screws, Screw-plates, Taps, round and hexagon special steel brass and iron rods. See list.—BUTLER.

"**Simplex**" **Gas and Oil-Engines**, new series, "Otto" principle, ½B.H.P. to 2B.H.P., from £9. Guaranteed.—Below.

"**Demon**" **Gas-Engines**, awarded prize medal, ½B.H.P. to 12B.H.P., low price, high efficiency, economical. Guaranteed.—Below.

"**Demon**" **Gas and Oil-Engines** are thoroughly reliable. First-class workmanship.—PASLEY and Co, Sherborne, Dorset.

New **Engine Castings**, ¼-horse, 5s. 6d.; half-horse, 11s. per set. Catalogue two stamps.—TOMLIN, Ironfounder, Oldham.

Rubber Outer Covers, average 16oz., Para rubber 5s. each.—FRANKLANDS.

Rubber Outer Covers, 3s. 6d. each, 36s. per dozen. —FRANKLANDS.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—FRANKLANDS.

Air Tubes, best quality rubber, 2s. 9d. each. Fitted with Dunlop valve, 3s. 9d.—FRANKLANDS.

Air Tube, Para rubber. Marvellous value. Large stock to clear. Perfectly air-tight., 2s. each.; 21s. per dozen.—FRANKLANDS.

Cycle Capes, 3s. 6d., 4s. 6d., 5s. 6d. Also a few cycle Capes, guaranteed waterproof, 2s. 6d. each.—FRANKLANDS.

Detachable Outer Covers, licensed, 12s. 6d. each. —FRANKLANDS.

Saddles.—A clearing line in ladies' and gents' saddles, 2s. 6d. each, 24s. per dozen.—FRANKLANDS.

Inflators, 18in., 1s. 6d. each, 15s. dozen.—FRANKLANDS.

Bells.—Special line, double gong, usual price, 12s. dozen, will clear 5s. per dozen.—FRANKLANDS.

Prepared Canvas, 90 by 9, 1s. 3d. each, 12s. per dozen.—FRANKLANDS.

Pedal Rubbers, 6d. per set of four, 4s. 6d. per dozen sets; no rubbish.—FRANKLANDS.

Spanners, nickel, usual price, 13s. per dozen. Will clear a few dozen at 7s. 6d. per dozen.—FRANKLANDS.

Cycle Accessories and Cycle Rubber Goods. We hold the largest stock in the North.—FRANKLANDS, Astley Gate Blackburn.

Brass and Gunmetal Castings of finest quality. Prices on application.—DANIEL YOUNG, Witney, Oxfordshire.

W. Probert and Son, Brassfounders, Whateley-road, Handsworth, Birmingham,

Manufacture Brass Fittings in quantity to sample or drawing.

Brass Tubes, Sheet, Rods, Wire or Strip.

Brass Castings to Pattern.

W. Probert and Son, Whateley-road, Handsworth, Birmingham. Works: Tower-road, Aston.

Calver's **Complete Equatorial**, best ever designed, revolving eye-end, set any latitude by screw and vernier at once. Second-hand Telescopes, perfect order. "Hints on Reflectors," 13 stamps.—G. CALVER, F.R.A.S., Chelmsford.

Mail Cart Wheels and Perambulator **Furniture.**—WALKER BROS., Primo Wheel Works, Sheepscar, Leeds.

"**Gem**" **Gas-Engines.**—Still simplest and best for small powers.—MOTOGEAR Co., below.

"**Gem**" **Gas-Engine Castings.** — Easiest to make up.—MOTOGEAR ENGINEERING Co., 78, Queen Victoria-street, London.

Wheel-Cutting.—Spur, bevel, mitre, or spiral gear, in all metals, to any pitch.—MOTOGEAR, below.

Differential and Spur Gearing as illustrated in "E. M." for motor tricycles. Special prices.—MOTOGEAR, below.

The Motogear Engineering Co. have duplicated their machines and plant to cope with orders received.

They regret **Past Delays** and **Orders Declined**, unavoidable through limited capacity to deal with the quantity of work placed in their hands.

Orders can now be dealt with more promptly.—Address, 78, Queen Victoria-street, London, E.C.

Denning's "Great Meteoric Shower of NOVEMBER," illustrated, one shilling.—TAYLOR and FRANCIS, Red Lion-court, Fleet-street.

"**Spesco**" **Belting Syrup** prevents slipping, and keeps belts in good condition; 1lb. sample tin, post free, one shilling. —SPESCO Ltd., Suffolk-place, Bermondsey, London.

Small Engineering Business, with (patent) speciality, for sale as going concern. Inspection invited.—BEECHING, Mareham, Boston

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 17, 1899.

INLAYING.—VI.

THE process of veneering may seem simple enough, and it is so to the practical workman; but with the amateur it is often a difficult task. If an uneven pressure has been given to the work where contact is not perfect, a series of ridges will show. Assuming half this work is perfect, the caul must be heated again and placed, not upon the part that is sound, but upon that portion that is imperfect. Pressure should commence from the centre to drive the excess glue outwards, using the felt carpet as explained in the last chapter.

Assuming the work has every appearance of perfect adhesion, it can be laid aside until thoroughly dry. The outer paper that has adhered to the cutting should be very carefully removed, but must be damped to facilitate matters. The tool that has been used for the shell will be of service to remove the paper by scraping, and this will soon bring up any imperfection. If any portion of either shell or brass seems to appear unsound, small cauls and felt must be applied with pressure until perfect.

We may next give the means employed to bring the surface up to the polishing point. After the paper is removed, a coarse file is worked in all directions to level the excess, using second cut and smooth files for finishing; after which a piece of flattened pumicestone is used, lubricated with linseed-oil, until all file-marks are entirely obliterated. The final polishing of shell and brass is gained by means of charcoal and oil. It is of vital importance that the charcoal is of the proper kind, and cut in such a manner that it will cut and polish, but not scratch. Choose a piece of box, if possible, that has been charred properly in a muffled furnace. It should be about 1½in. diameter, and should be cut on the angle, so that when separated four or five slightly star-shaped crevices are discernible. It should not be too dense or heavy, nor should it be light and spongy. The desired quality will show itself very quickly in working. In passing the coal over the work, a certain adhesion or biting should be distinctly present, and with the working, a film of oil, fully impregnated with the brass in the shape of minute particles, should be discernible to the eye. The brighter the brass shows up in the oil, the nearer will our work approach perfection. The proof will be plain if all file and pumicestone marks are polished out. The crust or bark of the coal must be removed. It is in the crude hard casing that is the enemy. If all has been well, the work, when forced from all oil, &c., should present an even polish, free from scratches. The final touches we can well leave until the polishing paper is discussed. Fig. 108 indicates the manner of blending part and counterpart. A portion has the ornament cut in brass, the other has it in the shell. The same holds good with brass or German silver and wood. The design is for a panel which is got by assembling the four cut corners and jointing up at the dotted lines, thus forming one large panel. Although we say jointing up, we imply that the small centre ornaments are added when the four corners are together; otherwise an unsightly joint would show in the brass, which should be closely fitted. As far as the shell goes, it does not matter. The centre portion (when jointed up) is for the purpose of showing the brass ornament cut in the shell, which when engraved shows up well. The outer corners are the reverse: hence we call them the counterpart, and if the reverse was the case as regards the outer corner, we should not gain that variety now obtained. Yet it must not be forgotten that the panel would be pleasing if the shell ornament was central and the brass formed the four corners. Therefore in cutting buhlwork have as fine a saw as will carry well and save all after gluing-up (assembling).

We now come to one of the most pleasing portions of our task—the inlaying of leather, one of the most simple processes imaginable, because the tools are few, the material cheap and easy to work, and the job will last long if varnished after all gluing is done, and always bear revarnishing.

Russia leather can be got in all colours, andof fairly even substance. We will take, for instance, the simple ornament (Fig. 109), which can be greatly enlarged. If we glue a piece of salmon-coloured leather on a piece of deal or any kind of wood, and cut the outline of the ornament from a design already prepared, we shall be able to lift the ornament before the glue sets. It then remains to let in the dot or ball in, say, red, the centre in blue, the other pieces in whatever colour may be chosen. If by chance the joints should show open, a little stretching will soon rectify matters. Even as it is, it will not look out of the way; but if we "crease" the joints the value is highly enhanced. Creasing-irons can be made or purchased. If made, they should be as sketched in Fig. 110, and from ⅜in. to ⅞in. wide. The

FIG. 108.

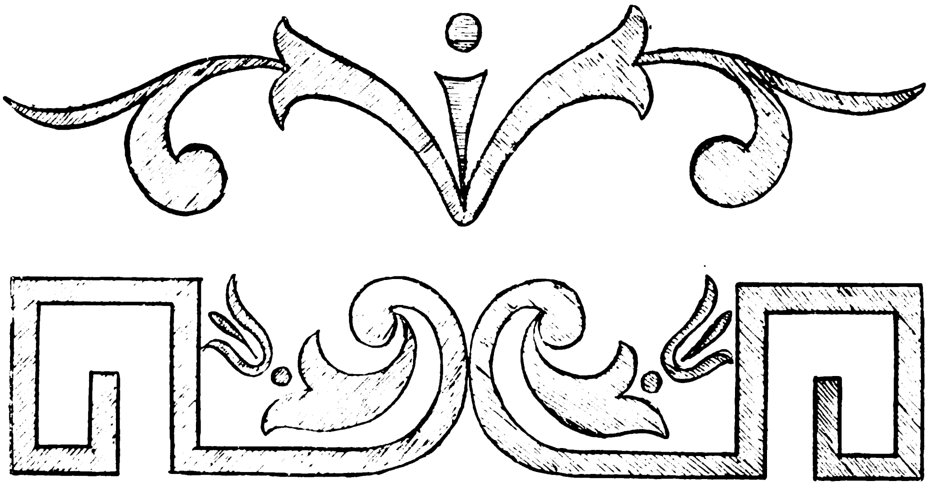


Fig. 109.

brighter or more highly burnished they are the better will be the crease line. A side tool is also shown. It is for the purpose of running a border line close to the edge of the work. Different thicknesses of creasing tools produce lines of corresponding widths,

Fig. 111.

so it will be readily seen the scope of ornamentation is unlimited.

We have given another example (Fig. 111) which requires a different method of working. The leather that forms the groundwork

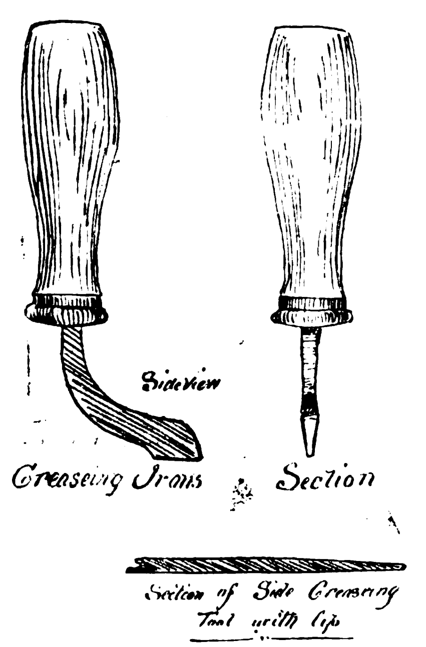


Fig. 110.

should be rolled with a round piece of wood to stiffen or toughen the skin. It should be laid on a board, and not glued at present. Four drawing-pins stuck in each corner will suffice. The chosen design is now laid on the leather, and with a sharp knife cut cleanly through to the back. The leather should be turned over, and the edge of the ornamental portion pared clean to about half its thickness, and extending about ¼in., which consequently forms a *feather* edge, inclining inwards. As each ornamental leaf or flower is cut, so must they be pared to correspond in substance. To give an appearance of roundness to the leaf or flower, a portion of the leather is carved out, so to speak, exactly coincident to the veins, on the under side, of course. When glued down and creased, the veins will consequently be lower than the outer surface, simply because all paring has been done on the under side. When all paring is done, the ground can be glued down, without stretching, adding the other portions afterwards. The parts that are thinnest should be well seated down to the glue, and that may be helped with the bone folder. When dry, or nearly so, the creasing-irons are warmed just up to the degree of heat that will burnish without burning. If the white of an egg, well diluted, is washed over the work, it will help the after-varnishing process. A special leather varnish is employed. Other designs can readily be elaborated with this simple caution—do not have any scrolls that cannot well be creased. Practise on larger work until efficiency is gained, and bear in mind the face side of the leather is *never* pared.

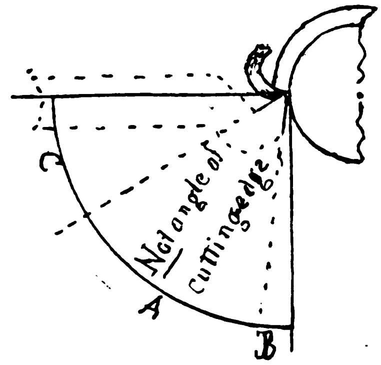
ON THE ANGLES OF THE EDGES OF SLIDE-REST TOOLS.—I.

By "D. H. G."

When referring to some back numbers of the English Mechanic a short time ago, I chanced upon a diagram given to describe the angles of the slide-rest tool, and was reminded thereby that I had intended to offer some observations suggested by the illustration; but, being unable to do so at the time, the matter escaped my memory. The diagram occurs in the series of articles entiled "Engineers' Machinists' Work," by "J. H." (*vide* "E.M." of May 1, 1896, No. XVIII.), and having re-read the two papers devoted to the subject, I venture to think that, although my remarks appear so long after date, the subject may still be of interest to amateurs who deal with metals in the lathe, and who hold that practice may be improved by the knowledge of the principles by which it should be guided.

There is no novelty about the diagram referred to above, which, though slightly changed in position on paper, is virtually a reproduction of that of Mr. Babbage to be found in the appendix of "Holtzapffel," Vol. II. p. 934. Although the diagram is useful as illustrating (in a very exaggerated form) certain points which ought to be borne in mind in the shape of the slide-rest tool regarded as a *whole*, it is probably responsible for much misapprehension on a still more important point of detail—viz., the angles of the edges which do the work. For some writers on the subject have taken the diagram as sufficient definition of the angle of the *cutting-edge* proper to be used on different metals, under the name of the "cutting-angle." "J. H." uses the diagram in this way; and the deductions which the writer founds upon this basis, coupled with the examples adduced in their support, afford unusually good material for the practical demonstration of the misleading character of the term "cutting-angle" when used in this sense. I think, therefore, it may, in the interests of the junior members of the amateur fraternity, be well to take this opportunity of drawing attention to the question. For the amateur will find that a sound acquaintance with the principles on which the cutting-edges of slide-rest tools are formed and should be applied may go far to compensate for the want of apprenticeship, and the lack of the practised eye which enables the trained artisan to form and select his tools by their general shape alone. Mr. Babbage has said that the excellency of all slide-rest work must, in the first place, depend on the angular relation of the facets which compose the edge to *each other* (and conjointly) to the *work*. But then these angles must be correctly measured, or they will become snares instead of aids.

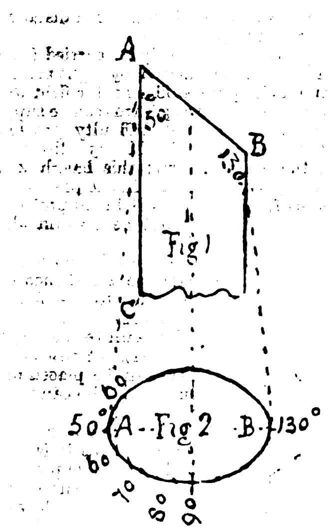
The following observations will be better understood by referring to so much of Mr. Babbage's diagram as relates to the particular question, though this must be familiar to most amateurs,



either in whole or part, from its frequent occurrence in manuals and essays on the subject.

Mr. Babbage divided the *quadrant* into three angles, which will here be called respectively the angles of "relief" (B), of the "tool" (A), and of "escape" (C). The definitions are Mr. Babbage's, but the distinguishing letters are those used by "J. H." It is difficult to believe that Mr. Babbage should have intended the angle assigned to the "tool" to define also that of the edges formed upon it. For it is obvious that no *plane* drawing, such as that of the quadrant illustration, can represent in the same view both the vertical elevation of the tool from point to stem, and also show the angle which the edge presents to its work when moving laterally in the horizontal direction. Yet "J. H.," in the text explaining the diagram, writes:—"In Fig. 110, A is the tool-angle or cutting-angle," adding only, "this is varied to suit different metals and alloys." If there were any fixed proportion between the angle of the cutting-edge and that of the so-called "cutting-angle," it would not be a matter of so much practical importance what the angle of the latter might be called. But Prof. Willis has demonstrated that in tools of this class the angle shown in a side-view of the tool (as shown in the "quadrant" diagram) must always be *more* acute than that of the cutting-edges; and also that this difference may be very wide indeed, as it will depend on the form given to the flat upper face of the edge. The so-called "cutting-angle" can, therefore, be no certain indication of the acuteness of the edge employed, for edges varying widely in their acuteness may be formed on one and the same

"cutting angle" simply by varying the shape of the upper face. Moreover, in a side view of the tool it is impossible to tell whether the edge may be pointed or rounded, and though the *principle* involved in the flat upper face is the same in both cases, its *action* is very different in degree (*vide* Treatise by Prof. Willis, in the Appendix of Holtzapffel, Vol. II. p. 991). The "cutting angle" can only show the angle which the *bevel*, or "top-rake," makes with the highest point in the front line of the edge. And Mr. Smith observes: "It is not only the front edge of the tool that *cuts*. A most important part of the cutting is done at the *side* of the edge" (*vide* "Cutting-Tools," by R. H. Smith, M.I.M.E., &c., Chapter V. pp. 82-3). The same authority also insists on the "mathematical impossibility" of describing the angle of any edge having a flat upper face by giving one angle alone. "J. H." admits that, "The subject of cutting angles is one of very great importance, as malformations cause waste of power and indifferent workmanship"; but the writer also says that "angles may exist in books, but do not survive in practice" (vide "E.M." No. 1624, p. 251). It is rather hard to harmonise these two quotations. Doubtless such books as describe the angle of the edge by the one so-called "cutting-angle," are open to this indictment; and as the writer adopts the same system of measurement, it is probable that this is the key to this sweeping censure of the value of "book-learning." But it is somewhat remarkable "J. H." should have adduced the two tool-holders of Messrs. Smith and Coventry in



support of the conclusions based on the theory of the one "cutting-angle"; for no two better examples could be found to demonstrate the misleading character of this system of measurement. The writer says that "the tool-holder for round bars maintains a constant cutting-angle of 50°, while those for *wedge-shaped* (*sic*) cutters embody a cutting-angle of 68°." With regard to the tool-holder for *round* cutters, their circular cross-section admits of the simplest form of mathematical demonstration that, so far from the angle of the edge being "*constant*," no two adjacent points can possibly be of exactly the same angle.

Let Fig. 1 represent the side view of a round cutter bevelled to contain an angle of 50°, and Fig. 2 be the *flat* view of the elliptical upper face so produced. If the angle at A be 50°, the angle at B must be 130°, or the supplement of 180°. Thus the edge must gradually pass (on either side) through every angle from 50° at the highest point at A to 130° at B. The gradual decrease of acuteness is approximately indicated by the degrees marked on either side of the highest point at A in Fig. 2, and continued on the lower side up to 90°, after which point the edge becomes obtuse. That Mr. Smith fully recognised this mathematical fact is apparent from his description of the tool-holder in question—to be found in his work on "Cutting Tools" (Chap. VII. p. 163-4), where the writer gives a very candid account of the merits and limitations of his holder. Mr. Smith writes thus: "The elliptical section forms the cutting-face, and the *cutting-edge is the highest sharp corner of the ellipse.*" It will be seen by reference to Fig. 2 that the decrease of acuteness in this section of the edge is confined to limits which are of no practical moment in a *light* cut. But the writer goes on to say that, "With a deep, heavy feed, the steel is apt to slip downwards a little, thereby causing inaccuracy in the work." As this holder places the cutter in a position very slightly relieved from the vertical, it can readily be supposed that this would be the case when the metal engages the edge at points where its decrease of acuteness may amount to 70° or 80°, or even more.

To describe these edges as "maintaining a *constant* cutting angle of 50°" gives no idea that the edge contains only *one single point* of this angle, and that it varies gradually up to 90°; nor of the limitation in its use as described by Mr. Smith; nor of what would be the case if the cross-section of the edge were other than truly circular—viz., that the variations of acuteness at the several points of the edge would all be different in degrees. "J. H." quotes the "cutting-angle" of the "wedge" (or V)-"shaped" cutters as being 68°. But this is equally misleading with respect to the true angle of the cutting-edges, which cannot be far short of 80°. This, however, will be more clearly understood when the way to estimate the value of solid angles has been considered.

(*To be continued.*)

MILLWRIGHT'S WORK.—XVII.

THE Lagrelle fasteners are shown in Fig. 102. The belt, butt-jointed, is laid face to face at the ends; the links or loops, *a*, are inserted in punched holes, punched slightly smaller than the loops, and bars, *b*, are passed through them.

Walker's plate jump-joint is illustrated in Figs. 103-105. There are several modifications.

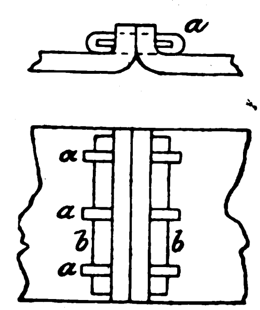


FIG. 102.

The older form consisted of links and pins only; in the later ones, the joint is stiffened with plates, Fig. 103 being the completed joint, Fig. 104 a link, Fig. 105 a plate. This is a good joint in cases when the projections are not objectionable.

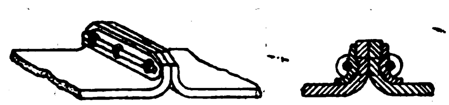


FIG. 103.

The advantage of the plates is that they prevent the pins from being pulled into the material of which the belting is composed.

The "camel" fastening of Reddaway and Co. is shown in Fig. 106. Like all those which grip firmly, the strain on the holes tending to tear out the belting is practically *nil*, resembling in this

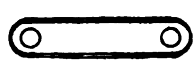


FIG. 104.

the frictional hold of rivets when first closed. The fastening consists of bolts dished upwards to bend the belt inwards in cup-shaped depressions. The nuts are screwed on the top of links which bridge across the joint. The Reddaway camel-hair belts are used largely in the Lancashire cotton mills for heavy driving. They possess several advantages for this class of work over leather. Their tensile strength is greater, and they are less liable to slip, having a higher coefficient of friction than leather. The combination of these two characteristics permits of the use of thinner belts in camel hair than leather. They lie closely to the pulleys, and slip but slightly. A $\frac{5}{16}$in. camel belt is as efficient as a $\frac{1}{2}$in. one of leather.

There is a leather belting in the market which is woven of narrow thongs, and which appears to fulfil the functions of link belting in regard to extreme flexibility, and in allowing the air to escape through the interstices. The joints are

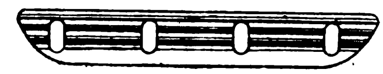


FIG. 105.

woven also. The price is the same as that of first-class leather belting. The leather link belting does good work, and is a distinct boon to engineers. That it has many advantages over the solid flat leather belting is clear from a consideration of some of the practical points already touched on. The frictional grip is better. In an ordinary belt there is always some air entangled between the belt and the pulley face, preventing intimate contact. Many pulley rims are pierced with holes, in order to permit of the escape of the air in cases where wide belts are used. The link belting allows the escape of air in a more complete way. It is very flexible, and will lap easily round the smallest pulleys, against which a double belt would be strained excessively. It is suited for short drives. Jointing-up can be done more easily than with any other kind, because the only fastening required is a pin which is inserted through the holes in the links, after adjustment for length. The joint so made is as flexible as any other part, which is not the case with laced belts united with a scarfed joint. But this is not the only advantage. For pulleys with convex rims, link belting is made with a convex driving

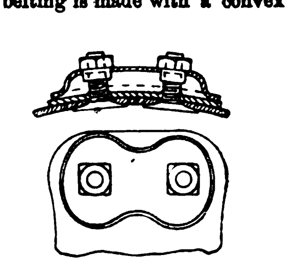


FIG. 106.

face to lap round the rim, and give frictional grip over the whole width of the belt. But its principal value is seen in twist drives. The difficulty of driving twisted belts of only a fair width is great, especially when, as is usually the case, the drive is a short one. A narrow portion of the belt only is in contact with the pulleys, and while that presses very hardly, the remainder is thrown off. In the hands of Messrs. Tullis and Son, the link belting has been made exactly adaptable to conditions such as these, so that it lies in contact with the pulley across its entire width, no matter how wide the face. The belting is made of a bevel or wedge section. The links are selected of different widths to suit a given twist, and the result is a thick-sided belt, which may vary in some cases from 1in. deep on

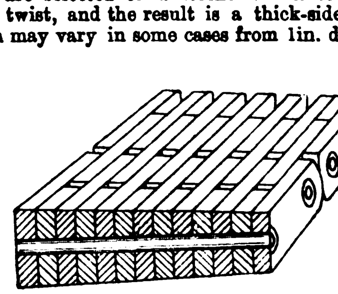


FIG. 107.

one edge, to $\frac{3}{8}$in. on the other. Fig. 107 shows a section through one of this class.

Tullis and Son adopt the plan for ordinary wide driving, of curving the link belting to suit the rounding of the pulleys. This is effected without straining the rivets, by a patent flexible centre. That is, there is a row of double links down the centre, which are not fastened closely like the others, but loosely, so that the belt will lie to the pulley on each side to right and left. Fig. 108 shows one of these belts, as

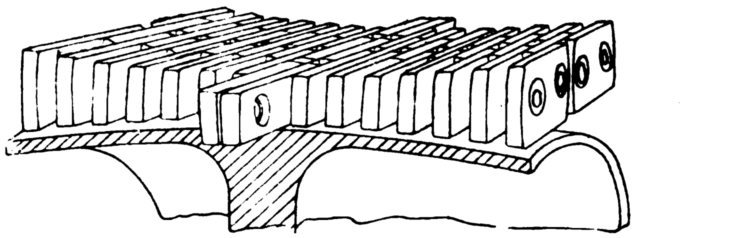


Fig. 108.

made for working at various angles, and Fig. 111. one for straight driving. Another advantage of the link belting is that it can be united more readily and rapidly than any other, since the links are coupled immediately by the insertion of their pins. Lastly, its great flexibility renders it especially adapted for

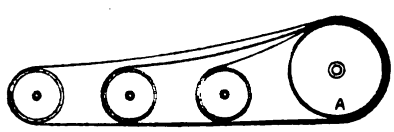


Fig. 109.

short drives, and it is probably less injured by binder pulleys than the rigid belting.

One of the most interesting developments of driving in recent years is that of compound belts—that is, super-imposed belts. The addition of a second belt adds immensely to the efficiency of the drive. Tullis and Son, of Glasgow, have fitted many of these, under varying conditions, and with entire success. There is more than one advantage in the adoption of this method:—

When a double belt is used, the outer layers

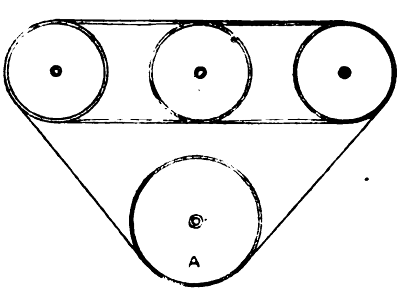


Fig. 110.

are under a greater strain than the inner ones. The belt moves stiffly round small pulleys. It is not always practicable to use pulleys of sufficient size for a thick belt to work with advantage; and it may not always be convenient to widen the pulleys and use wider belts, when an increase in power is desirable. Then the advantage of using two belts of moderate thickness comes in. Without experience, one would say that this method of driving would be impractical and unsuitable.

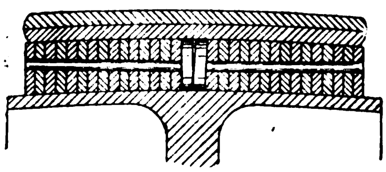


Fig. 111.

Actually, it is employed in a large number of instances, and under varying modifications.

Belts used thus increase the power transmitted; two, and in some cases three or four being used. When so employed, they run at slightly different speeds, the second travelling rather faster than the first, and the third than the second. They are also employed to drive from a single shaft to two or three or more shafts, situated at various distances apart, the advantage being that space is saved in the lateral direction. Fig. 109 is one of the Tullis' drives, in which power is transmitted from a main driving pulley A to two, three, or more driven pulleys in direct line. Fig. 110 is another, in which driving is from a main pulley A to three driven pulleys, the main belt driving outside the driven.

The compound system of belting is especially applicable to short drives, as well as small pulleys. Instead of using very tight belts, slack ones will perform the same purpose without straining the shafting. For compound driving, link belting forms a good basis for wide pulleys. Having a flexible centre-link belt, with top edge rounding, a shallow leather belt can be run upon this to gain in power, or to drive to a pulley other than that which the link belt drives to, Fig. 111.

In many of the mills in the North, the Reddaway camel-hair belts have been used compounded, and have given satisfaction. When more than one belt is to be run on a pulley, the latter should be strengthened to take the extra strain.

J. H.

ROYAL NAVY AND ARMY MEDICAL SERVICES.—THE ROENTGEN RAYS IN MILITARY SURGERY.

By John Hall-Edwards, L.R.C.P., F.R.P.S., Surgical Radiographer to the General Hospital, Birmingham.

FROM the report published in the *British Medical Journal* of November 4 of the arrangements made by the War Office for the transportation of Röntgen ray apparatus to the seat of war, it would appear that this adjunct to military surgery is not receiving the amount of attention which its importance warrants. Of the ten sets of apparatus provided, four only have reached South Africa, whilst two of these are located so far away from the field of operations that they must be of little service. The remaining six sets, we are told, are either on their way out, or are about to be despatched.

It is freely acknowledged that no medical equipment for active military service can be considered complete unless an X-ray apparatus is included; it must, therefore, follow that, in many instances, our wounded are not having the best possible done for them. Up to the present time some 750 men have been wounded, and as it is fair to assume that in at least 80 per cent. of the cases the X rays must have proved of service, the two apparatuses in Natal must have been kept exceedingly busy, or, as is much more probable, they cannot have been used in half the cases in which they were necessary.

It has been proved beyond the shadow of a doubt that the application of the X rays to military surgery constitutes one of the greatest advances of the century. Mr. Mansell Moullin, F.R.C.S., in his presidential address to the Röntgen Society, in July last, said:

"The benefit which surgery has derived from the improvements which have been effected in the use of the Röntgen rays during the past year is no less striking. Military surgery will have to be re-written. Thanks to the ease with which suitably planned apparatus can be carried on campaign, all the wearisome and intensely painful probings after bullets and foreign bodies, to which the wounded look forward with such dread, have been swept away."

As one of the first in this country to apply the Röntgen rays to practical surgery, and as a constant worker both in hospital and private practice since, I have no hesitation in echoing the statement above quoted. It may be argued that inasmuch as in modern warfare few bullets find their billets in the bodies of the wounded, the X rays must prove of little practical use. This is, however, incorrect, for in every case in which a bone has been injured the amount of injury can be ascertained, and the subsequent treatment arranged accordingly.

The great drawback to successful surgery in the field is the difficulty of carrying out the principles of absolute cleanliness, upon which modern surgery is founded. That at certain times and in certain places absolute cleanliness is impossible I freely admit, and, knowing this, it becomes all the more necessary that every possible step in the direction of securing the desired end should be seized upon. With the X rays at command, an injured limb can be examined and the injury diagnosed, the presence, shape, and exact location of a foreign body ascertained, and the amount of injury to a bone discovered, without giving the patient pain, and without removing the dressings. The probe is rendered unnecessary, and dangerous manipulation can be dispensed with. In many cases all can be done with a small apparatus at a field hospital, or even at a dressing station, whilst in others the larger apparatus at the base can be brought into requisition.

After the recent Nile campaign much dissatisfaction was expressed both in Parliament and elsewhere, because the ambulance arrangements were imperfect, and the X rays had not been fully utilised. The Under-Secretary for War said "that there had been no case of a wounded man at the Atbara to whom the absence of the Röntgen apparatus had made any difference." That this statement was not an explanation must be patent, as the results of the application of the X rays could in no case be foreseen. The excuse offered by the War Office was that the transport difficulties had not been overcome. Since this time the necessary apparatus has been much simplified and improved, whilst Major Beevor, myself, and others have demonstrated that the transport difficulties are more imaginary than real.

With an apparatus I have devised I have given two demonstrations in the field in conjunction with Surgeon-Major Freer and the ambulance section of the 1st Volunteer Battalion Royal Warwickshire Regiment. In each instance three negatives were produced, and developed under the conditions of actual war. The apparatus (including portable 8in. spark coil, accumulators, developing tent and stand, and box for tubes, plates, and chemicals sufficient for 100 exposures) was carried to the field in the ambulance waggon, and although it was freely jolted for a distance of six miles it worked to perfection.

Such an apparatus can easily be carried (should necessity arise) for a long march by eight men, and although small it is quite sufficient for field work; more elaborate and larger apparatus can be supplied to the hospitals. The chief difficulty previously experienced in applying the X rays lies in the changing of the accumulators; this has, however, been successfully overcome, and in the present war, where the line of operations will in all probability follow the railway, there should be no difficulty in this respect.

The fluorescent screen is of very little use in the field, owing, on the one hand, to a darkened room being necessary, and on the other to the fact that the surgeon in command of the X-ray apparatus is rarely the one who is intrusted with the subsequent operation. A negative or series of negatives is much more useful, as they can be placed in the hands of the operating surgeon, who can refer to them at any stage of the operation.

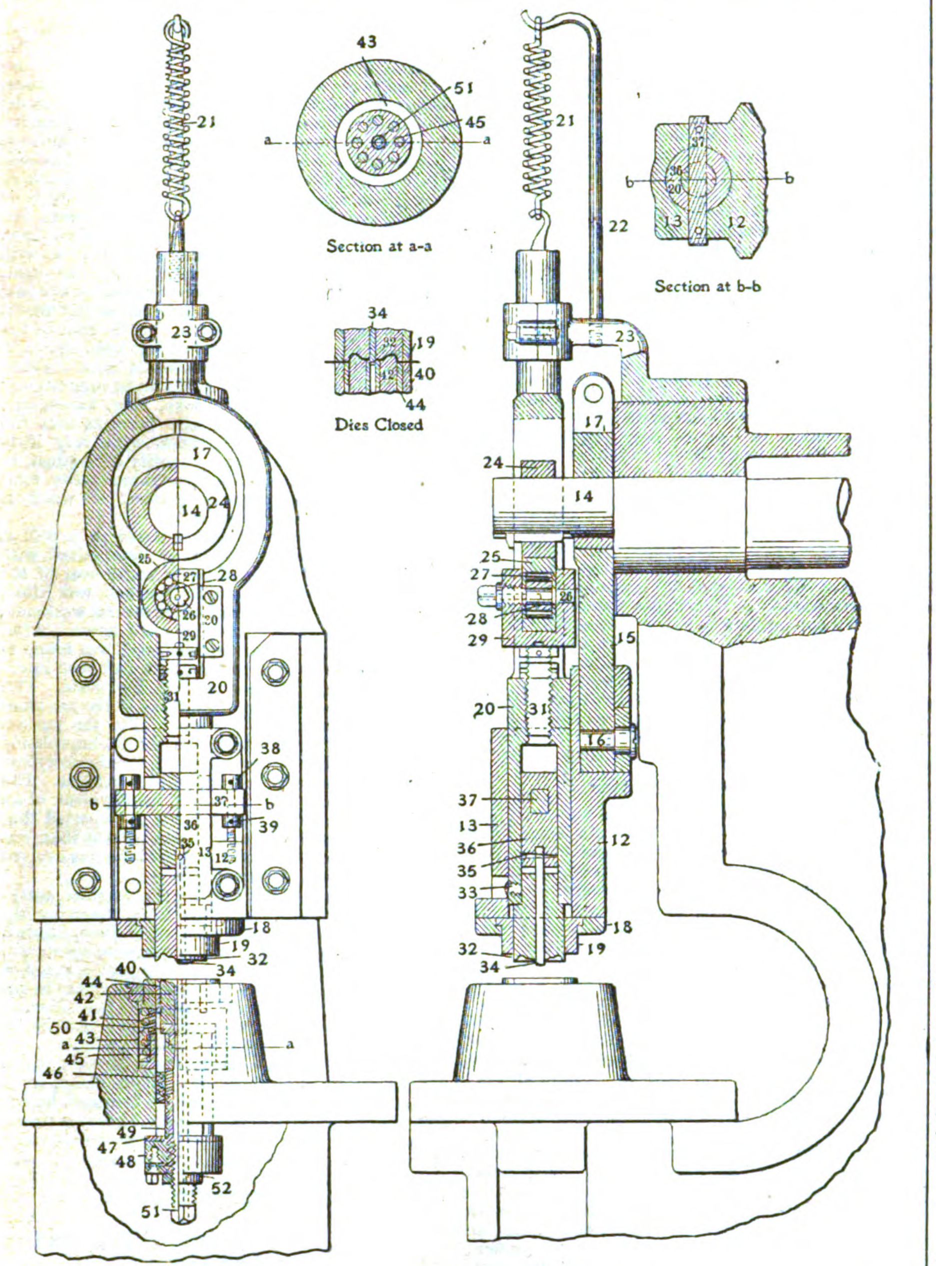
Even when the apparatus is working to perfection, the surgeon in whose hands it is placed must have a knowledge of photographic procedure, or his results will be useless, and in the event of anything going wrong the operator must have had considerable previous experience, in addition to a fair knowledge of electricity. I know not whether those sent out with the sets above mentioned have the requisite training to carry out their mission with success; but if they have not, I can confidently predict that their efforts will to a great extent fail. If military surgery is to be rewritten after the present campaign, no expense or trouble should be spared to render the Röntgen-ray arrangements as complete as possible.—*British Medical Journal.*

COMPOUND PUNCHING AND FORMING DIE.*

THE illustrations herewith show a novel arrangement of both press and the punch parts attached. Of the press, it may be said that it not being of the inclined variety, nor even having an open back, and it being desirable to remove the finished pieces by gravity, the plan of making the entire press sideways was adopted with perfect success in everything, except appearance, which was decidedly odd. New legs, giving a side inclination of 30° to the press, were provided in the place of the usual supports. The centre of gravity of the upper portion of the press being low, it was found to stand safely upon the new legs, and although the shorter one had on it by far the greater portion of the weight, no vibration or shakiness could be noticed while in action.

The special work for this press was the making of a small sheave pulley side, of mild bright sheet steel, about 2in. in diameter and ·04in. thick. These sheaves were produced in large quantities, about 40,000 sides per day being called for. They had previously been made by first blanking the side, then piercing the hole, and finally pressing into the desired shape in forming dies, the operations occupying three presses, each attended by an

* By W. E. Willis, in the *American Machinist*.



operator, as no automatic feeds had been employed on the work. After coming from the die the blanks were tumbled with sawdust as usual to remove any possible burr and the sharp edges, as well as to give a final semi-polish or brightening, and remove all trace of oil, which was plentifully used in the combined operation.

The design shown, while it was considered somewhat expensive in first cost, soon proved to be highly economical. Duplicate parts were made of those pieces which were likely to be broken or to wear out quickly, so that the press might run as uninterruptedly as possible, stopping only to make changes instead of repairs.

The alteration of the press, besides the inclined legs, consisted of a new special ram or slide, a new eccentric to move it, a special cam and cam yoke, operating through the slide, with a guide bracket on the top of the press, and a suitable heavy plate combining the functions of bolster, die-block, and support for the automatic roller feed, which was also added to it.

A detailed description of the drawing is given for those who may be interested. Fig. 12 represents the slide which is guided vertically in the press frame and carries a housing, 13, made in two parts for convenience of access, which form together a cylindrical bearing for the forming plunger. The slide 12 is connected with the crank 14 by a pitman or connecting-rod, 15, one end of the pitman being secured to the slide by a bolt, 16, while the other end encircles the eccentric 17, the eccentric being adjustably clamped by the upper end of the pitman, so that any desired adjustment relative to the crank may be had. To the lower end of the slide 12, by means of the ring 18, is secured the pressure-plate 19. This plate also serves as a blanking die.

Within the housing is guided the slide 20, which is held normally in an elevated position by the spring 21, which connects the upper portion of the slide with a standard arising from a fixed portion of the press frame, a portion of which, 23, forms a guide for the upper end of the slide. A cam, 24, is keyed to the crank 14, and operates the slide 20 against the pressure of the spring by bearing on a hardened steel wheel, 25, carried on the stud 26. Anti-frictional rollers, 27, are provided, travelling upon a hardened steel bushing, 28, fitted snugly on the stud. In order to obtain adjustment, this stud is carried in a yoke, 29, which is movable vertically in the slideway 30; an adjusting screw, 31, is provided for varying the elevation of the yoke.

The upper forming die 32 is fastened to the lower end of the slide 20 by a set-screw, 33, passing through an opening in the front of the housing. A piercer or punch, 34, is provided for punching the hole in the centre of the blank, which passes through a central opening in the former, 32, and has its upper end secured by a pin, 35, to the adjustable plunger 36, carried in a recess in the slide 12. An adjusting bar, 37, passes through the plunger 36, and has its ends secured adjustably to the housing 13 by means of the screws 38 and lock-nuts 39 in such manner that the punch 34 may be adjusted vertically with relation to the slide 12.

To hold the strip during the forming operation, a lower-pressure ring, 40, is provided in line with the upper ring 19, which is supported upon a strong steel spring, 41, serving to hold the ring 40 firmly up against the ring 19 when the latter begins to descend, thereby clamping the stock under a powerful tension. The lower former 42 rests solidly upon the ring 43, which is firmly supported by the cast-iron die-block, resting in turn on the bed of the press.

In order to blank out or sever the pulley section from the strip after it has been formed, a lower blanking ring or punch, 44, is provided, encircling the lower frame, said ring being supported on a series of laterally adjustable steel pins. Two of these, one of which is shown at 45, the other being diametrically opposite, are kept in contact with the punch by a coiled spring, 46, which causes the ring to act as a stripper, or means for forcing the blanked section out of the bottom former. The other pins rest on the steel washer 47, which is supported by the nut 48, the nut being split so that it can be securely clamped in any position.

The pins are of such length that there is a space between the bottom of the punch and the top of the pins, this space representing the amount of compression of the springs 46. As the blanking ring 44 is worn or ground away it may be adjusted vertically by the nut 48 on the screw 49. This pressure plate 19 also serves as a blanking die, the material being sheared between the edge of the plate or ring 19 and the edge of the plate or ring 44, as indicated in the sectional view of the punches and dies. It is to be noted that the severing of the blank from the strip of sheet metal does not take place until the blank has been fully formed.

On account of the reciprocating motion of the punch 44 there is a tendency of the former 42 to work up out of the holder, which is overcome by having a sleeve, 50, fastened to the bottom of the former 42 and threaded into the sleeve 43. In order that the hole in the centre may be punched by the piercer or punch 34 at the same time the blank is cut, a round die is provided, which is supported and adjusted by the hollow screw rod 51; this adjustable rod is threaded into the sleeve 43, and held in proper position by the lock-nut 52.

The operation is briefly described as follows:—The strip of metal is placed or fed between the formers, and the revolving of the crank forces the slides 12 and 20 down in unison. As soon as the rings or plates 19 and 40 come in contact with the work, the lower end is depressed and the formers 32 and 42 begin to draw the metal into shape, the surrounding stock being in the mean time securely held by the pressure-plates 19 and 40. When the former 32 has reached the limit of its downward stroke, and the blank is fully formed, the relative arrangement of the cams operating the slides is such that the slide 12, and with it the pressure plate 40 and punch 34, continues its downward movement. By this time, however, the springs 46 have been compressed until the ring 40 rests solidly on the pins, and the further downward movement of the pressure-plate 19, acting against the stationary edge of the ring 40, shears off the metal, while at the same time the punch 34 cuts out the centre hole. In the continued movement of the crank-shaft, as soon as the slide, with the ring 19, recedes, the pressure-ring 40 is forced upward by the springs 46 and 41 out of the former 42, when the cam 24 has revolved so that the former 32 will start downward, carrying with it the formed blank and strip, which, being moved along at the same time, should carry the formed blank out from under the tools, delivering it free from them and leaving the strip in readiness for the next operation.

PURIFICATION OF ACETYLENE.

IN common with all other writers on acetylene, we have repeatedly urged in past issues of the *Engineer* that under the existing conditions of calcium carbide manufacture, and the circumstance that this material is placed on the market in a "commercially pure" state, acetylene is not fitted to be used as an illuminant in dwelling-rooms unless it has been submitted to a rigorous and really chemical method of purification.

The gas can be evolved from carbide in two radically different ways; either by dropping the solid into a large excess of water—the so-called carbide-to-water principle, where the whole interior of the generator is full of water; or it can be prepared by bringing water into contact with carbide—the so-called water-to-carbide principle, where the whole interior of the generator is full of gas. We have already discussed the relative merits of the two processes; and in the present connection have nothing to do with the matter except in so far as the impurities of the resulting gas are concerned. The normal impurities of crude acetylene, which are of sufficient importance to require attention, are three in number—ammonia, sulphuretted hydrogen, and phosphoretted hydrogen. The two former are very soluble in water, the second is chemically absorbed by lime-water; and therefore it is not surprising that in carbide-to-water acetylene, phosphoretted hydrogen is practically the sole survivor. In another way, also, phosphoretted hydrogen is the impurity which gives most trouble to acetylene users; ammonia and sulphuretted hydrogen have for many years been well-known impurities in illuminating gas. Methods for their extraction have been thoroughly worked out by coal-gas makers, and all that "acetylenists" have to do is to borrow or steal existing processes. In the coal-gas trade, owing to its enormous size, these impurities become actual sources of revenue; and it is necessary to remove them from the gas in such fashion that the sulphur and the ammonia may be recovered in salable form. By the wildest flight

of imagination it cannot be conceived that the ammonia and sulphur in calcium carbide shall ever become pecuniarily valuable, therefore the generator maker is free to employ any processes for their extraction which seem good in his eyes, quite irrespective of the manner in which those bodies suffer during the operation.

In the Purification of Acetylene,

then, there is essentially but one substance to be dealt with; and this merits considerable study—first, because it is very difficult to remove without attacking the acetylene; secondly, because, left in the gas, it is far more objectionable and unhygienic than either or both of the others. On combustion, phosphoretted hydrogen is converted into phosphoric anhydride, which immediately takes up water and becomes phosphoric acid. Phosphoric acid in a closed room produces a whitish haze, misleadingly called by some generator makers a smoke, and is very irritating to the mucus membrane of the nose and lungs. Traces of sulphuric acid are bad enough, both in this way and in their action on gold leaf; probably, phosphoric acid would destroy picture frames and bookbindings to an equal extent, but it stands far beyond its rival as a throat irritant. In passing, perhaps a word of warning may be offered to those persons who are disposed to experiment wildly on the extraction of phosphoretted hydrogen. There are plenty of chemical substances that will oxidise and remove this impurity; the difficulty is to find something that will remove it without simultaneously oxidising the acetylene. Potassium permanganate and barium peroxide extract the phosphorus almost entirely, and some of the sulphur also; but they attack the acetylene and cause much waste of gas. Potassium bichromate at first removes the phosphoretted hydrogen, leaving the sulphuretted hydrogen behind; but its activity soon falls off, and it is not of much value as a purifying material. Ferric chloride touches neither the phosphorus nor the sulphur.

From the aspect of purification acetylene has passed through three stages. Originally purification was utterly ignored; next the gas was filtered through glass wool, asbestos, and similar straining materials, which undoubtedly are of service in extracting coke and lime dust, but which cannot be honestly termed purifiers; then some method of real chemical purification was found essential, and more or less intelligently was adopted. Writing in England, we fear the above sentence is scarcely correct; acetylene has not yet passed through the first two stages—it is still passing through them. Several English manufacturers have recognised the necessity of purification, and manfully have struggled to cope with it; others calmly put it on one side, smiling faintly when they are questioned about it; others provide their generators with purifying vessels containing some secret chemical (?) substance, and feel aggrieved when cautious expert writers will not affirm in print that the process is satisfactory.

Practically speaking, there are on the market at the present time three distinct methods of chemically purifying acetylene with varying degrees of efficiency. These are Ullmann's chromic acid, Frank's acid cuprous chloride, and chloride of lime. The primary reagents in the two former processes are solutions; but since liquids are not by way of being conveniently employed in practice, owing to the greater attention required during their utilisation, and to the greater loss of pressure in the service when the gas has to pass through a column of reasonable height, they are now being used in the form of solids after absorption in kieselguhr. Ullmann's solidified chromic acid is called commercially "Heratol"; Frank's solidified cuprous chloride is known as "Frankolin."

During the Past Few Months

all these processes have been submitted to careful examination in Germany by a number of investigators, whose conclusions respecting the value of the Frank and Ullmann powders all agree substantially with the opinions expressed by Dr. Ahrens, to which we referred on page 141 of our issue for August 11 last. Dr. Ahrens, it will be remembered, stated that chromic acid and cuprous chloride removed all the phosphoretted hydrogen, but left some sulphur behind; while chloride of lime extracted the whole of the impurities, but introduced others. The new impurities consist of carbonic oxide and certain compounds of chlorine, both sufficiently objectionable in their way; but, on the other hand, bleaching powder is so much cheaper and so much easier to manipulate that it is very desirable to be able to employ it. Moreover, on several occasions lately trouble has arisen with spent chloride of lime; every now and then it heats considerably, and in one case—at Budapest last spring—when the lid of an old purifier was lifted, the mass caught fire, injuring, we do not know how seriously, the man who was going to empty and recharge the vessel. Not altogether without cause, a small scare has sprung up, and chloride of lime has been proclaimed too dangerous a material to be adopted for removing the phosphoretted hydrogen from crude acetylene.

The earliest suggestion for using bleaching powder for this purpose was made by a couple of English, or Scotch, inventors—English patent 24,414, 1896; the real credit of working out the idea undoubtedly belongs to Lunge and Cedercreutz. The latter chemists carried out many experiments about two years ago, and said not a word about heating. The same reagent, too, we understand, has successfully been employed, either alone or mixed with some other substances, for quite a long time, by one of the chief Engish firms engaged in the acetylene business, who, with perfect justice, claim that their material vastly improves the atmosphere of an unventilated room where the gas is to be burnt, and who assert that they have "hundreds of purifiers" in use "giving great satisfaction." Yet a short while ago Prof. Vertess published an account of the acetylene installation at the Hungarian tower of Veszprim, in which he said that the burners smoked badly, and the gas exhibited all those defects which are recognised as characteristic of acetylene generated from calcium carbide of inferior quality, and burnt without purification. In a later communication to one of the German technical journals, Dr. Ahrens referred to the Veszprim difficulty, and explained—without noticing Vertess's observations—the whole matter. He said that the acetylene of that town was regularly purified with chloride of lime, but that the gas smelt so strongly of chlorine—by this expression we presume he meant that the products of combustion smelt so strongly of chlorine—that the consumers grumbled and threatened to go "on strike," and therefore the purifying apparatus was either temporarily or permanently put on one side. In the absence of the purifying system, Prof. Vertess no doubt examined the condition of affairs, and very naturally he heard complaints about the choking of the burners. The question thus arises, What is the practical value of chloride of lime as an acetylene purifier, and can it be employed with perfect safety or not?

The Whole Matter

seems to turn, like so many other industrial problems, on several small and apparently insignificant details. If chloride of lime is properly used it is satisfactory and safe; if it is improperly used it is a nuisance and a possible source of danger.

Although it is perfectly practicable to do so, it is not convenient in the small installations where acetylene is the illuminating agent to use liquid purifying materials. Chloride of lime could be bought into solution, but a slightly damp powder is preferable for various reasons. The acetylene, therefore, must not be too damp when it enters the purifier. Complete absence of moisture does not appear necessary; it is sufficient that the gas, either in the generator itself or in a separate condenser, shall be thoroughly cooled, and so freed from the greater proportion of its water vapour. Ammonia must be removed from the gas before it comes in contact with the bleaching powder, or the violently explosive chloride of nitrogen may be formed. In apparatus of such design, therefore, that the acetylene does not bubble through water—in which, of course, ammonia is enormously soluble—a washing vessel must be put before the purifier; or, if preferred, a vessel holding a little weak sulphuric acid. By remembering these two necessities—absence of excessive moisture and freedom from ammonia—acetylene can be quite safely brought into contact with chloride of lime, and by that material all the impurities will be removed.* Now it is said that chloride adds carbonic oxide and chlorine compounds. We cannot imagine that a method of withdrawing the carbonic oxide can be worked out, but we do consider that such a process is really wanted; for the proportion of this highly poisonous gas thus introduced must be extremely minute, and the acetylene after treatment cannot be regarded as in any way comparable to modern coal-gas enriched with carburetted water-gas, or to carburetted or non-carburetted water-gas itself, as regards toxicity. Probably if this introduction of carbonic oxide had not been noticed by very careful chemists the presence of the fresh impurity would have remained unrecognised for all time. The chloride compounds are more important, and, fortunately, are more amenable to treatment. By placing a second vessel charged with slaked lime only, after the bleaching powder purifier almost all the chlorine added by the chloride can be removed without injuring the acetylene; and as the percentage of chlorine compounds that need extraction must also be small, the second vessel should remain operative for a long while and require very little attention. In a recent investigation of chloride of lime for the present purpose, Dr. G. Benz has asserted that this lime vessel must always be added; and his prescription is endorsed by many other authorities. It most certainly appears a reasonable precaution, and should be followed until some means for preventing the formation of these chlorine compounds—if that be ever practicable—is discovered.

* This statement is distinctly admitted by Ullmann and Goldberg in a recent article; and Ullmann is the advocate of chromic acid.

The Occasional Heating

and the possibility of a fire when the spent chloride is brought into contact with air and light in the operation of recharging the purifier, is an unpleasant phenomenon, but it is equally under complete control, if we may trust, as we entirely do, the latest information on the subject. Ahrens has found that chloride of lime when used alone does not exhibit this liability to become hot. It has been the custom with some firms to dilute the bleaching powder with sawdust in order to render it more porous and, by increasing its surface, make it a more energetic absorber of phosphoretted hydrogen. And it is precisely this mixture of chloride with sawdust which is principally liable to heat. Manifestly, there is no peculiar virtue in sawdust as a diluent; a host of other harmless indifferent substances are to be thought of on the spur of the moment. Inasmuch as sawdust has been shown to be harmful, some of these materials must be substituted. Ahrens and Benz both make suggestions; coarsely powdered brick, coke, slag, kieselguhr, &c., will serve. Ahrens also remarks that the chloride must be mixed either with very little water, or with a very large quantity of sawdust, to make it quite safe; but, we submit, the total avoidance of the organic matter of wood is distinctly more advantageous.

Quite recently an accident occurred in a mill at Würtemberg, where chloride of lime mixed with kieselguhr was being used; the water-seal of the purifier was blown out, the holder bell was lifted, the gas caught fire, and suffocated several workmen, who remained unconscious for some hours. After the explosion, the purifying material was found to be pasty with water, although it had been introduced into the vessel in the dry state. This catastrophe seems to have been due to the gas passing directly from the generator into the purifier very hot and loaded with moisture; not improbably also the carbide was unusually bad, and the acetylene contained a notable proportion of ammonia. The trouble was aggravated by the employment of an abnormally large purifier; for it is reported that some 90 times more chloride was present than was necessary to deal with the whole of the gas evolved by the generating apparatus.

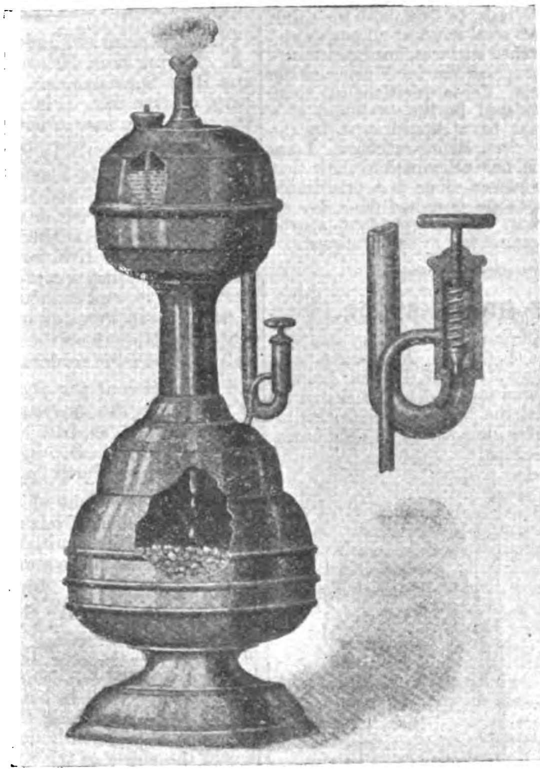
Thus we see that by keeping the original acetylene free from too much moisture, removing the ammonia, treating it with chloride of lime, diluted, if necessary, with some inert inorganic substance, and making it afterwards pass through a vessel of slaked lime, more of the impurities in the crude gas are extracted than if the Frank or the Ullmann process be adopted. The operation is said to be simpler for a non-chemical attendant; it is obviously far cheaper. The one disadvantage of the purified gas, its minute percentage of carbonic oxide, is far too trivial to be considered, and no fear need be felt that the half-spent material may become a source of anxiety by overheating, or the spent material a source of danger by actually catching fire.—*The Engineer.*

PREPARATION OF OIL COPAL VARNISH.

THIS is prepared by melting coarsely-crushed copal 240grm., purified oil of turpentine 260grm., readily-drying linseed-oil varnish 360grm. The copal is placed in a glazed earthen pot of sufficient size, and well moistened with oil of turpentine; the pot is then closed with a lid, placed on glowing coal, and left there about a quarter of an hour, until the copal is melted. When melting commences, stir with an iron rod until the copal has dissolved completely. Now add boiling hot linseed-oil varnish, slowly and with constant stirring, the coal fire being increased, so as to cause the mixture to bubble up a few more times, whereupon the pot is removed from the fire to cool off, and the warmed oil of turpentine kept in readiness is added.

The varnish produced in this manner is sifted through oakum into a dry, previously-warmed vessel. Before applying the varnish, the wooden articles are coated with weak glue-water (size) or with linseed-oil varnish, and when the ground has dried perfectly the varnish is put on uniformly with a good brush. As a rule, one coat of this varnish suffices; but if a second one becomes necessary, it should only be applied when the first one is completely dry. Later on the dry varnish is smoothed and rubbed down. The fusing of the copal may also be carried out in a glass flask surrounded with wirework. Hang the flask over a gas-flame, and keep it in constant motion until the copal has melted.—V. H. SOXHLET, in *Neueste Erfindungen und Erfahrungen.*

The Empire State Express was delayed one day recently, and in the successful endeavour to "get there" on time, the engineer made the splendid run of the 150 miles between Syracuse and Buffalo in 140 minutes. What this really means is best realised by engineers who handle fast trains daily.—*Locomotive Engineering*, N.Y.



PORTABLE ACETYLENE-GAS LAMP.

A NEW acetylene-gas lamp has been invented by Peter Josserand, of Josserand, Tex., which is particularly adapted for use as a table-lamp, and which is arranged to insure a uniform, perfect, and brilliant light, says the *Scientific American.*

The lamp comprises a base supporting a bowl forming a generator in which the calcium carbide is contained, and in which the gas is generated. A cap screws on the generator, and terminates in a pipe by which a water-reservoir is supported. A tube, provided at its upper end with a burner, extends through the reservoir, and serves to conduct the gas. Water is supplied from the reservoir to the generator below by means of a pipe provided with an automatic valve. As shown in our enlarged detail view, this valve has a downwardly extending stem fitting loosely in the end of the waterpipe, and an upwardly extending stem receiving the end of a rod screwed in a cap closing the valve-chamber. The screw-rod is provided with a collar engaged at its lower end by a spring coiled around the stem. A tube opening into the lower valve-chamber above the valve conducts the water to the generator.

When the screw-rod is screwed down, the valve is seated to cut off the water supply; but when the rod is screwed out until the collar abuts against the under side of the cap so as to allow the spring to hold the valve loosely to its seat, then the water rises in the valve-chamber, and flows drop by drop to the generator. When the gas pressure overbalances the water pressure, the valve is seated, thus preventing the further generation of gas. When the gas pressure has diminished, the valve is opened by the water, and generation is resumed.

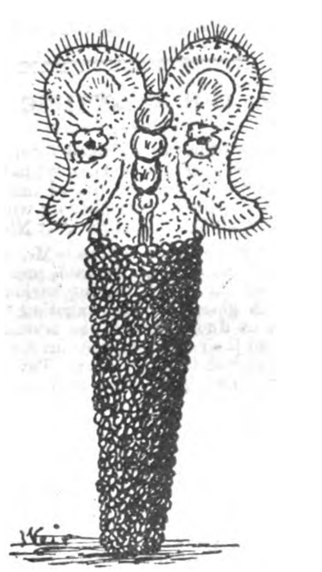
The supply of carbide can be replenished by unscrewing the generator cap, and placing the required quantity of the material within the bowl. The water reservoir can be filled by means of a filling cap.

HABIT OF AMUSEMENT IN ROTIFERS.*

WHEN a feeling of pleasure is experienced by an animal which is not aroused and incited by the gratification of an appetite, that feeling must be, necessarily, æsthetic in the abstract; yet many animals low in the scale of life experience such pleasure. This fact is plainly demonstrated by the habit of amusement which obtains in almost all genera and species, from the lowest to the highest throughout the entire animal kingdom. I have on several occasions seen ants when they were engaged in sports and pastimes. I once saw a spider which spun a broad silken ribbon which she used only as a pleasure resort; her hunting or trap web was some distance away. She would promenade up and down her shining roadway of glittering silk, for all the world like some ultra-fashionable dame, who, decked in a Parisian gown with which she hoped to dazzle the eyes of her less fortunate and envious sisters, "strutted her little hour" as only a well-dressed and complacent woman can. But not until I began to study the rotiferæ, did I discover the fact that animals of exceedingly low organisation likewise indulged in sports and pastimes.

This phase of animal intellection has been but little studied by observers; in fact, it seems to have been almost, if not wholly, neglected by students who have made the psychology of the lower animals the main object of their investigations.

There is a beautiful rotifer living in Tennessee river, which was listed by myself, and which I



named Melicerta Copeii, in the honour of my friend the late Prof. Cope, which shows plainly that it has moments of relaxation, during which it engages in sports and pastimes.

This almost microscopic animalcule builds little conical tubes in which it lies in wait for its prey, or into which it retreats when molested by an enemy. This melicerta lives close inshore in still and sheltered inlets or bays; therefore, its habits can easily be studied. It is so large that it can be seen as a small white object, the size of a pinpoint, with the naked eye, when it is swimming about in the water. It is a creature of much intelligence, comparatively speaking, inasmuch as it is able to find its way back to its home (the conical tube mentioned above) after an excursion abroad. This can be readily ascertained by watching one of these with a lens (x 15) when it leaves its tube on pleasure bent, for I am convinced that it never leaves home unless in search of pleasure.

Several of these little animals will meet in a still pool and immediately begin a game of "tag" or "hide-and-go-seek." One will playfully assault another, then presto! it is off in the twinkling of an eye, with the assaulted one in swift pursuit. Around and around the little pool they will circle so swiftly that the eye can scarcely follow them. Finally, the pursuer will overtake the pursued, which at once becomes the pursuer in turn and chases the other, which flies from it with all the speed it is capable of. This game of tag will be kept up from ten or fifteen minutes, then each little sportsman will seek its individual and particular home, which it enters tail first, and after protruding its cephalic or head extremity, will set its cilia in motion, thereby causing a current of water which sweeps food-particles (still smaller animalcules, microbes, bacteria, starch grains, &c., &c.), into its wide-open gullet. The sports of these rotifers are not incited by sexual promptings, for obvious reasons, neither have they anything to do with the satisfying of hunger; therefore, they must be play pure and simple.

The eyes of Melicerta, and it has two, are remarkably well developed for a creature of such low organisation. In point of fact, there is no other animal as low as this rotifer that can see as well. The eyes have both corneæ and retinæ, thus enabling them to form visual pictures of objects; they have vision. All other rotifers, as far as I know, as well as all kindred creatures, have primitive eyes—eyes which can only discriminate between light and darkness; they have sight, but not vision.

I have been able, in the case of the rotifer under discussion, to make out with a $\frac{1}{12}$in. objective, oil immersion, an arrangement of cells in the retina analogous to the "rods and cones" of the human retina! There is another creature, belonging, however, to an entirely different family, that is but little higher in the scale of animal life than Melicerta, which has eyes even more highly developed. I refer to Alciope, a marine worm.

This annelid's eyes have corneæ, lenses, and retinæ—the retinæ being composed of four layers—the rods and cones, the pigment layer, the granular layer, and the fibrous layer. In the case of Melicerta, however, the eyes may be safely considered unique and very wonderful. When playing "tag," this minute animal is directed in the pursuit of its fleeing playmate by sight, and not by another and analogous sense.

Again, while at play, one of these little creatures will hide behind a small pebble or bit of alga; when one of its playmates approaches, it will suddenly dart out upon the unsuspecting passer-by and greatly startle it. Their actions are so evidently innocent sport that the most casual and obtuse observer cannot mistake them for anything else. When we take into consideration the fact that this animalcule is almost microscopic in size, and that it is of very low organisation, this habit of amusement seems very wonderful indeed.

* By James Weir, jun., M.D., in *Popular Science*, N.Y.

SAILING BIRDS ARE DEPENDENT ON WAVE-POWER.

By L. Hargrave.*

THERE are many birds frequenting the southern oceans beyond the limits of the S.E. trade winds that are not adapted for soaring, and yet they circle, glide, and swoop around without flapping their wings. These have been well called sailing birds; and it is one of their oft-repeated evolutions that shows me, and I hope you, that sailing flight is not at all incomprehensible.

I will first point out that the Tropics are the home of heavy short-winged birds, such as gannets, boobies, divers, and small gulls. These seldom make any attempt to glide, much less sail or soar. The only exceptions I know are the frigate bird, and the boatswain bird; these two soar at high altitudes for long distances on motionless wings

It is worthy of remark that large flocks of sailing birds accompany vessels running down their easting, and this gives no opportunity for observing whether sailing birds really can work to windward. This point can only be determined from on board a steamer going westward, and south of what, I believe, is the usual track from Australia to the Cape.

My own opinion is that sailing birds cannot make anything to windward except during the limited time that the sea is running in an opposite direction to the wind; and, as an argument, I call attention to the absence of sailing birds in the S.E. trades, and attribute the scarcity to their inability to get out of the trades by standing to the S.W. if they get too far to leeward.

The most ordinary conditions for observing sailing birds are when the wind and sea are both aft. The waves are probably overtaking the ship, and passing at about six knots. Large numbers of birds follow the vessel and make wide circuits on either side of the wake; their interest is centred on

* Read before the Royal Society of N.S. Wales, Sept. 6, 1899.

garbage, and their efforts are directed to keeping astern, their weight and area are such that they must keep moving through the air at a nearly uniform speed in order that they may be supported; this velocity I estimate at 40 miles per hour.

If you direct your attention to the position of a bird *with regard to the wave surface*, it will speedily be noticed to be nearly always on the rising side or face of the wave and moving *apparently* at right angles to the wave's course, but really diagonal to it.

The bird is going to leeward as fast as the wave is; and, if that speed is too great for its requirements it turns towards the crest, points one wing to the sky, and uses its velocity to shoot upwards high above the back of the wave, and then descends to the trough of the following wave, along the face of which it glides; the back of the wave is its peculiar aversion. Now, there has been no flapping, and the performance takes place with or without wind; all the bird requires is the wave.

As to the effect of the wave on the air, we will suppose the water to be quite flat and the air motionless, a heavy undulation comes on the scene, it has to pass, so it pushes the air up with its face, letting it fall again as its back glides onwards. The air on the face is slightly compressed, that on the back lowered in pressure, both operations taking power out of the wave, and eventually largely contributing to its extinction.

The closer the bird is to the surface of the water, the firmer and more inelastic is the uplift of the rising air. The bird appears to almost feel the surface with the tip of its weather wing.

The case I wish you to consider is that of a sea-wave, for example, 180ft. long and 10ft. high, travelling at 18 knots, or, say, 30ft. per second, under calm air. This wave will raise all the air as it passes 10ft., at the mean rate of 3¼ft. per second.

The rate will vary from zero in the trough, attaining its maximum velocity at half the wave height, or where the wave is steepest, and falling to zero at the crest. Let us suppose the maximum velocity of uplift of the air to be about 4ft. per second and the steepest part to be 10° slope.

Now, according to Prof. S. P. Langley, a plane surface 30in. by 4·8in., weighing 1·1lb. will glide on air, without losing its elevation, at a speed of 49·8ft. per second, if sloped 5°. That is, the plane pushes 4·33ft. of air vertically downwards whilst it is translated 49·8ft. in 1 sec.

The same effect with regard to the position of the plane at the end of its journey of one second's duration is produced if the plane be sloped 5° downwards, and the air through which it passes be pushed bodily upwards 4·33ft. in one second.

Now the air over our wave is being lifted about 4ft. per second; so if the 1·1lb. plane were launched with 5° downward slope in the same direction the wave is travelling, from 1ft. above the steepest part of the wave, it would overrun the wave, which has only a velocity of 30ft. per second. It would thus get out of the air that is being lifted, and shoot into the water in the trough. But if the aspect of the plane be changed so that it face 53° either to the right or left of the track of the wave, its position above the mean sea level, and situation on the wave slope, will be unaltered; and if the wave was of unlimited width, the plane would continue on its course till dashed ashore.

The plane is simply abstracting the power stored in the wave by a distant gale, and using it to counteract gravity. And if the work be continued long enough, or a multitude of planes be continually drawing on the reservoir of power, the wave must inevitably be flattened.

The velocity of 49·8ft. per second is sufficient to raise the plane to an elevation of 38ft. in 1½ seconds; if its course be changed from horizontal to vertical, it there comes to rest. And from a poise at this station the plane may swoop down, at great disadvantage if close to the back of the wave, at various slopes and directions till it cuts into the air that is being raised by the face of the following wave, which again enables it to resume its velocity.

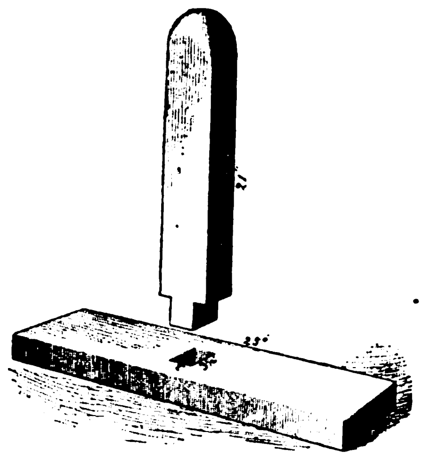
Observe that the wave I instance in this example, is one of the low round-topped sort that prevail in calm weather. If we were to base our calculations on a wave with a sharp crest approaching to the breaking dimensions, our plane would be travelling on its course through air having a velocity of uplift of 30 instead of 4·3 per second, if the wave slope were 45°, and would need loading approximately to $\frac{30}{4 \cdot 3} \times 1 \cdot 1 = 7$ 6lb. per square foot to keep it down to its original mean height, and could be made of seven gauge wrought iron.

If we figure out the result with 2° angle of incidence, and a horizontal velocity of 65·6ft. per second, we find that the 1·1lb. plane will be supported where the wave face is only 4½° slope, giving a velocity of uplift of 2·289ft. per second, and will make a course 62° 40′ to the right or left of that of the wave. Couple this with the fact that the head resistance of a sailing bird's form and the delicate arch of its wings are the survivals of untold numbers of cruder types, and no surprise should be felt at any intricate tactics pursued when further aided by the power derived from the wind and roughened sea.

This is the solution of the problem of a sailing bird's progression totally denuded of complications. It becomes a giant's task to compute the result when the effect of cross seas, wind at all angles and ever-varying force, arched surfaces, head resistance, ratio of weight to area, and the intelligence of the guiding power crop up. These questions all combined have been considered in the evolution of a sailing bird, and must be reckoned with by the designer of a wave-driven flying-machine. I am not aware that anyone has attempted to show that sailing flight by wave power alone is a practicable art; but even if someone else has done so, an observation free from an independent source confirming old work cannot fail to be of interest.

A HANDY HORSE STOOL.

THE foot-rest for a horse shown in the annexed engraving is sent to the *Blacksmith and Wheelwright* (N.Y.), by Mr. A. M. Talsma, Jamestown, Pennsylvania, who says:—I send a sketch of a horse stool that I rest the horse's front feet on to finish them up. It saves hard work, and the horse



likes to rest on it. It is made as follows:—Take a piece of plank 25in. long, 7in. or 8in. wide, 2in. thick. Mortise hole in the centre 3½in. by 2in. Then take a stick of 3½in. by 4in., 21in. long, make a tenon on one end 3½in. by 2in. rounding the other end for the horse's foot to stand on, and the stool is done.

USEFUL AND SCIENTIFIC NOTES.

THE first use of power obtained from the falls of Niagara was as long ago as 1725, when the French erected a sawmill near the site of the Pittsburgh Reduction Company's upper Niagara works, for the purpose of supplying lumber for Fort Niagara.

Crystals Etched on Glass.—Mr. C. E. Benham, of Colchester, has, it is said, produced some interesting effects by crystallising various salts in a thin layer on glass, and then exposing the glass to the vapour of fluoric acid. The crystals act as a "resist," and their microscopic forms are beautifully reproduced etched into the glass. The exposure to the vapour varies from three to five minutes, the glass being first well warmed to prevent the crystals from dissolving.

AN attempt made some time ago in Germany to convert coke-dust into briquettes, with a cement consisting of cellulose residue, did not succeed, because a prolonged drying in the open air was necessary for the briquettes to stand carriage; but in that case they crumbled in the fire, while they also burned so slowly that the furnace could not be kept at the desired temperature. For counteracting these disadvantages it was proposed to mix nitrate of soda with the cementing substance; but the only method which has hitherto been found to give good results is to use the dust itself as fuel, with one of the devices for feeding powdered fuel which have recently been introduced.

Copper Smelting.—In a paper read before the American Institute of Mining Engineers, the President, Mr. James Douglas, referred to the remarkable changes which have been effected within a few years in the methods of copper smelting. In place of small furnaces in which it was thought a feat to smelt 10 tons a day, some of the furnaces now in use will smelt as much as 400 to 500 tons of ore daily, and their contents being discharged into Bessemer converters, are converted into pure copper within as few minutes as formerly it occupied days to roast and re-roast, to fuse and re-fuse the ores and mattes when the cupola process of reduction was used.

SCIENTIFIC NEWS.

THREE more small planets are announced as having been discovered by Dr. Max Wolf and Herr Schwassmann, of Königstuhl, Heidelberg, on Oct. 27. It is not determined whether they are really new or not.

In the *Bulletin* de la Société Astronomique de France M. Camille Flammarion has an article in which he describes and illustrates the eclipses of the 20th century, which will be visible in Paris. Let us hope that the distinguished French astronomer will live to verify his drawings. There is the usual report of the meeting (séance) of the society, and then an article by M. Flammarion on the Perseids in 1899. A note by the Abbé Th. Moreux on the ninth satellite of Saturn will interest some readers.

The position of the Perth Observatory, W.A., is given by the government astronomer, Mr. W. E. Cooke, as Lat. 31° 57′ 09·63″ S., Long. 7h. 43m. 21·74s. E. Other observations gave the longitude of Perth 7h. 43m. 21·78s.

The first president of the newly-established Astronomical and Physical Society of America is Prof. Simon Newcomb, Assoc.R.A.S., and Prof. G. C. Comstock is the secretary.

The election of the officers and council of the Royal Society will take place at the anniversary meeting, St. Andrew's Day, Nov. 30. It is understood that Lord Rayleigh, F.R.S., Professor of Natural Philosophy in the Royal Institution, has been selected for the award of the Copley Gold Medal of the Royal Society—the highest scientific distinction, it may be said, that it is in the power of the Society to bestow. The medal is given in recognition of Lord Rayleigh's brilliant and, in many respects, unequalled investigations in mathematical and physical science.

The Christmas lectures at the Royal Institution will be delivered by Prof. Vernon Boys, F.R.S., on "Fluids in Motion and at Rest."

The "juvenile lectures" at the Society of Arts will be delivered on Jan. 3 and 10 by Mr. Herbert Jackson, on "The Phenomena of Phosphorescence."

A course of Cantor Lectures before the Society of Arts will be delivered by Mr. H. H. Cunynghame on "Art Enamelling upon Metals," commencing Nov. 20 at 8 p.m., and continuing on three following Monday evenings.

In his address as president of the Royal Geographical Society, Sir Clements Markham said that the Fellows would be glad to hear that the School of Geography at Oxford had been established, and was now in working order. It was regulated by a Joint Committee, consisting of four members of the University and three members of their council. A lecture-room and laboratory had been fitted up for it in the old Ashmolean Museum; there was an efficient staff under the direction of Mr. Mackinder, and the course of instruction had commenced this term. The subject catalogue was in an advanced state, and the work of the Nomenclature Committee was progressing. Dr. Mill's investigation of the geography of Southern Sussex, in connection with the Ordnance map, was practically completed, and they hoped to publish it soon as a sample of what might be done with the aid of the Ordnance maps in working out the detailed geography of our native land, and indicating the influence which it had exerted on the country's history, on distribution of population, on agricultural, industrial, and commercial development. The president has invited M. Gerlache, commander of the Belgian Antarctic Expedition, to visit this country and give an account of his voyage.

Prof. O. J. Lodge suggests a method of establishing telegraphic communication over short distances by laying a wire east and west, and "earthing" the two ends thoroughly, so as to get as long a base as possible. Insert in the wire a powerful battery or dynamo and a signalling key, and an alternative switch, a pair of low resistance telephones, and a condenser to keep out earth currents. Another party is to lay a wire of greater length than the other, and with similar arrangements, and then unless the soil is hopelessly dry slow signalling by earth-tapping can be certainly achieved provided sufficiently strong currents are used.

It is stated that a "severe shock of earth-

quake" was experienced at Leghorn on Friday last; but unfortunately these "earthquakes" are not recorded with sufficient accuracy to make them of any use in the study of seismology. If these "earth shakes" were properly recorded as to time and extent, they might be useful in formulating a theory as to the cause.

In a memoir presented to the Paris Academy of Sciences, M. Ed. Branly refers to the transmission of Hertzian waves through liquids. He placed a "receiver" in the centre of a large glass vessel containing the special liquid, and then made measurements of the distance to which the exciter could be removed before the effects upon the receiver were reduced to nothing. It appears that distilled water possesses much greater absorptive power than oil or air, and sea-water practically prevents the passage of the radiations through a thickness of 8in.

The University of Vermont has been presented with £10,000 by Mr. J. A. Converse, of the Baldwin Locomotive Works, for the endowment of a professorship of commerce and economics.

Vienna, somehow, seems to be the city from which the most extraordinary "inventions" come, whether they are scientific or political. Here is one:—"The Austrian War Office has ordered a series of experiments to be made on a flying-machine invented by an engineer named Joseph Manniger. Herr Manniger states that the machine can carry one man, and travel at a height of 1,000ft., in any weather, at a speed of 60 miles per hour. It can remain in the air for six hours, and can be steered in any direction, even against the wind. The apparatus is simple, and only costs £10. Herr Manniger points out how useful the invention would be to General White at Ladysmith."

The report of Col. A. Ford, Chief Inspector of Explosives, on the disastrous explosion of potassium chlorate at the Kurtz Chemical Works of the United Alkali Company (Limited), at St. Helens, when five persons lost their lives and a number of persons sustained injuries, was issued last week. Col. Ford states that so far as he had been able to ascertain, an "explosion" of potassium chlorate had hitherto been unknown in the United Kingdom or in any other country. Accordingly, experiments were carried out to further test the matter, with the result that it was found that potassium chlorate is, after all, liable to explode under certain conditions. In view of this result, adds Col. Ford, it cannot be doubted that an explosion of a small portion of chlorate actually took place at St. Helens. Having regard to the fact that potassium chlorate had hitherto been held to be not liable to explode under any conditions, Col. Ford does not think that any blame could be justly attached to the United Alkali Company or anyone connected with the works. He, however, has no doubt that they will now take the necessary precautions to prevent a recurrence of the disaster by adopting the use of non-inflammable materials.

Whether chlorate of potash can be exploded by itself is a question for experiment. It is well known that it is used in the heads of lucifer matches, and, mixed with sulphur, is a very old "exploding" experiment in the elementary text-books of chemistry. It is used for preparing friction fuses in firing cannon, and as "white gunpowder," in which it forms the principal ingredient, has been the cause of many accidents.

It is stated that the new naval gun known as the "12in. steel and wire gun," is "far superior to any gun possessed by a foreign navy," and if mounted on the heights of Dover, can drop a shell on the shores of France. It weighs 50 tons, is 41ft. long, and has a muzzle velocity of 2,367ft. per second. The projectile weighs 850lb., the bursting charge being 83lb., and the firing charge 167½lb. of cordite. The Admiralty has ordered 450, at a cost of £10,000 each. Of these 150 have been completed, and 300 are still in the hands of the contractors. Each man-of-war will carry four of these formidable weapons, and when the navy is supplied, they will be issued to forts on the sea-front.

The fourth annual motor-car trip to Brighton took place on Monday, and it is stated that 95 cars completed the journey, the time occupied varying from three hours to five. It is reported that a large percentage of breakdowns occurred on the road. According to the Motor-Car Club, any of the machines used could run to Brighton and back easily in a day.

The French submarine boat *Goubet* has, according to reports from Toulon, remained under water for five hours, and, although the boat was hermetically sealed, and was frequently covered by waves, the crew suffered "no ill effects." It would be interesting to have "reports" from the crew.

A new lighthouse has been erected on Eilean Mor, an island off the west coast of Lewis, about 18 miles from Gallon Head. Two flashes of white light will be shown in quick succession every half-minute, and the power will be equal to 140,000 standard candles. The light will be visible all round, and, being elevated about 330ft., will be visible about 24 nautical miles in clear weather.

The following will be of interest:—"Naturalists will hear with regret that the two climbing perch, or Indian climbing fish, at the Zoological Gardens, have both succumbed to the English climate. This loss will be deplored by the public, who watched their movements with wonderment, especially as they were the first examples of these curious creatures exhibited here for the past 20 years. The history of their tree-climbing propensities dates back (according to the *Telegraph*) for a thousand years or more; but up to now the only testimony upon which the story rests is that of Lieut. Daldorf, who, in a communication to the Linnean Society, towards the end of last century, declared that he had seen one of them ascend a palm-tree for the purpose, unquestionably, of obtaining moisture."

As to the poisonous effects produced when cattle eat yew-tree shoots, Dr. A. Rawlings, of Herne-street, near Canterbury, says that "There are numerous cases on record of death resulting not only in cattle, but in human beings, from eating the leaves and berries of this tree (*Taxus baccata*). It acts as a cerebro-spinal poison rather than an irritant poison. The most prominent symptoms are convulsions and coma. There are only two coniferous trees that grow in England that are poisonous, the yew and the savin (*Juniperus Sabina*). I believe, as a rule, animals carefully avoid eating from them, having a mysterious intuition of their deadly nature. In Herne Churchyard there are some very ancient yew trees, and here sheep and cattle are often turned out to graze, but I have never heard of any resulting evil effect. I have also noticed that in some of these trees birds frequently nest and rear their progeny; but the yew may not be poisonous to birds, as there is a peculiar natural fact that what may be poisonous to one species of animal may be innocuous to another. Thus parsley is a deadly poison to parrots; the rabbit, again, can live and flourish when fed wholly on the deadly nightshade (*Atropa belladonna*); the horse can be given arsenic and nitre far out of all proportion as to what one would think the dose should be when comparing his size with that of man."

A patent has been obtained in America for the manufacture of artificial marble, by means of which the expensive method of "polishing and graining the marble is entirely dispensed with." The method consists in mixing lime-water and silicate of soda, and then adding cement. The mixture is allowed to harden on a highly polished surface. As a patent has been granted in the United States, it must be presumed that nothing of the kind has been heard of before.

There are five coal-producing centres in the Transvaal—namely, Boksburg, Heidelberg, Middelburg, Lydenburg, and Klerksdorp. The three former are by far the most important, and contain between them twenty-four mines. The total production in tons last year was 1,907,808.

It is significant of the success of the Manchester Ship Canal that the company is about to promote a Bill in Parliament sanctioning the purchase of the Manchester racecourse at New Barnes, which immediately adjoins the Manchester docks. The racecourse covers an area of about 100 acres, and is needed principally for railway sidings, and warehouse and storage accommodation.

The leading dimensions of a type of heavy two-cylinder compound Consolidation engine in use on the Southern Pacific Railroad are: Cylinders, 23in. and 35in. diameter by 34in. stroke; weight in working order, 86 tons—77 tons on the drivers. Boiler, 72in. diameter; working pressure, 220lb.; tubes, 332 in number, and 2¼in. diameter, affording a heating surface of 2,817·30sq.ft.; fire-box heating surface, 210·50 sq.ft., and the grate area 35·3sq ft.; driving-wheels, 57in. diameter.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

**_* In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

PHOTOGRAPHING A "SPIRIT": THE TRUSTWORTHINESS OF SECOND-HAND TESTIMONY—A STAR CATALOGUE BY PROF. SAFFORD — A NEW NEBULA IN MONOCEROS: THE INFINITY OF SPACE — THE CONSTANT OF ABERRATION AND THE PARALLAX OF POLARIS — IS A PERAMBULATOR A CARRIAGE?—PHYSIOLOGY OF THE BRAIN—THE MOON AND THE WEATHER—A SIXTIETH LONDON SUMMER — SIDEREAL TIME INDICATOR — METRES AND LINKS—WORKS ON ARTILLERY —ORBITAL VELOCITY—PLACES OF THE PLANETS—DO HOMING PIGEONS FIND THEIR WAY BY THE SUN?—STONEHENGE.

[43015.]—"NEVER," says a trite adage, "believe anything you hear, and not more than half what you see"—an adage of the truth and common sense of which I have just had a very remarkable and impressive illustration. In a letter which I wrote (41461) on p. 92 of your LXVIIIth Volume, I told a very curious story of the apparition of the seated figure of a deceased peer in a photograph taken of his empty library after his death—a story which I subsequently supplemented by details given on pp. 138, 186, 233, &c. This narrative I reproduced, practically verbatim, as it was told me by a common friend of mine and of the family—himself a man of rank and title, whose veracity and bona fides are beyond all question or dispute, and who lent me the photographs on which I commented. Now, however, I have learned, within the last 24 hours, that the account I gave (as it was given to me) was erroneous in many very material respects, and that the evidence that there was anything supernatural, or "spiritual," about the affair, is nearly as shadowy as the figure itself. Let me correct some of my—or my informant's—mis-statements seriatim. *Imprimis*, I have it now that Lord *x* did not die at (what I will call) *x* Hall at all, but in London, *x* hall being let at the time to the sister, Lady *z*, of the actual photographer (whose name has since been made public, so that I have no reason for concealing it), Miss Corbet. Secondly, neither Mrs. *y* nor Lady *z* were at *x* Hall at the time. Thirdly, it was by accident, and not by design, that the photograph was taken on the day of the funeral. Fourthly, neither of Lord *x*'s daughters either took or developed the photograph. Fifthly—and most important this is—I was utterly misinformed as to the room having been closed during the exposure of the plate in the camera, for Miss Corbet states that "the door was left open all the time the photograph was being taken, the camera being placed in the open doorway, while she and her sister went out for a walk, apparently leaving the house empty, except for the servants." Now, this being so, I revert to what I said in letter 41667, on p. 233 of your LXVIIIth volume: "I am driven to the conclusion that someone *must* have sat in the chair for a very short time during the exposure of the plate." I gather from an independent source that my friend Mr. Espin's very interesting experiments on the production of a similar "ghost" by light reflected from a vase on a tall brass pole are to be the subject of further investigation. I need hardly reiterate here that I have not the very slightest faith in "spiritual" apparitions, and (as I have often said), broadly divide spiritualists into two categories — knaves (the so-called "media") and fools (their dupes); but, like all men of science, I hold my opinions more or less loosely, and regard "Audi alteram partem" as essentially *the* motto of everyone who wishes to arrive at the truth. Hence, when I received the story, just as I told it, from what I regarded as an absolutely unimpeachable source, I did not think that my own belief or disbelief ought to stand in the way of my making it public, however much it might conflict with my own utterances public and

private. But this only furnishes yet another instance of the fallibility of testimony, or perhaps of the inability of the average man or woman to repeat a story with anything approaching to verbal —or even material—accuracy. I have been struck with this in one way, amongst others, which might have acted as a caution to me. I sometimes do a little conjuring, and have been at once amazed and amused to hear certain of the spectators subsequently tell people what they had *seen* me do; so wildly wide of the truth have their perfectly ingenuous narratives been. However, I have, I hope, learned my lesson this time, and will trouble my brother-readers with no more stories of apparitions, be they of peers or potboys, because I could only really give such a story first-hand if I were myself qualifying for a lunatic asylum.

The United States Government has recently circulated a catalogue of 621 stars, prepared by Prof. Safford, as an excerpt from the Report of the United States and Mexican Boundary Commission, 1892-1895, which is noteworthy for the pains which appear to have been taken to determine the proper motions of its component stars with the greatest attainable accuracy. This should be valuable to all those engaged in geodesical operations.

The number of your contemporary *Knowledge* for the current month contains one of Dr. Isaac Roberts's astonishing photographs of what appears to be a hitherto unknown nebula in Monoceros; and well worthy of study it is. The extraordinary black gap or rift, which appears in this great gaseous mass irresistibly suggests that we are looking through a hole or tunnel in it into the blackness of darkness of illimitable space beyond it. Some of those who argue that space is finite contend that were it infinite the infinitely distant stars in their aggregation would cover the face of the sky with light, quietly ignoring the fact that they are postulating something like an equable distribution of stars in space, which is utterly contrary to all observable phenomena. That infinite space involves the assumption of its occupation by an infinite number of suns symmetrically arranged throughout it, is the wholly unwarranted and unwarrantable assumption on which such an hypothesis can alone be founded. A glance at Dr. Roberts's beautiful picture will show that in looking through the opening in the nebula which it reproduces we are, at any rate, gazing into vacuity.

I think that it may be said of the determinations of the constant of aberration what the author of "Ecclesiastes" asserted of the making of books—that "there is no end." The latest one I have come across is in the pages of the *Observatory* for November, whence I learn that a certain Herr Johannes Kuiesche, of the University of Göttingen, has, from a discussion of the Greenwich observations of the Right Ascension of Polaris from 1851 to 1888, determined the nutation constant to be $= 9{\cdot}236'' \pm 0{\cdot}003''$, and the constant of aberration to be $= 20{\cdot}537'' \pm 0{\cdot}003''$. This would make the earth's mean distance from the sun upwards of 97,000,000 miles, which it most certainly is *not*. Incidentally, Dr. Kuiesche finds the parallax of Polaris to be $0{\cdot}1518'' \pm {\cdot}0041''$, as against Peters's $0{\cdot}073''$ and Pritchard's (photographic) $0{\cdot}052''$. Kuiesche's parallax give the distance in light years as only 21·49. I wonder what Mr. Holmes would say to the *fourth* decimal place, by the bye.

Will "B. H." (reply 96759, p. 278), mind telling me when and where it was decided in the High Court of Justice that a perambulator is not a "carriage" within the meaning of 5 and 6 William IV. c. 50, s. 72? Moreover, can he refer me to any decision in the case of a Bath chair (which is only a glorified perambulator) either under that statute or the subsequently interpreting one 51 and 52 Vict. c. 41, s. 85?

The paragraph quoted in query 97005 on p. 282 is the veriest penny-a-lining. There can be no doubt that the function of the cerebellum is to coordinate voluntary movements. Disease of this portion of the brain causes a condition of giddiness, and a mode of movement strictly akin to that of a drunken man. I do not suppose that there is a physiologist, or physio-psychologist, in the empire of the smallest authority who doubts that the frontal lobes of the brain are those mainly concerned in the higher intellectual operations.

I freely make "A. B. M." (letter 42989, p. 291) a present of the somewhat enigmatic utterance of Prof. Hazen *re* the occurrence of thunderstorms near the time of new moon; and would once more refer him, as I have done others, to the Aphorism of Bacon, "Men are more apt to mark when they hit than when they miss." It would be worth while to note how often a *prophecy* of a thunderstorm about the time of that particular lunar phase was fulfilled in any selected place.

Has not the summer of 1899, during a *minimum* of sunspots, been hot and protracted enough for Mr. MacDowall (letter 42999, p. 295)?

I do not know for what purpose Mr. Bentley (query 97015, p. 303) requires a sidereal time indicator. If it be merely to know when to begin to look out for a star-transit, Chambers's device illustrated on p. 261 of the volume of which your correspondent speaks will be found quite sufficiently accurate. A more elaborate and accurate apparatus, the invention of the late Major Skelton, is sold by Horne and Thornthwaite, the opticians. Unless, though, he is afraid of a little trouble, I cannot see why Mr. Bentley cannot get all he wants from the *Nautical Almanac* by the aid of the tables on pp. 586 to 589 inclusive. As my own observatory is at some little distance from the house, I always myself have one of Cooper's excellent sidereal watches on my library table, at which I can glance to see the Right Ascension of the stars on the meridian at any given instant. The transit tables, which were brought out by Mr. Latimer Clark, have long ceased to be published. Mr. Clark took the idea from the table with which your own "Astronomical Notes" have concluded for very many years past.

I know of no cheap book on modern siege and field artillery such as "Second Differential" asks for in query 97026 on p. 303. My own copy of Owen's standard book is somewhat out of date. If he can see the "Encyclopædia Britannica" in any public—or private—library, he will find a quantity of information of the kind he desires. With reference to the second portion of the query, two things would be needed to answer it—old back numbers of the *Astronomische Nachrichten*, and a competent knowledge of technical German—neither of which I possess.

I may tell "Enquirer" (query 97022, p. 303) that there are 4·97106 links in a mètre, and hence there must be 24·71143 square links in one square mètre. Now to find the area of a triangle of which the three sides are given, we employ the formula probably familiar to your correspondent. Find the sum of the three sides, and halve this sum, which is called s. Next find the difference between this half-sum and each of the sides, and call their differences a, b, and c respectively. Then the area of our triangle will be—

$$= \sqrt{s\,(s-a)\,(s-b)\,(s-c)}.$$

In his case we had better first compute the area in links. Here we have—

$a = 1660$
$b = 1454$
$c = 1372$
2)4486
$s = 2243$

$s = 2243$ log. 3·3508293
$s - a = 583$ log. 2·7656686
$s - b = 789$ log. 2·8970770
$s - c = 871$ log. 2·9400812
Divide by 2 to get the log. of sq. root 2)11·9536561

24·71143 sq. links in 1 sq. mètre — 5·9768281 log. of sq. links; log. 1·3928978

38364·6 sq. mètres log. 4·5839303

the area of his hypothetical triangle. I hope that this is not an examination question. I have looked at it with some hesitation, but will give "Enquirer" the benefit of the doubt. But are not feet and inches good enough for any Englishman?

"Neptune" (query 97036, p. 303) will find everything he requires by the study of the *Nautical Almanac* for the 40 years covered by his question.

I have had a letter signed "Jeune Homme" from a gentleman whose acquaintance I have hitherto been debarred from the privilege of making, discussing the question of the means by which the homer pigeon finds its way back after having been liberated at a considerable distance from its home; and asking whether I think that the sun can in any way assist the bird in determining the direction in which it should fly? To which question I should certainly return a negative answer. As viewed from the surface of the earth, in the latitude of Greenwich, the sun travels over an azimuth of upwards of 260°, on the longest day between its rising and its setting, and hence it seems to me almost idle to imagine that a bird can derive any notion whatever of direction from a body whose position, as referred to the cardinal points, varies so enormously in 24 hours. I am not a pigeon fancier, and hence speak under correction, but it appears to me that if, as I assume, homer pigeons are being trained by being taken gradually farther and farther away from their dovecot, sight and memory must come in as the leading factors in the identification of a route once flown over, and they must go on picking up identifiable terrestrial points. I fancy that a good many birds must be lost in training for long-distance flying. Instinct —in any legitimate sense—can have nothing to do with the bird's power of finding its way back again. Nor can I believe in its possession of anything in the shape of a sixth sense. At any rate, I utterly disbelieve in its making the slightest use of any celestial body, such as the sun or moon, in finding its way.

I learn from a reprint from the weekly supplement to the *Leeds Mercury* that the venerable ex-President of the Leeds Astronomical Society, Mr. Washington Teasdale, F.R.A.S., has been delivering an address before that body on the origin of Stonehenge, and has been discussing various astronomical, or quasi-astronomical, theories in connection with this. Unfortunately, I have never seen Stonehenge myself, and hence am in no condition to judge of the accuracy with which the azimuth of the so-called "pointer stone" has been determined; but if the orientation of this has been accurately ascertained, and it was originally so placed at the time of its erection as to mark the precise point of sunrise at the Summer Solstice, it would be by no means a difficult task to compute the amount of shift, and hence to fix the date at which the wonderful structure of which it forms an integral part was set up. Prof. Petrie, as I gather, fixes this as possibly as early as A.D. 400; that very able mathematician, Mr. Whitmell, more definitely as A.D. 476.

A Fellow of the Royal Astronomical Society.

γ^2 ANDROMEDÆ—TO "A MEMBER OF THE BRITISH ASTRONOMICAL ASSOCIATION."

[43016.]—The closing sentences of letter 42991 are altogether uncalled for. There is not the slightest proof that "where 12in. Newtonians have failed Gregorian reflectors have been (said to be) able to divide," at least from any data within the reach of readers of the "E. M." only on this subject.

Although the apertures of these despised Gregorians is unmentioned in 42991, by reason no doubt that no possible aperture of such telescopes could ever match a 12in. Newtonian, presumably the 6½in. so inaccurately referred to by the Master himself in this department of criticism is meant. We have record in "Ours" of comparatively recent date of *only one* set of observations on the above-named star by the use of *a* Gregorian reflector; that one was of 6½in. aperture, and the epoch which was fully and candidly explained, as well as revealed by the comparative results from refractors of moderate apertures, was at a time when a 12in. Newtonian could scarcely have failed, even if made in the way amateurs are usually supplied with the article. (See correspondence in "Ours" from Oct. 7 down).

H.

CRATER NEAR TIMOCHARIS.

[43017.]—The sketch given by "R. P." seems to dispose of the suggestion of error in orientation.

Referring again to-day to Elger's Notes in the *Astronomical Register*, I found that at 6h. Nov. 15, 1885, he "remarked a large round black spot near the summit of the western wall, and a conspicuous oval-shaped depression slightly to the south of it, and somewhat further from the edge." This may form a clue to the crater 2 on "R. P.'s" sketch. To-night I could see no detail except the break in the north wall. E. D.

TO COLONEL E. E. MARKWICK: CONCERNING AN "AMATEUR'S OBSERVATORY."—TO "H." AND "F R A S."—THE COMES TO ALDEBARAN.

[43018.] — Having read, with great interest, Colonel E. E. Markwick's very useful and instructive description of his observing house in letter 42996, I should like to avail myself of his kind permission, and ask two questions of him which might be of general interest.

Firstly, does an observing house, as a fixture, become the landlord's property, though erected by the tenant, and, if so, by what means may the tenant reserve to himself the right of removal?

Secondly, seeing an ordinary chair in Colonel Markwick's Observatory, I should be glad to learn if he uses any means for preventing neck-ache, without recourse to an expensive observing chair.

May I take this opportunity of thanking "H." for his very amiable reference to some of my letters, and "F.R.A.S." for his kind reply, in letter 42928, to my query (96860)? I thought new measurements would be of general interest, as the *comes* to Aldebaran is mentioned in some of the textbooks as a light-test for a 3in. achromatic, while my experience with 3½in. Gregorians, which showed it distinctly with Aldebaran in the field, led me to think that this test might be misleading at the present epoch. C. H. Stielow.

METEORS.

[43019.]—Two very fine fireballs were seen here last night, Nov. 10. Unfortunately at the time I was walking along a brilliantly-lighted street, and the glare of arc-lamps, together with the light of the moon in her first quarter, made it impossible to locate the paths of the meteors with any approach to accuracy. The first was seen at 7h. 41m. G.M.T. Its path, as well as I could make out, started from $+4°$ north of δ Ceti, and ran nearly parallel to the S. horizon, passing about 4° south of ζ Aquarii and 8° or 9° above the moon. The meteor was brighter than Jupiter, pale green in colour, leaving a train which would have been very conspicuous but for the moonlight. Just before disappearing, it separated into two unequal parts, travelling about 30° distant

from each other in the line of its motion. It disappeared when about 10° N.W. of the moon, having remained in sight about five seconds.

At 8h. 6m. 30s. I saw another fireball, equal to Sirius in brightness, but red in colour. It travelled downwards from near β Pegasi to close above ο Ceti; motion very slow, some train visible, but difficult to see owing to moonlight.

Meteors of a smaller size have been abundant here during the past week. On the night of Nov. 6, between 6.30 and 7.30, I saw three above second mag., besides smaller ones, all appearing to proceed from a radiant low down in the N.E.

Wm. F. A. Ellison.

THE LEONIDS, ETC., 1899.—I.

[43020.]—WATCHES that have been kept on favourable occasions for early Leonids have, thus far, only yielded two as the result here.

The watches in question were on the following dates:—

1899, Nov. 8	10h. 55m. to 13h. 10m.	=	2h.	15m.
10	11 25 14 0	=	2	35
			4	50

The numbers of meteors seen were 22 and 13 respectively. These, with one seen on Nov. 6, are recorded in the annexed table.

No.	1899.	G.M.T.	From.	To.	Mag.	Dur.	Description.
		h. m.	° °	° °		s.	
1	Nov. 6	6 44	57½ + 50	66 + 29	2	—	Rather swift.
2	„ 8	10 58	60½ + 19½	67 + 15½	4	—	——
3	„ 8	11 2	57 + 24	55 + 5	3	0.3	Very swift.
4	„ 8	11 6	92 + 30	81½ + 28½	4	0·2	Very swift.
5	„ 8	11 6	87½ + 45	90 + 47½	3	0·2	Swift.
6	„ 8	11 7	49 + 49	67½ + 48	3	—	Very swift.
7	„ 8	11 17	63 + 27½	87 + 36	2	—	Slow; faint train.
8	„ 8	11 19	56½ + 22½	55 + 10	4	—	Very swift.
9	„ 8	11 23½	80 + 27	81½ + 25	4	—	——
10	„ 8	11 26½	72 + 45	135 + 60	1	—	Slow; faint train; pale green.
11	„ 8	11 33	72½ + 12½	89 + 3	1	—	Slow; hardly perceptible train; pale green.
12	„ 8	11 39	81 + 33½	81 + 22½	2	—	Swift.
13	„ 8	12 1½	68½ + 44½	115 + 64	3	—	Slow.
14	„ 8	12 23½	130 + 27	111 + 28	1·5	—	Swift; streak.
15	„ 8	12 30½	91½ + 15½	91 + 11	4	—	——
16	„ 8	12 33	85 + 27	135 + 19	2	—	Slow.
17	„ 8	12 35	18 + 63	135 + 59	4	—	Very swift.
18	„ 8	12 46	70 + 27½	100 + 32	1·5	—	Rather slow.
19	„ 8	12 48	81 + 29	83½ + 30	4	—	——
20	„ 8	12 52	89 + 37½	23½ + 59	4	—	Extremely swift.
21	„ 8	12 55	102 — 13	93½ — 20	2	—	Extremely swift.
22	„ 8	12 58½	110 + 51½	110 + 80	2	0·3	Swift; streak.
23	„ 8	13 4	91½ + 15½	71 + 9	2	—	Swift; streak.
24	„ 10	11 28	95 + 5	80 + 3	3	—	Very swift.
25	„ 10	11 44	120 + 46½	112½ + 37½	4	0·2	Very swift.
26	„ 10	11 53	105 + 28½	87 + 50	3	0·4	Swift.
27	„ 10	12 0	81 + 16	90 + 12	3	0·3	Swift.
28	„ 10	12 7	42½ + 49	5 + 74	1	—	Slow.
29	„ 10	12 20	108 + 29	94 + 21½	3	—	Very swift; streak.
30	„ 10	12 31½	115 + 18	107½ + 7½	2	—	Very swift; streak.
31	„ 10	12 45	102½ + 22	111½ + 30	4	—	Very swift.
32	„ 10	12 50	160 + 73	112½ + 61	4	0·2	Very swift.
33	„ 10	12 55½	109 + 20	108½ + 25	3	0·3	Swift; streak.
34	„ 10	13 12½	126½ + 47½	90 + 41	3	0·2	Extremely swift.
35	„ 10	13 27½	109 + 19½	115 + 32	3	0·3	Swift; streak.
36	„ 10	13 58	116 + 29	141½ + 27	4	0·2	Extremely swift.

Several bright Taurids (Nos. 2, 7, 10, 11, 13, 16, 18, and 28) have been observed. They were from a radiant at 52° + 22½°.

The Leonids were Nos. 14 and 23.

There was a remarkable scarcity of meteors from 13h. to 14h. on Nov. 10. Walter E. Besley.

Clapham Common, Nov. 13.

THE METEORS.

[43021.]—WRITING these lines before the meteors have made their appearance, I am possibly "putting my foot in it," as the saying is; but I cannot help noting that, owing probably to the paucity of news from the seat of war, some of the papers have furnished amusing matter over the "shower." In one London morning paper I saw the heading thus (I cut it from the paper):—"The Astronomer Royal Points Out How Amateurs May Add to the Sum of Knowledge by Individual Work." When I came to look, I found that it had nothing to do with the "Astronomer Royal," but is apparently a circular letter issued from the "Solar Physics Observatory," which it appears is at South Kensington. For all I know the information given may be something better than the Astronomer Royal could give; but why he should be credited with it I fail to understand, for his quarters at Greenwich cannot be called the "Solar Physics Observatory," and I do not believe he has issued the letter; but the fact remains that in a London paper the letter is attributed to the Astronomer Royal. In a London evening paper I find "It may be observed that the comets such as 'Biela's,' which are known to be intimately connected with meteor swarms, are telescopic objects and rarely visible to the unaided eye, and it may happen that though in past ages they have been sufficiently large and brilliant to create a panic amongst the ancient inhabitants of the globe, as many and many have done, that they are now rapidly approaching a period of decay and death, and that a meteor swarm is a comet's legacy to the celestial hosts.'[2] I am without any knowledge of what the "ancient inhabitants" of the globe thought, but I have an idea that if they expressed some of the opinions I have read in the papers they must have been rather unwise—to put it mildly. I wonder, with Mr. Crummles, "how these things get into the papers." B. Am. A.

IS THE UNIVERSE FINITE?

[43022.]—THE question raised by Mr. Burns in your columns (No. 42994) is one on which I have written many notes, the latest being in my "Introduction to Stellar Astronomy," recently published. Of course, in speculations of the kind we are only dealing with luminous stars. Generally speaking, an examination of the heavens throws no light on the existence or non-existence of dark bodies in space. We occasionally learn their existence by means of an eclipse or of the perturbed motion of a luminous star, but we can form no rational estimate of their numbers.

If the stars were uniformly distributed in space (uniform in brightness, mass, and distance), the total light of the stars of the $n + 1$th magnitude would always exceed the total light of those of the nth magnitude. The number would, in fact (if we adopt Pogson's scale), increase for each magnitude in the proportion of $10^{0.6}$, while the intensity of the light would diminish in the proportion $10^{0.4}$, the total light thus increasing in the proportion of $10^{0.2}$ or 1·585 for each magnitude until so many stars got in the way of each other that a large proportion of the total light would be lost by means of eclipses.

But, of course, the amount actually lost by eclipses will depend on the number of dark bodies as well as of luminous bodies in space. If the total amount of star-light increased with each magnitude, the uniform brightness of the sky would follow as a matter of course. The stars of the tenth magnitude taken collectively would give ten times as much light as those of the fifth, and so on. But even if we supposed the total light of the stars of each magnitude to be the same, then the total light of the stars up to the millionth magnitude would be one million times the total light of those of the first magnitude. Will anyone place the total starlight as high as this? But, if so, let us go on to the stars whose magnitude is a million of millions. Plainly, we must stop before this.

Of course, if the sun is a member of a cluster, a thinning out of the stars as we move away from the sun, or the earth, is easily explained; but as soon as we have once got clear of the cluster the foregoing considerations again come into play. Even the stars in the Galactic Circle can hardly extend to infinity, or else that circle would be much more luminous than it is.

An infinite universe of bright stars (even if on the average less luminous than the sun) transmitting their light to us with but slight loss is thus inconsistent with the actual condition of the sky. This, I think, I have proved long ago, and probably others did so before me; but I hope Mr. Burns's letters and articles may help to attract the attention of astronomers to a problem which has been too much neglected. W. H. S. Monck.

THE FINITE NUMBER OF STARS.

[43023.]—WHILST not professing to be well versed in astronomy, I yet venture to disagree with Mr. Burns's postulate in letter 42994, that were the number of stars infinite, the brilliancy of the starry sky would be comparable with that of the sun.

Does every orb throughout the universe emit undulations capable of exciting vision? Surely not. And if dark worlds exist in comparative proximity to the earth, can one justly assume that beyond the uttermost shining star there is not a multitude of others unincandescent, or whose light has not yet reached the earth?

But apart from this, there seems another objection to an hypothesis that the number of stars is finite. It causes one profound astonishment to reflect on the extreme sensitiveness of the eye to light when one thinks of the minuteness of the retinal surface exposed to an illuminant so many millions of miles distant as the nearest star. The amount of light received depending on the distance of a surface from its illuminant, of course the farther off the star, *cæteris paribus*, the less light the earth receives from it. But at a certain, though indefinable, distance, the light reaching us is insufficient for the eye to distinguish the star. The light received, however, may still be sufficiently powerful to disturb the molecules of a sensitive photographic plate if the exposure be sufficiently prolonged. I believe, indeed, that it is practically necessary to limit the exposure, owing to the number of stars which register themselves increasing with the time their light is allowed to act. If this be so, we may fairly assume infinity of stars until plates register a finite number, no matter how long the exposure. The reason why the midnight sky does not appear as brilliant as the sun is clearly that a large proportion of the light we receive is too faint to have any sensible effect on the retina during the time it is possible to continue gazing steadily at a particular portion of the sky.

If we conceived an eye so sensitive to light that a star, even of the first magnitude, could only be regarded with the same precautions now taken when studying the sun, a starry night would obviously be much more brilliant than noonday now is. But such an eye would find the glare of our present noonday absolutely intolerable. Hence it seems to me we cannot argue the number of stars finite from the comparative dimness of the midnight sky, for our eyesight is suited to present terrestrial conditions, and, so far as we know, to those conditions alone. J. Dormer.

THE NUMBER OF STARS NOT INFINITE.

[43024.]—To start with, I should say it is quite illogical for anyone to assert as a dogma that the number of stars is infinite. The most that can be said is that we can find no proof of any limit to the universe, and the natural presumption is that there is no limit. The difficulty is to define infinite without degenerating into mere meaningless verbiage. Imagine the *apparent* surface of the heavens to be an elastic envelope, and placed at such a distance from the earth that the visible stars would completely cover its surface—say x stars. Now increase the diameter of the hollow sphere, and it will now require $x + y$ stars to cover the surface. Make the diameter infinite, and $x + y$ becomes infinite. Now it appears to me that two equally valid and yet apparently irreconcilable conclusions may be stated as the outcome of the problem: (1) No matter how great the surface, it will always be covered by stars if their number be infinite. (2) No matter how great the number of stars, they can never cover the surface if it be infinite. The former is the premisses on which Mr. Burns bases his argument; but has it any better claim to rank as a logical conclusion than the latter? Mr. Burns's method of reasoning is interesting and ingenious; but I doubt hardly covers all the ground. What about the probable existence in space of non-luminous bodies, such as exist in our Solar System? Again, on what line of reasoning does he base his assumption that "the superficial brightness . . . is independent of the distance"? The brightness of any given star (excluding any intercepting medium and also atmospheric effect) will depend (*a*) upon the intensity of the light-waves, (*b*) on the number in unit area. The former will be determined by the intensity of the origin of the light, the latter undoubtedly by the distance; for though for practical purposes we may take the rays of light from a star as not differing sensibly

from the parallel, in considering such a problem as this, it must be borne in mind that they are not parallel. There is a limit to the sensibility of the human eye. Direct the eye to a blank point in the sky, now apply a telescope, and a star appears, because the glass of the instrument increases the number of rays falling upon unit area in the eye. Although Mr. Burns, therefore, proves conclusively that any straight line drawn through space will intersect a heavenly body if their number be infinite, it does not necessarily follow that that body will be visibly luminous to the human eye, even when assisted by optical instruments.

W. J. G. Forman, C.E.

THE NUMBER OF STARS NOT INFINITE.

[43025.]—In Mr. G. J. Burns's interesting communication (42994, p. 292), he says that he believes "the number of *fixed* stars is finite." Is it usual now to speak of "fixed" stars, seeing that they have both rotary and orbital motions? The conclusion arrived at by Mr. Burns is, to my mind, unanswerable, although perhaps some difference of opinion as to the steps by which he has reached it may exist. Is not number itself necessarily finite? Should we not distinguish between indefinite or unlimited increase as a process to which finite quantity may be subjected, and the attainment of such a condition? In other words, can we not conceive of constant additions to the existing number of celestial bodies at any period, however remote, without assuming the impossible postulate of an existing infinite number?

If infinity be attained, we cannot add to it, hence any condition which permits of increase implies finiteness. Further, whatever be the number of stars scattered throughout space, that number cannot be other than finite, for if the process of stellar formation be continuous, the alleged "infinite number" is capable of augmentation, which is absurd; while if the universe of stars be already completed as to number, it is necessarily finite. In other words, the popular phrase "infinite number" is incorrect and nebulous, being confused with the *condition of unlimited increase*, a state necessarily never reached.

West Norwood. Henry T. Burgess.

MOCK-SUN.

[43026.]—This phenomenon was seen here on Sunday, the 12th inst., at 1h. 45m. p.m.

It was nearly due south, and same altitude as the sun, and lasted fully 15 minutes. It looked like a short vertical rainbow, with colours not quite so pronounced, with an ill-defined brighter patch or knot in the centre, and concave to the true sun. David Booth.

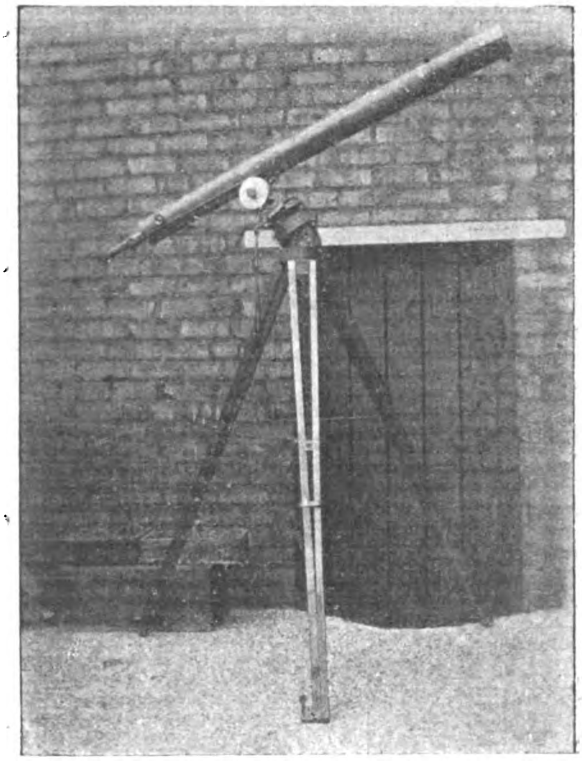
The Fall, Bramley, Leeds.

EQUATORIAL STAND FOR A FOUR-INCH OR FIVE-INCH REFRACTOR.

[43027.]—Having been asked by many correspondents to give a detailed account of the equatorial stand to which I have already referred in several letters to the "E. M.," I now proceed to do so to the best of my ability. Probably many readers who are better mechanics than I will be able to improve upon my plan. The problem, then, is:—Given an altazimuth mount (with or without slow motions) of the form usually adapted to a refractor of about 4in. to 5in. aperture, to convert the same into a steady and serviceable equatorial, to which divided circles can be fitted, if desired.

A glance through the catalogues of almost any of the leading opticians will show the kind of altazimuth referred to.

The legs of the tripod take the form of very long isosceles triangles, giving great rigidity. The sides of the triangle are bars of stout oak or mahogany, about 1in. by 1¼in. section. If I were making my stand over again, I should use thicker sides, say, 1¼in. by 1½in. section. If the legs of the original stand are of this form, it will save the trouble of making them, as they can be simply used again for the equatorial. However, my old stand, as I bought it, had legs made of each a single piece of hard wood, a very inferior plan, and sure to be unsteady. As this may be the case with other readers, and some may desire to buy the altazimuth head, and make the stand to mount it on, I give sketches of the legs of the tripod in Fig. 1, which should explain themselves. The block B is of oak, with 2in. square section. The mode of fitting it to the head will be given further on. The upper ends of the two sides of the leg are shod with sheet-brass to give strength and smooth working, and a bolt, *b b*, about 4½in. long by ¼in. thick is put through all, as shown, and can be tightened up as desired. It should have good wide washers to avoid crushing the wood. The little block *c* is useful as affording an attachment for the strut, as shown. It should be long enough to project about 1in. or 1½in. inside the leg. The manner of pivoting the strut to this projecting end is immaterial. In my case the strut



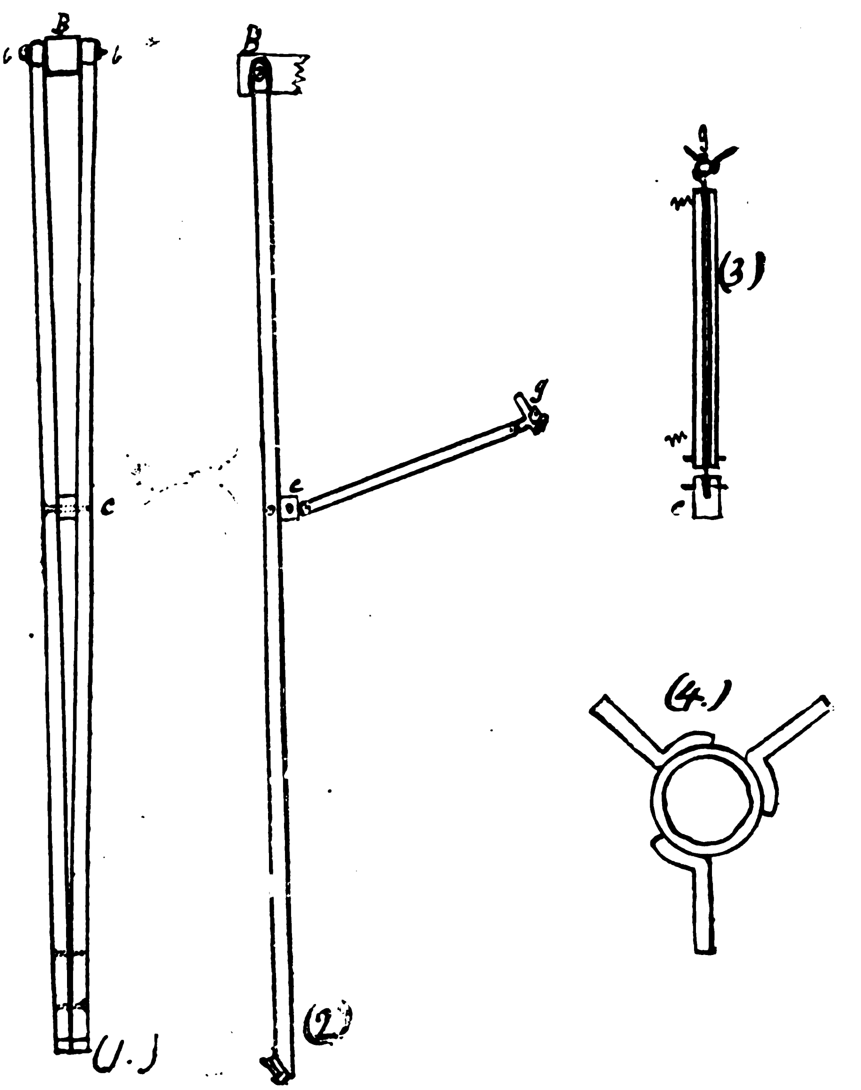


Fig. 1.

is made of two parallel pieces, with a piece of stout sheet-brass inserted between them at the end. This projects about 1in., and is inserted in a vertical saw-cut in the block *c*, and a stout screw put through from side to side.

Now comes the most important part—viz., the head of the stand. It is indispensable that this should be absolutely rigid. To this end we must have two thick discs of solid material. I got them made of oak 6½in. diam. and 2in. thick. One of these is to form the top of the stand to which the legs are rigidly bolted. Fig. 2 shows how this is

done. D D is the oak disc. B B B are three oak blocks, 2in. square section, and long enough to project about 1in. beyond the circumference of the disc when fitted, as shown. One end of each of these must be cut to an angle of exactly 120°. This can be done by plotting out the angle on stiff paper or card, either by the aid of a protractor, or by means of a geometrical construction. A little study of Euclid, Book I. Prop. 1, will show how it can be done. When the angle is

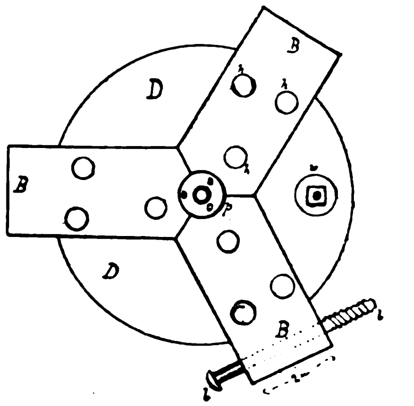


FIG. 2.

drawn, cut it out, and trace the outline on the wooden block to guide the saw. If correctly cut, the three blocks will fit each other exactly in the centre. They should be screwed to the disc with three very strong screws each. I used 2½in. screws, sinking the heads 1in. deep in the blocks by boring to that depth with a ⅝in. centre-bit. Thus 1½in. of each screw projects to grip in the disc. The holes for screws are shown at *h h h*, Fig. 2, which also shows one of the bolts to fasten the legs. The holes for this, both in the leg and in the block, should be bored with a shell-bit of the exact size of the bolt. This gives a very smooth hole, and a tight fit. At *p*, Fig. 2, is an important part of the apparatus. This is a small brass casting, known to gasfitters as a "ceiling-plate." It should be fastened exactly in the centre, attached to the blocks by three screws as shown. Into it screws the brass rod forming the "pillow," upon which the struts from the legs work; *w* is the nut and broad washer by which the adjustment for latitude is made, as will hereafter be described.

Having completed these fittings, and bolted the

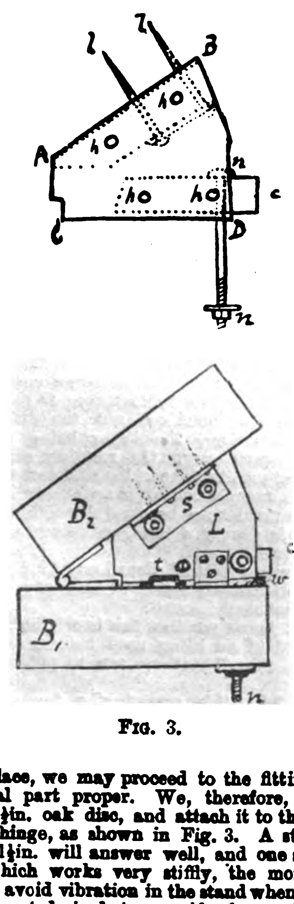


FIG. 3.

legs in place, we may proceed to the fitting of the equatorial part proper. We, therefore, take the second 6½in. oak disc, and attach it to the first by a strong hinge, as shown in Fig. 3. A steel hinge 3½in. by 1½in. will answer well, and one should be chosen which works very stiffly, the more so the better, to avoid vibration in the stand when finished. If it be not desired to provide for a change of latitude, all that is now necessary will be to get a strong wooden block, cut it to the necessary angle, and insert it between our two discs, bolting it securely to each. But to give a little variation in latitude we must complicate the arrangement somewhat.

The first step will be to cut out a pair of latitude blocks from a piece of 1in. oak plank (the harder and denser the better). Fig. 3 (*a*) shows the shape of one of these. The angle between the lines A B and C D should be a *little less* than the co-latitude of the place. The deficiency is made up by the wedges shown at *w*, Fig. 3 (*b*). We also require two connecting blocks of the shape shown by the dotted lines in Fig. 3 (*a*), and about 1½in. wide, cut from the same wood as the latitude blocks. These are placed as shown between the latitude blocks, and the holes *h h*, *h h*, bored through all while firmly held in the vice. To bore the holes use a ¾in. shell-bit, and see that they are bored accurately at right angles to the surface of the blocks. Have ready four 4in. bolts ¾in. thick, and two pieces of strong sheet brass (not less than 1/16in.) bent to a right angle, *s* Fig. 3 (*b*). These should measure about 3in. by 2½in. before bending, and holes should be drilled in the one flange of each to correspond to the holes *h h*, *h h*, and in the other five or six holes for 1in. screws to screw into the upper disc when all is in position (see *f f*, Fig. 4). Without removing the blocks from the vice, place the brass plates S in position, and drive the bolts through all and screw up tight. It is desirable that the upper connecting block have holes bored previously for the two 2½in. screws *l l*. These, with the screws through the

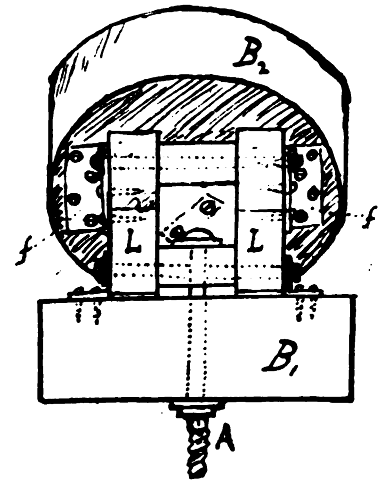


FIG. 4.

flange of the brass plate S, form its connection with the inclined disc B_2, and, of course, must be strong enough to be absolutely rigid. It will be well to place wide brass washers on the heads of the screws *l l*, or to pass them both through a little slip of stout sheet brass, as they then can be screwed home as hard as the brace can do it without damaging the wood.

The lower connecting block also must have a hole bored with the ⅝in. bit to receive the long bolt *n n*. This hole should be outside the hole *h*, as shown, but as near as possible to it without breaking into it. This bolt goes right through the disc B_1, and is provided with a strong nut and a very wide washer. (The nut and washer are seen at *w*, Fig. 2, and at *n*, Fig. 3, *b*, and A, Fig. 4.) The lower connecting block must project a little (*c*, Fig. 3, *a* and *b*) to give room for this bolt sufficiently near the edge of the disc B_1. To adjust for latitude, slacken the nut *n*, and insert or withdraw wedges at *w*, until the desired angle of inclination is obtained.

It only now remains to mount the altazimuth head upon the block B_2, and the arrangement is complete.

When describing the legs of the tripod, I omitted to give directions for the fitting of the struts (Fig. 1) upon the brass rod upon which they work. Into the "ceiling-plate" *p* (Fig. 2) we must screw a stout brass rod. A piece of ⅜in. or ½in. gaspipe will do. The lower end should be provided with a nut and a short piece of tube 2in. or 3in. long, just large enough to slide freely upon the rod. To this are attached three brass lugs, cut from stout sheet brass, bent to the shape shown, and soldered firmly to the tube. Fig. 1 (4). Each has a hole drilled in it, and, when in position, it is inserted between the two parallel pieces of the strut, and a screw put through from side to side. When the stand is folded up, the sliding tube carrying the inner ends of the three struts travels up the brass rod until the struts lie parallel to the rod.

It will materially add to the rigidity of the stand also to put a strong screw-eye into each side of each leg about half-way up, and connect these when the stand is open with three stout iron rods. Each rod is bent at one end into a ring, which hangs from the screw-eye, and at the other has about 1in. of its length turned down at right angles, to form a hook, which slips tightly over the opposite eye. When the stand is folded up, these rods hang down parallel to the legs; and it will conduce to neatness and portability to have a stout leather strap with buckle attached to one of the legs about 2ft. above its lower end, which can be buckled round the legs and iron rods when the stand is out of use. It is hardly necessary to describe the levelling screws. Any brass founder will make them for about 1s. each.

At *t*, Fig. 3 (*b*) is seen a small but most important article. It is one of Taylor, Taylor, and Hobson's circular spirit levels. One of those sold for use with a hand camera will do perfectly well. It only costs 1s., and occupies next to no space, being just 1in. in diameter.

To attach the metal parts to the block B_2, it may be necessary again to invoke the aid of the brass-founder, for three small castings; but as different makers differ in the design of this part of a stand, it is impossible to give directions which would be generally applicable. In the case of my stand, the brass attachments of the original legs a little modified, and with a few screw-holes drilled, answered the purpose.

The accompanying photograph shows the general effect of stand and telescope. The orientation of the legs of the tripod is a matter of some importance. If the hinge (Fig. 3 *b*) be mounted upon the disc B_1, immediately over one of the blocks B B B, Fig. 2, then the leg corresponding to this block will point due north when the stand is in the meridian. A small compass can then be mounted upon the strut corresponding to this leg, and will serve (with due correction for declination) to guide in placing the stand approximately in the meridian. A more accurate position can then be easily obtained by optical means, and when found rendered permanent by suitably marking the ground where the legs rest.

Monkwearmouth. **Wm. F. A. Ellison.**

PROF. BONNEY ON THE AGE OF THE EARTH.

[43028.]—"E. L. G." (43001, p. 295) seems to forget that Prof. Bonney was not writing on comets, but the earth. No doubt the information he could give us on comets would be of a much more sound, reliable kind than that which "E. L. G." has treated us to lately. It is astounding to think that "comets, sun, and our satellite" are the only bodies that interest us at all. Where does the vast sidereal system come in, to say nothing of the rest of the Solar System.

If, by the statement "we have witnessed in the Andromeda nebula the birth of an earth," "E. L. G." is referring to the star which appeared in the said nebula in 1885, I think that has been satisfactorily disposed of by "F.R.A.S.," 42973, p. 274. I fail to see any connection between the Andromeda nebula, the birth of an earth, the destruction of Sodom, and Nov. 15. Why not make it Nov. 5? It is a much more suitable date!

Earlsfield, S.W. **Silverplume.**

REDUCING INTENSITY OF LIGHT—VEGA—"ASTRONOMY" (?) FOR AMATEURS.

[43029.]—LET me thank "H." for his letter (42997). Into the depths of mathematics, of course, I cannot follow him, nor can I touch the subject of curves for glasses when complicated by the conditions he introduces. It seems, however, as if my contention would be applicable enough in the case of a star, if not of the sun, or objects having a measurable disc; but this is hardly relevant, so we will let it alone. My plea was for a plane glass (if no better could be suggested) behind the eyepiece, and I still contend that for most purposes the disturbance of definition produced thereby would be immaterial.

"H." certainly did lead me to try a method which proved a thorough failure, for I should not have thought of trying a perforated stop (or "screen," if he likes it better) for stellar work, if he had not recommended it. But there is nothing like "try again," and I will try again at the next opportunity, using other kinds of screens than perforated zinc. That which I used in my former experiment was composed of a piece of ordinary perforated zinc, of about 80 holes per square inch, holes being 1/16in. in diameter.

Perhaps "H." would tell me what a poor fellow is to do who possesses no scientific equipment beyond his telescope and a love of the beauties of the heavens, and would like to do some useful work, however humble? Prebendary Webb had no better apparatus for the greater part of his life than I have, yet his work was more than mere "instrumentation."

As for my observation of Vega, either "H.'s"

copy of "Celestial Objects" is an old edition, or else he has not verified his references. Referring to the place, I find, a few lines after the words he quotes, the following:—"It" (the companion to Vega) "has been detected by Erck with $2\frac{1}{10}$in. of $7\frac{1}{2}$in. achr., glimpsed by Ward with $1\frac{6}{10}$in. of $4\frac{3}{10}$in. achr." After this, my seeing it with a $2\frac{3}{4}$in. is insignificant. Perhaps "H." could not see it with this aperture; but I have sight above the average. To me ε Lyræ has always been an easy naked-eye double, and I can count 16 or more stars in the Pleiades on a good clear night. The night of Oct. 11 last in Dublin was exceptionally clear, and the air steady. I was engaged in testing a $2\frac{3}{4}$in. Tulley, which a friend had recently bought, but he was dissatisfied with its performance. I soon found that it only needed adjusting, when its performance, both in light-grasp and definition was all that could be desired. Wm. F. A. Ellison.

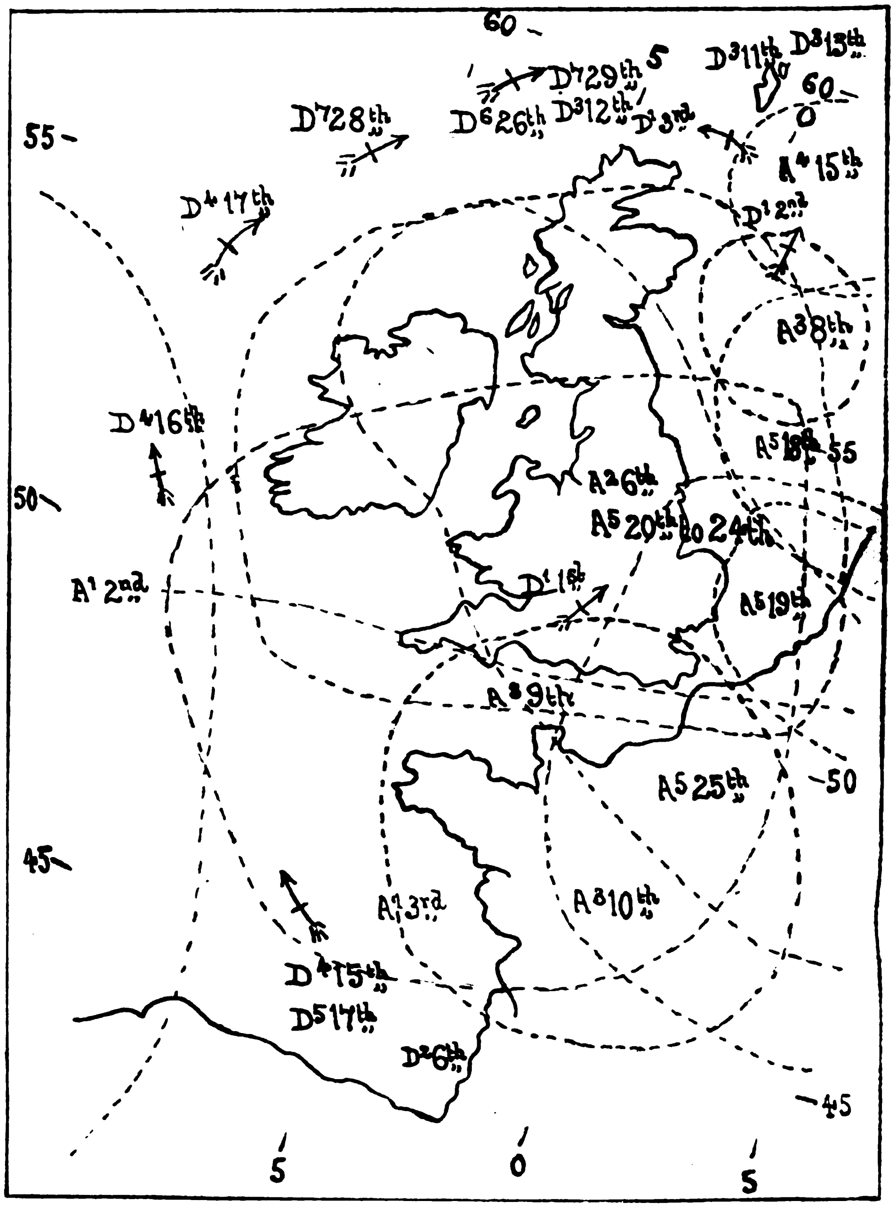
Monkwearmouth, Nov. 10.

THE WEATHER OF THE BRITISH ISLES IN OCTOBER.

[43030.]—

Date.	Cause.	Effect.
Oct. 1 to 3	Depression of considerable intensity passed directly across our islands, from S.W. to N.E.	Violent gale in the English Channel, accompanied by heavy thunderstorms. Much rain over the entire country.
2 to 5	Low-pressure system passing away to northward. Anticyclone moving in from the Atlantic.	Much quieter conditions generally. A fair amount of sunshine was recorded in the South of England.
6 to 12	Large well-marked anticyclone, almost stationary.	Very fine in the west, but foggy in the east; especially in the morning.
13, 14	Depression in the far North.	Rain in Scotland, but fair elsewhere.
15 to 18	Large high-pressure system lying over the Scandinavian Peninsula, Denmark, and the Baltic.	Very fine, clear, and warm in England, cloudy in Scotland, and also in Ireland.
19	Anticyclone reaches the eastern shores of the North Sea.	Weather fine everywhere, except in the extreme North of Scotland.
20 to 24	Anticyclone envelops our islands and remains stationary.	Fair; but much fog and mist generally throughout the country.
25 to 31	A series of depressions in the North. High pressure to the South-east.	Squally S.W. winds, heavy falls of rain, and very high temperatures for the time of year.

Meteor.



NATURAL HISTORY STORIES.

[43031.]—In spite of the space occupied by war news in the papers some extraordinary tales find their way into the journals. The sea-serpent is, I think by common consent, played out; but what about this robin redbreast? It appears that "last winter" a gentleman in Edinburgh had a somewhat remarkable experience with a robin, which during the cold weather "took refuge every evening in the lobby of his house after dark. The lobby contained a castor-oil plant, and upon this the robin perched himself as soon as it became dusk, getting access to the lobby by the open doorway. It mattered little to robin how many people were passing in or out. He remained all night on his perch in happy contentment, and as soon as the housemaid opened the door in the morning, he flew away with a chirp which might be interpreted as an expression of thanks for the night's entertainment. He returned on the following evening, again to rest on the plant, and kept up this programme during the whole winter, bidding farewell to his friends on the return of fine weather." It is not quite clear what is meant by "last winter," but presumably it is the winter of '98-99. The point is that robin has returned. It is announced that robin had almost been forgotten by his friends, "but he appears not to have forgotten them, for the other day he again put in an appearance, and commenced to roost as usual on the castor-oil plant, acting precisely in the same manner as he had done on previous occasions. Every evening he enters the open doorway and resumed his perch on the plant. When daylight arrives, and the door is opened, he flies away with his usual chirp, and returns again punctually in the evening. This will probably go on for the ensuing winter, as he appears to consider himself now a member of the household, with liberty to come and go at his own sweet pleasure." It is well known to naturalists that when robin wants "grub" he becomes a comparatively fearless bird, and will come even where the cheeky sparrow flies away when human beings appear; but the tale lacks the evidence of truth, because the horticulturist would want to know what sort of a plant is meant by "castor-oil." That a plant of Ricinus communis should survive the winter is almost as curious as the behaviour of the robin, for sceptics will want to know how a castor-oil plant managed to live through the winter. It is an annual, and dies off at the end of the year, never to come up again. Presumably some other plant is meant—possibly an Aralia. These little discrepancies throw doubt on these stories, which, well told, are nevertheless to be received with caution.

Here is another "natural-history story," which may be true, but which needs a little verification before it can be entered in the textbooks:—"The crew of the Stonehaven fishing-boat *Frigate Bird* are reported to have met with a curious marine monster while eight miles off the Kincardineshire coast last week. It was said to be black in colour, with a thin white stripe running to the tail. It came pretty close to the boat, and raised a long, slimy-looking arm out of the water till it towered 30ft. above the deck. The object remained in sight for five minutes." A fish, or "marine monster," with an arm 30ft. long must be a curiosity, and it is a pity it was not captured. Perhaps it was an undeveloped sea-serpent. Biela II.

AUTOMATIC BATTERY SWITCH.

[43032.]—I have recently been testing some high-speed steam and petrol engines, and as the location of the cause of a "knock" on small quick-revolving engines is always a matter of some difficulty and trouble, I devised a simple apparatus for rapidly ascertaining the loose brass, journal, or joint, and for allowing it to be very accurately adjusted. The success of the method was such as to save many hours of adjusting parts, and to produce almost total silence of running, even on a 5H.P. engine run up to 1,000 r.p.m. (explosive type).

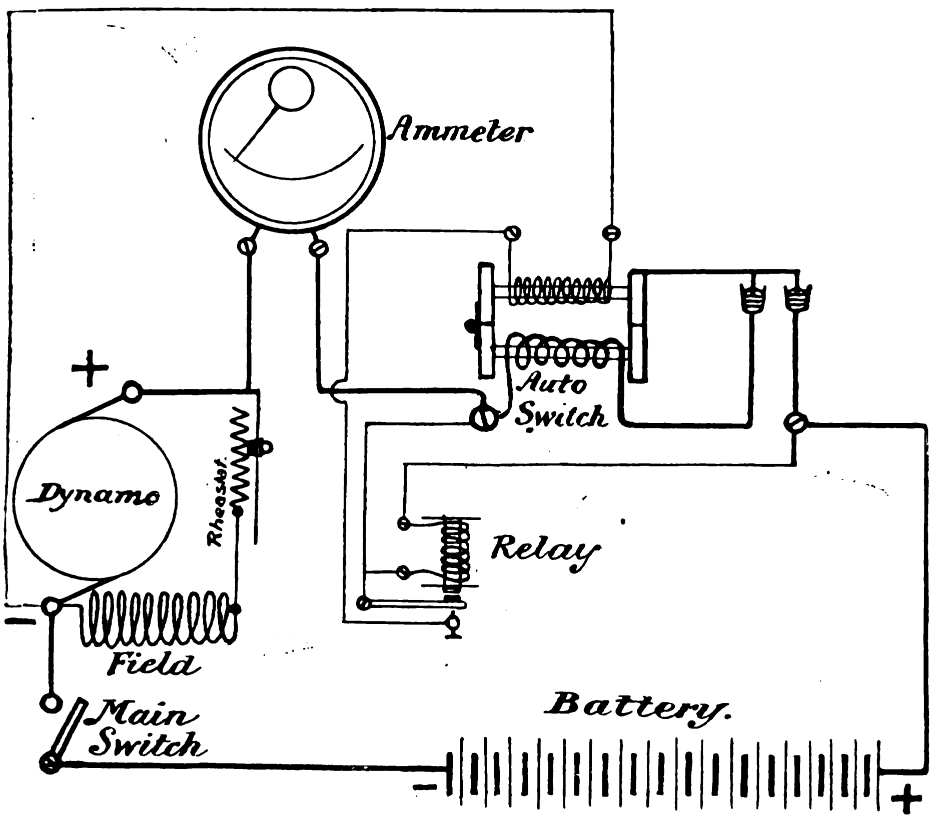
Let us suppose that an engine is erected and put under steam (or gas, or oil, &c.), and that a "knock" becomes audible. The culprit joint is *very* probably the "big end," and this will always knock unless most accurately adjusted. To test the joint, and gain perfection of adjustment, I attach a flexible wire—insulated—to, say, one of the crank-head nuts, or by other means connect it to connecting-rod. Fix a bit of springy brass or copper to bear against crank-shaft, but in such position that no keyway or projection passes spring when shaft rotates. A wire from spring is joined to a single dry or Leclanché cell, and the other wire to a telephone-receiver, the latter being joined to battery in usual way. On running engine and putting telephone to the ear, the slightest "knock" or looseness becomes audible as a violent "banging." The joint should then be carefully tightened until the sound is simply a loud, grinding noise. Oil should be used.

Every moving joint of almost any kind of engine or pump can be easily tested in this way, and very perfect adjustment insured.

I do not know whether this is original. I have never heard of its being used before, and if you consider it of sufficient use use to publish, please do so.

May I take this opportunity for making a remark *re* automatic accumulator switches? The usual kind consist of an electro-magnet wound with two coils: one a shunt-coil of high resistance, joined permanently across the dynamo terminals, and the other a series coil of thick wire, through which the charging-current passes. By means of springs or weights the switch can be set so that it cuts in when the voltage of dynamo reaches a certain value, and cuts out when, for any reason, the voltage of dynamo falls below that of battery.

Mr. Bottone's recent simplification of the type,



by substituting his dynamo-magnet for the shunt-coil, and a spring for the series coil, is a great step in advance; but even that leaves something to be desired. All these kind of switches have one failing. That is the knack of cutting in quite regardless of any abnormal variation from the usual battery voltage.

Suppose a switch is set to cut in at, say, 100 volts, and suppose the battery voltage, on this particular occasion, to have fallen to, say 85 volts for some unhappy reason. On the cutting in of switch an enormous current will pass for a few seconds, and I have known gas and oil engines to be pulled up dead by it, and often belts have been thrown off, and armatures strained.

I have lately been using a switch of this kind with a very ill-used battery, and had so much trouble from this cause that I tried the following dodge, and can most strongly recommend it to anyone who has a good auto. switch which he does not want to get rid of and to replace with one of the expensive trade-made variety. Break one of the connections (preferably the + one) from dynamo to shunt-coil of switch, and connect up to contacts of a high resistance (300 or 400 ohms) relay, so constructed as to *break* contact when magnets are excited, and to *make* contact when they are not. The relay magnets are connected between the + dynamo and + battery terminals, as is the auto. switch. A switch of ordinary pattern is put between – dynamo and – battery terminals, as shown in sketch.

To work the apparatus, proceed thus:—Close negative switch. This causes a current of very small volume to flow through relay magnets, dynamo armature, and back to battery. The arm of relay is instantly raised, *disconnecting shunt-coil* of auto. switch from dynamo. Run dynamo up to speed. As voltage increases *in correct direction for charging* it opposes the current through relay magnets more and more, until that current becomes zero at the moment when dynamo and battery voltages are *equal and opposite*. The arm falls, connects shunt-coil of auto. switch to dynamo, and auto. switch instantly connects battery to dynamo, the switching causing no current whatever to pass at the moment. Dynamo is then run up till required charging-current is attained.

Assuming that the auto. switch requires, say, a minimum voltage of 50 to close it, this method causes the switching-in to take place at *any* voltage above 50 (up to that prohibitive for switch-windings, owing to overheating); and the switching can *only* take place when the battery and dynamo voltages are exactly equal and opposite.

Ivon M. de Havilland.

LATHE MATTERS.

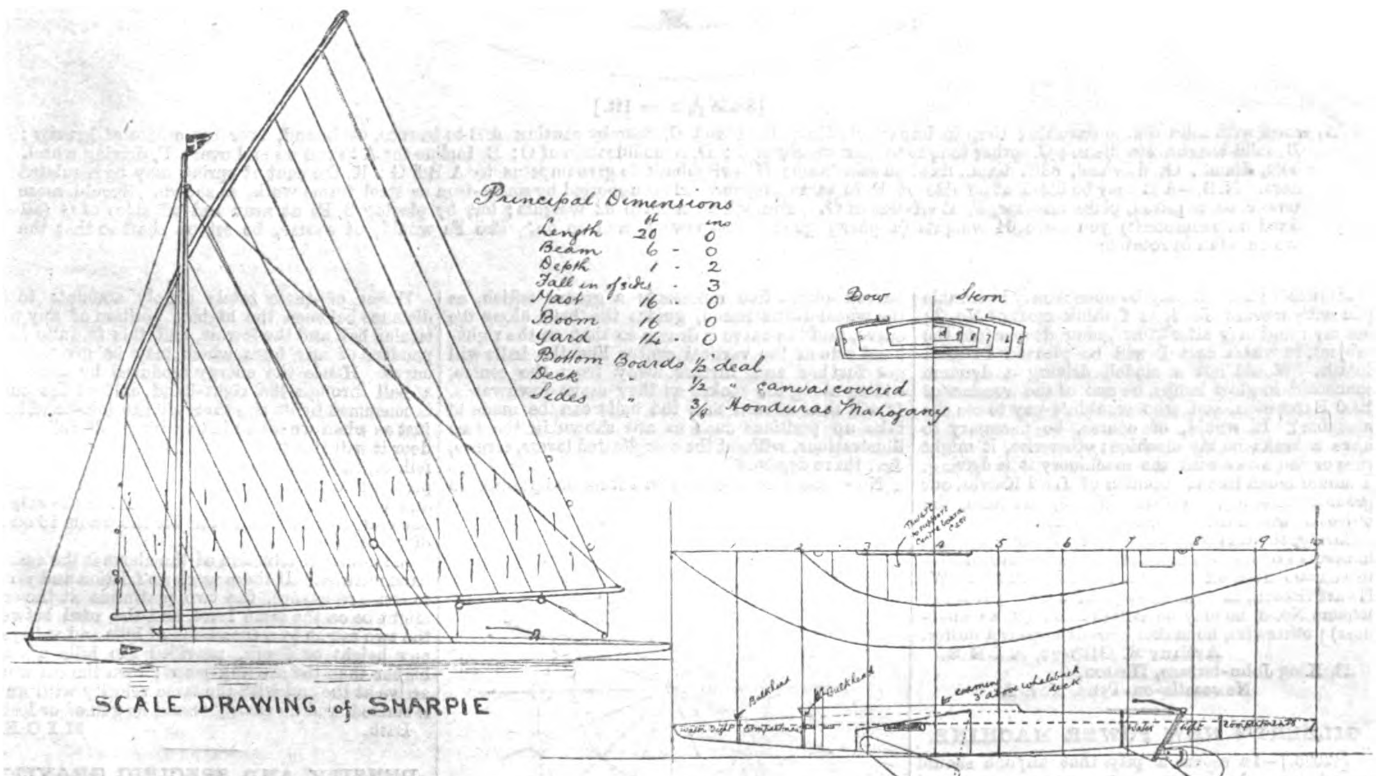
[43033.]—Having used a 4½in. back-geared, non-screw-cutting lathe for some years, I am thinking of supplanting it with a No. 16 screw-cutting lathe, 5in. centres, of the Britannia Co., but before doing so would like some kind reader of the "E.M." to tell me whether I should find the treadling of such a size to be heavy work? Would someone say if the above size is too large to be worked without tiring one's-self, and, if so, suggest a better? Of course, I should not be using it continually, nor is the rate of working any serious item. Also, I should like a sketch of some arrangement whereby one could sit down to the work, as, I believe, is done in some of the American lathes—Barness', for instance—though I have an idea that such an arrangement is only suited for small machines. Is this so? Lastly, having read in the "E.M." more than once that the Willis tool-holder is the best for general work, I should be pleased to have a rough description of it. Screw-Cutter.

BOAT FOR RIVER WORK.

[43034.]—Some weeks ago I put a query in these columns asking for the lines and dimensions of a sharpie 20ft. long, but received no reply. I have since made various inquiries, and as a result have plotted out the accompanying drawing, which is to scale. The principal dimensions are:—Length 20ft., beam 6ft., depth 1ft. 2in., fall-in of sides 3in., mast 16ft., yard 14ft., boom 16ft. Bottom boards and deck ½in. deal, the latter canvas covered. Side boards ¾in. Honduras mahogany. Sail area 160ft.

I may add that the boat is for up-river work only.

W. J. Shaw.

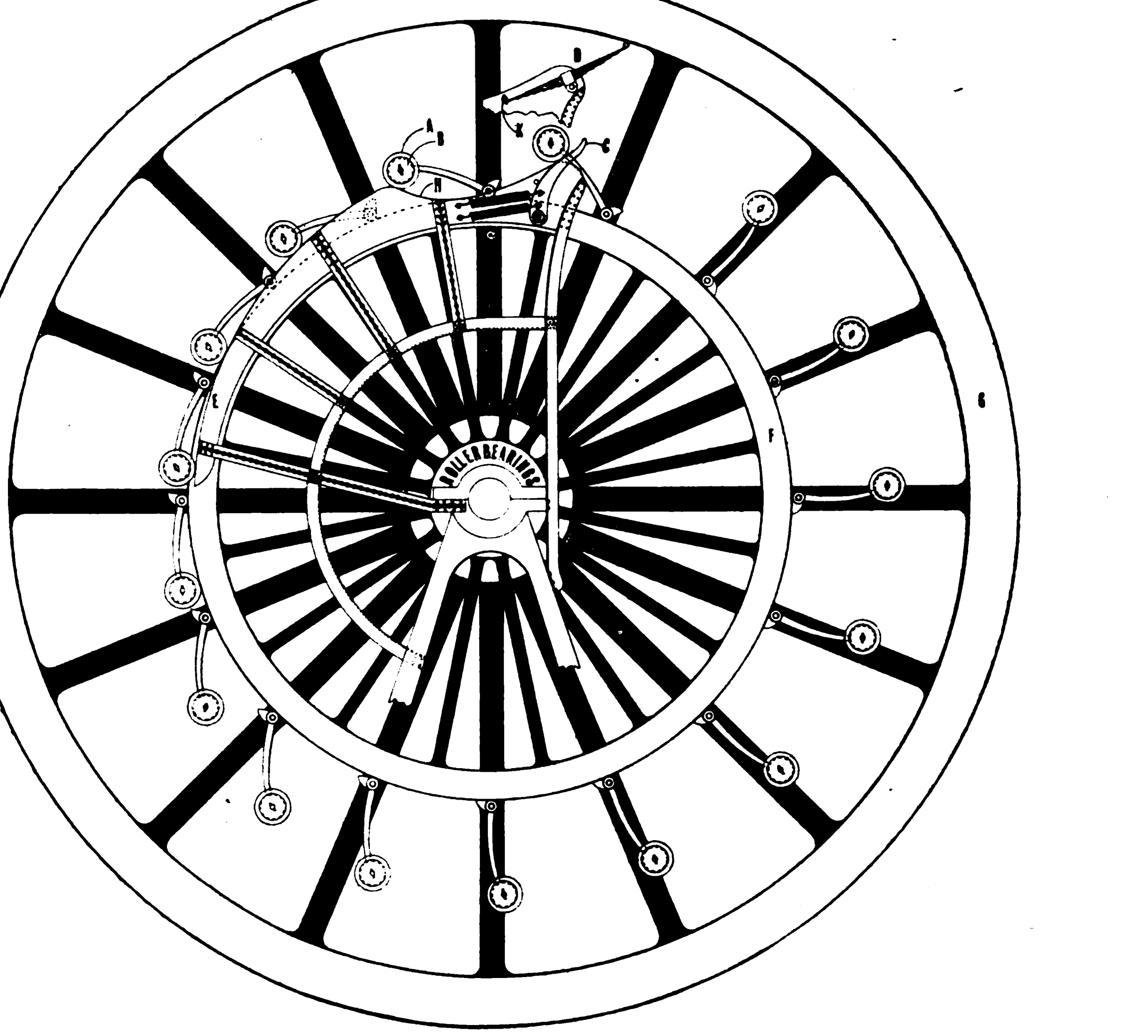


SCALE DRAWING of SHARPIE

GILBERT'S NEW POWER MACHINE.

[43035.]—I beg to forward block and particulars of my No. 3 machine, and to ask you to kindly

No. 3.



[Scale $\frac{1}{16}$in. = 1ft.]

A, wheel with solid 6in. indiarubber tire, to impart elasticity at H and C, thereby causing A B to bounce, or bound, over the centre of gravity; B, solid weight, 2ft. diam.; C, spring tongue to kick weight over; D, a modification of C; E, incline for A to run on and over; F, driving wheel, 50ft. diam.; G, flywheel, 88ft. diam., fixed on same axle; H, switchback to give impetus to A B F G; K, the cant of spring may be regulated here. N.B.—A E may be fitted at off side of F, in same manner. E is supported by angle-iron or steel frame work, as shown. Should more power be required, place another, F, at off-side of G. You will then have 32 weights; but by placing 2 Fs at near and off sides of G (all fixed on same shaft) you have 64 weights (a pretty good horse-power), and so on. The Fs would, of course, be set on shaft so that the weights fall in rotation.

reproduce same. It may be unnecessary to trouble you with scheme No. 4, as I think most of No. 3; but my mind may alter after going deeper into the subject, in which case I will be pleased to send details. Would not a model, driving a dynamo connected to glow lamps, be one of the wonders of 1900 Exposition, and who wouldn't pay to see the machine? It would, of course, be necessary to have a brake on my machine; otherwise, it might race or run away with the machinery it is driving. I should much like the opinion of Lord Kelvin, our greatest scientist, on this (No. 3) machine, the object of which is to dispense with fuel.

Surely, sir, it is less wonderful to cause a wheel to revolve by its own mechanical parts, than to hear speech 500 miles off *through a solid wire!* If W. Ewart Gibson, in your issue of 27th ult., will study scheme No. 3, he may be enlightened (if an engineer); otherwise, he makes himself appear a duffer.

Arthur E. Gilbert, A.I.E.E.

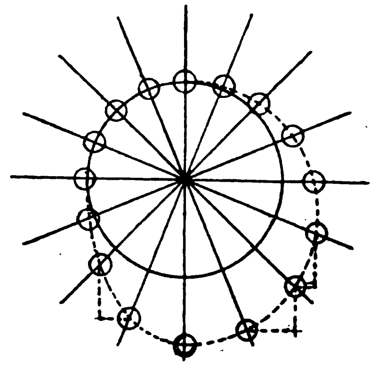
23, King John-terrace, Heaton,
Newcastle-on-Tyne, Nov. 2.

GILBERT'S NEW POWER MACHINE.

[43036.]—It seems a pity that anyone should spend his time in trying to produce perpetual motion; it has been proved over and over again that it is impossible. The two large illustrations on p. 210 are founded on the old idea that, if by any combination of levers, &c., you can remove certain weights on the rim of a wheel to a greater distance from the centre, *during the descent of the weights*, perpetual motion must be the result, owing to the greater leverage exerted by the weights.

In my diagram, the spokes of the wheel are supposed to be continued beyond the rim, the weights, or balls as I have drawn them, have holes through which the spokes pass, the balls sliding without friction along the spoke. In addition to this, the curved dotted line represents a groove which, as the wheel turns round, guides the balls along the curve, and the curve is drawn so that on the right-hand side of the vertical centre line the balls will get further and further away from the centre, sliding along the spokes as they move downwards. It will thus be seen that the balls can be made to take up positions such as are shown in the two illustrations, without the complicated levers, screws, &c., there depicted.

Now, the motion of any ball from one position to



the next may be resolved into components, a vertical and horizontal: these would appear as steps on the diagram. I have drawn a few, and if these steps were drawn all round, it would be seen that, although all the steps differ from each other, yet the total of all the *vertical* elements of the steps on one side of the centre line is equal to the same total on the other.

Either of these totals simply amounts to the distance between the highest position of any particular ball and the lowest, and this is quite independent of any form which may be given to the curve. Hence the energy produced by the fall of a ball through the right-hand half of the curve is consumed by its rise through the left-hand half, just as when we let an indiarubber ball fall on the floor it will rise to the same height from which it fell, or, rather, it would do so if the elasticity were perfect; so that the energy resulting from the fall and rise is nothing at all. If this is the case for one ball, it must be the same for the whole 16 on the diagram.

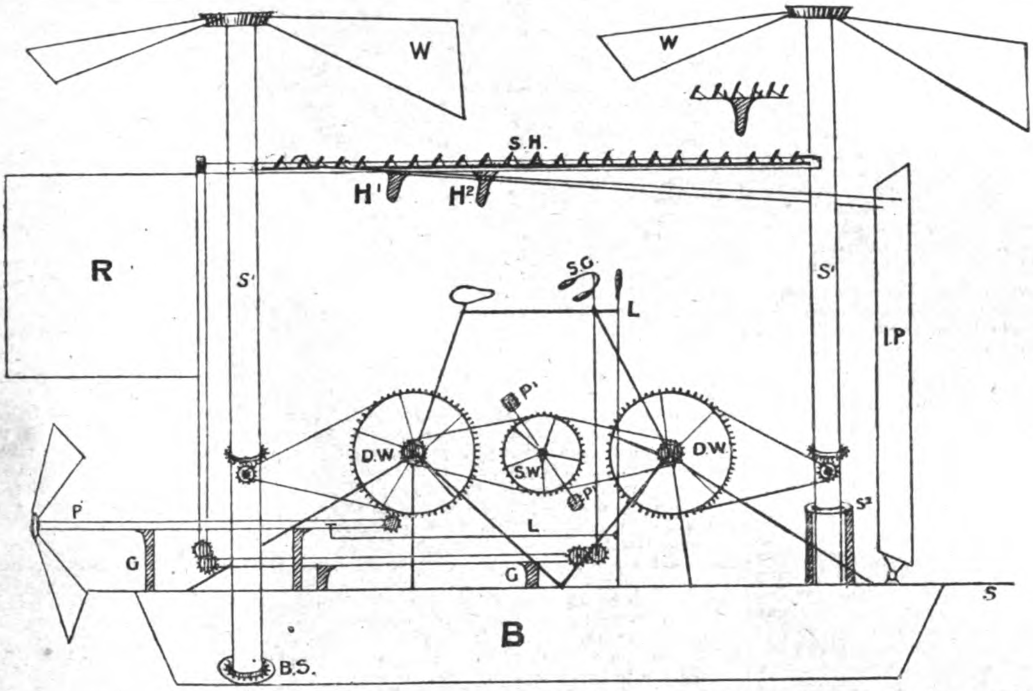
A familiar illustration of the above is the switchback railway. If there were no friction and no air to cause resistance, the two platforms at the ends might be on the same level, and the road between the two might be a succession of hills and valleys of any height or depth, provided the hills are not higher than the starting-point; then the car would arrive at the end with the same velocity with which it started, and no energy would be gained or lost.

Bath. M.I.C.E.

DENSITY AND SPECIFIC GRAVITY.

[43037.]—I am puzzled over the terms "density" and "specific gravity." By the latter term I understand the weight of a body compared with an equal volume (in case of liquids and solids) of water at 4° C. (gases) of hydrogen under similar conditions of temperature and pressure.

So far, so good; but I read in another textbook that "the specific gravity of a gas is its weight compared with an equal volume of air; the density of a gas is its weight compared with an equal volume of hydrogen." Now, the use of these terms seem to me loose and inexact. Both terms refer to the same quality or property, but using



B, body; B S, bottom of shaft; D W, driving-wheels; G, grooves for propeller and rudder shafts; G W, gear-wheels; H, hinges; H^1, handle for stays; H^2, handle for stay-holds; I P, inclinable plane; P, propeller; P^1, pedals; R, rudder; S, stays; S^1, shafts; S^2, socket for shafts; S G, steering gear; S H, stay-holds; W, wings or helices, each one at an angle of about 40°. I should have the body, wing and propeller blades, rudder, and inclined plane of aluminium; but all the other parts of steel, and it should not weigh more than 60lb., in my opinion.

different standards of comparison. Further, of the two terms "specific gravity" seems to be the most natural, since the property of weight is derivable from the action of gravitation.

Again, taking the term "density" in its common meaning—i.e., degree of closeness, I get a seeming contradiction of Avogadro's law. This law proposes that equal volumes of gases (similar temperature and pressure being assumed) contain the same number of molecules. Well, since "density" means the degree of closeness with which these molecules are packed, then all gases will be of the *same density*.

Thus, supposing we have a quart of each of the following gases—hydrogen, hydrochloric acid, carbon dioxide, and ammonia. Each measure contains, say, a million molecules. Then, since the molecules are equally closely packed, the densities of the four gases are the same. Their specific gravities are, of course, in the proportion 2, 36½, 44, 17, or, 1, 18¼, 22, 8½.

Again, with regard to molecule weights. Are these taken as the sum of the atomic weights, or half this quantity? That is to say, do we regard hydrogen as 2 or 1? Of course, the *proportion* is unaltered; but the actual number is. Hence, are the molecular weights of hydrogen and carbon dioxide 2 and 44, or 1 and 22? Will "Sigma" or other scientist kindly help? **Technicus.**

FLYING MACHINE.

[43038.]—Will you kindly publish this sketch of a flying machine in your paper, as I would like the opinion of some of your correspondents on it? **Roderick D. Hall.**

457, Rooley-lane, Bradford, Yorks.

A SIMPLE WATER-MOTOR.

[43039.]—Mr. Foreman's motor is practically the same as Bailey's "Thirlmere," and many others; but their consumption of water is considerable and power small. Water to work them would have to be paid for by meter, according to the usual conditions of supply; and at, say, only 1s. per thousand gallons the cost would soon mount up to pounds. I do not consider wood is a suitable material for any part of such a machine. **A. S. L.**

JIG FOR PLANING CLUTCH.

[43040.]—The following note on a method of making a jig for planing clutch is by Mr. Ned Wilson, writing to the *American Machinist*, and I think it may be useful to your readers. Mr. Wilson says:—

It looks queer in these times to see a man trying to make duplicate parts without jigs. I have a vivid recollection of a job of this kind which I had to do in a traction-engine shop. The engine was thrown in gear with drivers by means of the old-fashioned three-tooth clutch. The job was the planing up of about twenty of these clutches for stock. The foreman gave me a sort of an excuse of a jig, which, although it helped to hold the job, was absolutely useless for accurately spacing the teeth. The job is shown at Fig. 1, and the jig at Fig. 2. The work was to be planed by means of a side tool on the line *a b*, Fig. 1. The way I was compelled to do it was to first fasten Fig. 2 to the planer by means of a couple of bolts in the notches. Then I had to put the work on the boss *c*, and clamp it to the planer. After one face had been planed, the work was unclamped and turned about on the boss *c*. Then by a cut-and-try method the next cut was started so as to make it correspond to the sheet-iron templet, Fig. 3. The clutches made by this method nearly always had one tooth slightly larger than the rest. Consequently, the clutch

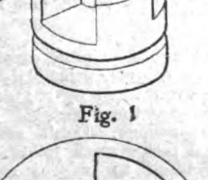


Fig. 1

Fig. 2

Fig. 3

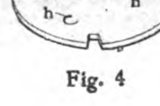


Fig. 4

drove with only one tooth. I asked the boss to let me make another part of the jig similar to Fig. 2, but larger. This part, shown at Fig. 4, was to be clamped to the planer bed and a hole drilled in Fig. 3 to fit snugly over the boss *d*. Three holes *h h h* were to be drilled in Fig. 4, 120 degrees apart, and a similar hole in Fig. 2 at *i*. The holes were then to be reamed to fit a taper pin. The work could then be clamped to the piece Fig. 2, and after the first face had been planed, it could be rotated and the pin inserted in the next hole. Such a jig would have shortened the time necessary to finish the job, and at the same time have made all the clutches alike. But the boss wouldn't listen to my scheme. He had always planed the tooth faces with the old jig, and he guessed it would do. It is needless to say that that boss got no more suggestions from me.

The jig question is a study of itself. The jig is as important a factor in a shop turning out new work as is the milling machine. I always proceed on the assumption that there is no job for which some kind of a jig cannot be devised. There are lots of jobs which necessitate a good bit of thinking before reasonably reliable jigs can be designed for them; but perseverance in the right direction will overcome the obstacle at last.

I send this mainly to wake up your readers, many of whom can give better hints than the above.

Springfield, Ohio. **C. P.**

USEFUL AND SCIENTIFIC NOTES.

The mileage run by trains on the London and North-Western Railway last year was 47,548,652.

With electric energy at 3d. per unit, it is calculated that an electric lift of the direct-coupled high-speed type can be operated on average duties in a block of offices, making, say, one hundred trips per day, and having a maximum carrying capacity of five persons, for a cost of 6d. per day, or 4d. per day if electricity is 2d. per unit.

According to a return recently issued with regard to flax culture in this country, the acreage has fallen off from 895 acres in 1898 to 465 acres this year. Lincolnshire has dropped from 109 to 20 acres, and Norfolk from 10 to 5 acres. Even the East Riding, the largest flax-growing country, has reduced its area from 258 acres in 1898 to 106 acres now.

The principal mining counties in the kingdom, whether judged by the mineral produced or number of persons employed are:—Durham, with an output of 34,737,347 tons of coal; Yorkshire, with 25,639,021 tons of coal, and 5,785,588 tons of iron ore; Lancashire, with 25,324,685 tons of coal, and 749,427 tons of iron ore; and Glamorganshire, which yielded no less than 19,140,742 tons of coal in spite of a strike lasting five months. The above figures are the official returns for 1898.

Instinct in Birds.—Dr. W. T. Greene, writing in the November number of the *Pall Mall Magazine*, remarks that within the last few years thrushes belonging to several species, and blackbirds, have greatly increased in London, no doubt in consequence of the secure retreats they have been able to discover in the parks; so that in some places their numbers are really considerable, in spite of the cats which persistently stalk them in the early morning, and disturb their repose at night, if they are foolish enough to roost among the bushes or on the lower branches of the trees. There is no doubt that birds, like other bipeds, gain wisdom by experience, and profit by it too; for I have noticed that the thrushes especially, but also the blackbirds, have taken to sleeping on the topmost boughs of trees instead of near the ground. No doubt the latter position was adopted in the first instance as the safest when hawks and owls abounded, but since these winged police have almost totally disappeared and cats have become the most dreaded enemy, the position chosen for sleep has been, or rather is in course of being, gradually changed.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96712.]—**Lantern Slides.**—Any good hand camera that will give a good picture for printing will do well for lantern slides. I use a Lancaster's "Stopit," magazine camera. You will find that the production of good lantern slides depends a great deal more on the operator than upon the camera.
S. Bottone.

[96712.]—**Lantern Slides.**—From your query I gather you have had little practice in photography, and as you want to take the photos the same size as lantern slide, I should advise you to get a ¼-plate focussing camera, and mark in pencil on the focussing screen the size of the lantern-slide mask, and before taking a photo arrange that the subject is the right size on the screen. I think it is better to take the photo the size of the plate you are using, and reduce in a lantern-slide camera, one of which can be bought at small cost. It is better to use ¼-plates than the 3¼ by 3¼ size, as the former are obtainable anywhere. The films used in the Kodaks are easily developed, and can be cut off and developed singly as exposed; but this causes waste of material, as when the film is cut it has to be again attached to the roller, and this operation wastes an exposure every time the film is cut, so that it is more economical to wait until the whole is exposed. I have had some experiences with both plates and roll films, and should advise you to use plates. There is no easy way of developing a negative as a positive, and even if there were the result would not approach the ordinary lantern plate for brilliancy and variety of tone. I think it was mentioned in the "E. M." some time since that a parallel ray is a practical impossibility. W. C. C.

[96712.]—**Lantern Slides.**—Each can only answer from his own experience. Mine, which has ranged over half a dozen cameras of varied makes, leads me to prefer the "Frena," advertised in "E. M."—that, in fact, is how I came to try it. Get the No. 1 lantern size, and learn to compose your slide on the finder. You have no further trouble when this knack has been acquired. Slides are printed by contact, which avoids fussing round when enlarging or reducing. Armed with one of these cameras, I made some hundreds of fine slides of street life in Paris, that travelled round England with a lecture, and were then sold at a good price.
H. H. S.

[96712.]—**Lantern Slides.**—Try Lizard's "Challenge" ¼-plate magazine, for plates or films, price 42s.; the address is 101, Buchanan-street, Glasgow. I have found it most reliable. I think you will find plates better than films; they are certainly easier to work, and are less expensive. You make your lantern-slides from ¼-plate negatives by contact printing. The difference in size (4¼ by 3¼ for the negative and 3¼in. by 3¼in. for the slide) allows of the latter being shifted in the printing frame so as to get the most pleasing effect. If it is too much trouble to print lantern-slides by contact, it is infinitely more difficult to get good snap-shot negatives, and if this is your first attempt at photography you had better start with a stand camera. Tylar, of Birmingham, if I recollect rightly, has plates for taking positives directly in the camera; but I think they are only suitable for time exposures. Read Ganot's "Physics," or other kindred works on light, which will, I think, answer the remainder of your query. Engineer.

[96712.]—**Lantern Slides.**—I should think Spiers and Pond's "A. B. C." lantern camera would meet your requirements. I have had a ¼-plate "A. B. C." in use for over a year, and am well satisfied with it. I would not advise you to touch films of any description unless you have had plenty of experience in photography. Kodak films can be detected and developed before the whole spool is exposed, but it is a ticklish jobs, and the case would have to be an urgent one to necessitate it. The principal objections to films are:—They are difficult to develop; more liable to defects than plates are; and more expensive. I do not know whether such a plate as you suggest can be devised, but there is not much demand for such a plate at present. You will find it the best way to make your slides in the ordinary manner.
Earlsfield, S.W. Silverplume.

[96730.]—**Curl in Photo Films.**—If you are referring to roll films, these should be given a soaking for one minute in a three per cent glycerine bath after washing, and then put aside to dry, removing any superfluous wet with a piece of blotting-paper. The films should be stored flat under slight pressure.
W. C. C.

[96934.]—**Motor Tricycle.**—It is difficult to tell without seeing machine cause of trouble. It may arise from leaky crank-case or screw-plug in same, or perhaps you keep vapour open too far. This tends to get motor very hot quickly. Something may be binding or galling, causing extra work on engine; hence the heating. Examine all bearings on engine or tricycle, especially ball-race next to engine. Try tricycle without engine on it. After, next see if eccentric bolt that carries engine in brackets has loose nuts. If this is case, engine will drop, and hang heavily on large spur gear-wheel, making it grind. The machines you mention are not water-jacketed, the tank you refer to being carburator, battery box, and reserve supply-tank combined in one case. You can get a Dion with a water supply made in form of a small copper coil outside cylinder, connected at top and half-way down, which is depth of jacket. This has a small relief valve on top. For a tricycle-motor water is not required ordinarily. The new French tricycle for next year is a water-cooled motor of 4½H.P., capable of doing 40 miles per hour; it works well.
Monty.

[96935.]—**Motor Cylinder.**—You should give more particulars. For a cylinder, it should be about 8 or 10 B.W.G., if it is good solid-drawn tube. I have seen some quite clean inside and out. If lap-welded, I am afraid you will have all your work cut out. If it is good, it will make a cylinder for an engine or motor. By your saying "motor," you mean for a car—i.e., oil-motor. At any rate, you will not bore it out, to make a job of it; but you must lap it out, and that can be done with a hardwood lap—Spanish mahogany, birch, beech, sycamore, plane-tree, or heart of oak. The lap will have to be 2½ times the length of the tube. About one-third of the length of the tube upon the lap should be slack, then two-thirds tight, and the rest slack, so that you can pass it over the brow to and fro to feed with No. 1 emery, if the inside is good; but if black and rough, No. 2. Finish with pumice-powder. But before you start grinding, see that your tube is true at the ends; if not, take a wooden mallet and dress it into shape over the beak of an anvil, and scrape the ends out bell-mouth, that it will not sheer the emery off. Let some plates into the end of your lap with good centres in, then a piece of iron about $\frac{3}{16}$in. thick and an inch square, with four or five ¼in. screws at the corners.
Jack of All Trades.

[96805.]—**Geological.**—It is quite probable that there is a fault, and the sea-water finds its way to the pump sump. It is a fact that salt water is found below 1,000ft. of chalk, that is about the only explanation—there is a rift in the chalk through which the sea-water finds its way. L. M.

[96938.]—**Question in Arithmetic.**—Lay out field with walks required. It will then be found there are four equal square portions ungravelled. The area of each of these squares will be the fourth part of 2½ acres—that is, 3,025 yards, and, therefore, the side of each square will be 55 yards or 165ft. But the wall of the inclosure is equal to the length of two squares and three walks, one at each end and one in the middle. Therefore, length of wall equal $2 \times 165 + 3 \times 13 = 369$ft., and length of four walls = 492 yards. Arithmos.

[96942.]—**Motor Tricycle.**—Crank cases frequently leak and cause trouble, principally from careless treatment received when apart; a dent, blow, or bruise will render them useless. Yours must be damaged somewhere. Don't use any packing at all, as in all motor work joints should be metallic—only blacklead to prevent seizing, though this would not happen with crank-case. Have it carefully examined, and put on mandrel, and very light cut taken off same; then put cases together on their own shaft, with spot of oil on, and work about to get a face. You may use a scraper lightly on hard lumps, but don't touch with a file. Back off bosses from thickness of case a one-sixty-fourth to outer edge, both sides. This will allow bolts to draw on faces only, and give it a better chance for tightening. All early cases were made with seven bolts, which was insufficient. It should run twenty miles at least with one charge of oil, which should not exceed two tablespoonfuls at a time. Monty.

[96954.]—**Motor for Car.**—The best carburator to use for car is Longuemare, which is essentially same as described by "Writer of Articles." These are better suited for a car than a tricycle, as you can only get one set mixture from them; whereas you can usually get an extra spurt out of Dion type for a short time by giving a shade more vapour. One reason for this is, as a rule this type of carburator when put on a tricycle is far too small, and wick surface is not sufficient to supply vapour fast enough. Make it twice as large as example given, and with a wick surface three times as large. You must supply the air for these heated up by exhaust, and don't forget that the hot-air supply pipe should be slightly larger than if ordinary air was drawn in. Your dynamo is too small for any practical use; you might charge accumulators in about a week with it, though if it has a Siemens armature with a two-part commutator it will be next to useless for charging purposes, owing to changes of potential. I described and sent sketch of a silencer that would suit you about two months ago, which you can get full particulars from. Monty.

[96962.]—**Multiple Wimshurst.**—To Mr. Bottone and "J. W."—Many thanks for replies. I find that the fault is not in the neutralising circuit. I mounted two glass plates with 24 sectors on each, and it excited at once. It does not appear to be the knotting (which is a mixture of methylated spirit and shellac, and, I am afraid, sometimes resin), although this was, as Mr. B. suggests, wet, this is a good non-conductor when dry. I have taken off the 15in. discs and cleaned as suggested, but without any better result, so that I am forced to the conclusion that it is the ebonite. Assuming this to be the case, it will, I suppose, be due to some substance in the composition of the ebonite that should not be present, and that is a conductor of electricity. What is it likely to be? and is it possible to get rid of it by treating the material in any way? On rotating the plates in the dark, I get very small sparks at the neutralising brushes, but this seems to be due to friction from a piece of string that I have between the plates to prevent them rubbing, for when I take the string away the sparks disappear. There was a slight error in the size of the sectors given; they are 4½in. long. My reason for putting so few was to get a long spark from the machine, and to avoid leakage to the bosses. I covered the sectors half-way up. I am not an authority, but it seems to me that in Mr. Bottone's machines the shortening of the sectors is partly nullified by there being so many of them creating leaking one to another. Will not more rapid rotation of the plates make up for a smaller number of sectors (when once excited)? Is not the width at the wide end of the sectors regulated by the distance they are apart at the narrow end? What I mean is, cannot you have any width (say from ½in. to 1½in.), providing you keep the edges of the sectors parallel? I have been very unfortunate with this machine. I started with glass plates, but have had no less than six plates out of eight fracture. It appears that the common glass is in a constant state of strain, and when the hole is cut in the centre the strain is partly released and ready to fracture the glass on the slightest touch; in fact, I have had plates go without being touched. All the fractures start from the centre hole—none from the outer edge. Could one have the glass annealed, or would this spoil its electrical efficiency? I find it is an advantage to bed the plates on the bosses on a soft bed of thin leather. F. W.

[96973.]—**Sand Blast.**—Tilghman's process for glass, &c., engraving:—A common fan is used, 30in. diameter, with 1,500 revolutions per minute, giving blast of air of pressure of about 4in. of water through vertical tube, 2ft. high by 60in. long, and 1in. diameter. See Dr. Ure's Dictionary, Vols. II. and III. Regent's Park.

[96983.]—**Steam Motor Waggon.**—1. The pressure is rather low for the purpose; 100lb. is not much use for a compound engine, and it is perfectly evident that as a single engine the power is much too low. By all means compound low-pressure cylinder, 6in. bore by 4in. stroke. 2. To enable the back wheels to take corners, some kind of differential movement is required; the usual plan applied to traction-engines is generally used, and (as I understand "E. D. T.'s" proposed arrangement) it would be best applied to the countershaft, from which I presume he means to drive his road-wheels by a chain to each. If he can manage it, it would be desirable to box in these, as they wear very rapidly if unprotected. 3. Nothing equals the "Ackermann" system for locking the front wheels. Almost all the heavy motor vehicles, as well as the light cars, are so fitted; but it requires great care in design. "E. D. T." ought to carefully examine a heavy motor waggon if possible; but, briefly, each fore-wheel runs on a stout arm, which is hung in a horizontal knuckle-joint. 4. The *simplest* form of speed gear is one arranged like the back gear of a lathe. I do not say this is the *best*. The sizes of the wheels must depend on circumstances, and can be easily calculated from any mechanical pocket-book of tables. Bear in mind, however, that small pinions are as far as possible to be avoided. 5. As to load, two tons is as much as "E. D. T." will be able to *economically* manage if he has gradients of 1 in 6 to negotiate. 6. Fletcher, "Steam on Common Roads," back numbers of *The Automotor Journal*, in which see also Mr. Thorneycroft's article on the subject read before the British Association at Dover (in the October number, I think), and also see the August number for the Liverpool trials; Farman's "Autocars," Wallis Tyler's "Motor Cars," and many others. If "E. D. T." can obtain access to the back numbers of the English Mechanic, he would also find several steam carriages. In conclusion, if "E. D. T." will advertise his address, I should be able to go far more fully into the matter. Precursor.

[96989.]—**Polish for Brown Shoes.**—Waterproof:—Garnet shellac 7lb., methylated spirit 3½ gallons, Venice turps 2½ gallons, castor-oil 6oz., camphor 2lb., yellow spirit aniline 1lb., oil of cassia 1oz. Add spirit to shellac in mixer, dissolve; add

turps, camphor, castor-oil, rub up aniline in spirit till smooth; add this to mixture, run all day; add oil of cassia, leave to settle for one day, draw off, strain, and bottle. Add or reduce quantity of colour, according to the shade required. Brown or yellow tan cream:—Turps 2 gallons, distilled water 2 gallons, yellow beeswax 4½lb., castile soap 8oz. Yellow aniline colour (water), or for darker shade use Bismarck brown, 8oz. Melt beeswax, add turps, then soap (dissolved in two gallons of boiling water, distilled), with colour well mixed in, pouring in gently, well stirring until cool; then tin or bottle off. Or yellow beeswax or part ceresine 17lb., yellow aniline dye 1oz., turps 2 gallons, oil of citronelle 3oz. Melt wax, rub up colour with a little turps, and add remainder of turps to wax. Now stir in colour (have very little heat on copper), add citronelle, stir well for quarter of an hour, turn off heat, stir till cold, fill off with knife. Or, beeswax 4lb., turps 1 gallon, water 3 gallons, pearlash 2oz., soft soap 4lb., Bismarck brown 2oz. to 3oz. Melt wax, add turps; have water, soap, pearlash, and coloured mixed and boiling, pour wax and turps on top of water; stir till cold. Or, beeswax 6lb., ceresine wax (yellow), 2lb., turps 2 gallons, washing soda 24oz., Bismarck brown 1½oz. Melt waxes, add turps, dissolve soda in water, add colour, well mix, add to melted waxes and turps; stir well, and fill off hot. REGENT'S PARK.

[96992.] — **Petroleum-Drinking.** — L. Lewin has investigated the action of petroleum, and he has come to the conclusion that it is a poison, showing irritation and inflammation of the stomach, lacerations at bottom of stomach and vessels, and prominent black spots or points filled with blood on the mucous membrane of the stomach. Petroleum vapours when inhaled are not poisonous, injurious effects being produced only under extraordinarily bad external and individual conditions. Skin diseases are, however, of frequent occurrence among workmen handling petroleum, especially the heavy oils, and hence the utmost cleanliness and frequent warm baths are advised. Skin diseases appear as acne in forms on thighs, knees, arms, trunk, neck, face, ears, scrotum; as a rule only caused by heavy oils. Officinal petroleum reddens skin, causing scaling off, and hair to fall out; the action is weaker than that of oil of turpentine. The hair, however, grows again rapidly. Taken internally in excessive doses, it has caused oppression, giddiness, palpitation, faintness, and headache. Absorbed by the blood it acts similarly to oil of turpentine. It kills tapeworm, lice, &c., but does not destroy bacteria. Preferably used in veterinary practice. See W. T. Braunt on "Petroleum" (S. Low and Co.)
REGENT'S PARK.

[97006.]—**Metallurgy.**—Prior to the invention of puddling (circ. 1784) the conversion of cast-iron into wrought-iron was uniformly effected by a process which, though differing markedly in certain details, yet in all cases essentially consisted of exposure to oxidising atmosphere and agitation until practically all the carbon and silicon, &c., was removed. As the iron becomes purer its fusibility lessens, so that ultimately it collects into pasty semi-solid masses, which, when united together, form a ball, which is taken out and forged into a bloom. The ancient bloomeries and the blast furnaces of the present-day primitive iron workers—those of India, Burmah, China, Borneo, Africa, &c., as well as the Corsican or Catalan furnace, still used in the Pyrenees and other part of Southern Europe—are all of very small height, not merely low on account of the smallness of the charge, but very low even in proportion to this. Their height but slightly exceeds their breadth. The reason were and are only used for the reduction of the richest and purest ores by means of nearly pure carbon—i.e., wood charcoal, &c. See "Encyclopedia Britannica," Mattieu Williams, Crookes, and Rohrig and Fairbairn, &c. REGENT'S PARK.

[97009.]—**Cleaning Paper.**—F. Andrews places one or two papers at a time in shallow dish, pours water over them till saturated; then carefully pours off water, pours on prints solution of chloride lime, 1 of Cl to 39 of water. As a rule, stains go off; if not, he pours on spot pure liquid calcis chlorate; and if this is not quite effectual, adds a little dilute nitromuriatic acid. Has never failed. If anything, they become too white. As soon as clean, carefully wash with successive portions of water until all chlorine is got rid of. Then place in very weak solution of isinglass or glue, and many collectors colour this solution with coffee-grounds to give a yellow tint. Dry between folds of blotting-paper either in a press or under a heavy book, and, finally, ironed with flat-iron to restore glass, placing clean paper between iron and print. For grease stains, benzine best, French chalk powdered over, a piece of clean blotting-paper over chalk, and work over that hot iron. REGENT'S PARK.

[97009.]—**Cleaning Paper.**—If the paper is merely surface soiled, probably rubbing over with a bit of bread will clean it sufficiently. If not, make up a solution of chloride of lime, and dip the sheets in that; then afterwards in water that has been boiled. The chloride of lime will flush all the dirt that is likely to be on the paper, but it must be washed out carefully afterwards by soaking in boiled water, and then drying. M. T.

[97012.]—**Accumulators.** — You do not say whose make of cell you are using; but after being fully charged the cell should discharge 12 ampères for 10 hours at 2 volts. The specific gravity of acid should be 1,190. The cells will take a charge and discharge with acid of a lower density; but years of experience have proved that the above specific gravity is the best.

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[97012.]—**Accumulators.** — (1) Depends altogether upon the type of cell; roughly, about six ampères for 20 hours. (2) The specific gravity of the uncharged cell should be 1·190; when charged, 1·2. (3) Not satisfactorily. Any great variations, either above or below the correct specific gravity, will destroy the plates, and necessitate repasting.
W. J. G. FORMAN.

[97012.]—**Accumulators.**—You do not mention the type of cell, so that it is not easy to say the ampère hour capacity. Roughly speaking, about 36 ampère hours. If these cells are coupled in series, the volts increase by 2 for every cell, while the discharge capacity remains the same—viz., 36 ampères for 1 hour, or 1 ampère for 36 hours. But if any number of cells be coupled in parallel, the voltage remains 2, but the amp.-hr. capacity increases directly as the number of cells so joined up; hence 2 cells = 72a.h., 4 cells, 144a.h., and so on. The specific gravity of acid should be 1·190. This can be got by mixing 4 parts by measure of good brimstone oil of vitriol (sp.g. 1·84) with 21 parts of water. The cells will work even when the specific gravity of the dilute acid is lower or higher than this, but not so well. Take the sp.g. of your suspected acid by means of a proper hydrometer, and add water or acid until it registers the right sp.g. When the cells are fully charged electrically, the sp g. rises to 1·200 or 1·210. S. BOTTONE.

[97013.]—**Ice Storage.**—1. Build round brick wall with small grating for drain at bottom for escape of water from melted ice; cover the bottom with a thick layer of good wheat straw; pack the ice in layers of ice and straw; fix a wooden cover to well. 2. Firebrick lining to walls circular shape, larger at top than at bottom, where drain should be provided. Some make of wood, double lining with core of insulating material. If in Gray's Inn-road, look in at one of manufacturers on east side opposite Gray's Inn, corner house. REGENT'S PARK.

[97017.]—**Gas v. Steam.**—We have no hesitation in saying that a gas-engine is far preferable to a steam-engine for the small power you require. Assuming you use 6cwt. of coals per day of eight hours at 18s. per ton, will amount to about 5s. 6d. Now, a good gas-engine consumes 22c.ft. to 24c.ft. of gas per H.P. per hour, 24 × 8 × 8, at 4s. 2d. per 1,000, = 6s. 4d., which is 10d. per day more for gas consumed than cost of coal; but against this extra cost of 10d. per day you save a boiler, stoker's wages, wear and tear of boiler and brickwork setting, cost of water, and cost of carting away ashes. Moreover, the greatest advantage of all is that a gas-engine is ready to start in three minutes, and when done with no further waste of fuel occurs. We are makers of both gas and steam-engines, and use both, but never steam if we can help it. Our candid opinion being, after years of experience with both gas and steam, that for any power under 100H.P. gas is far preferable and much cheaper, all things being considered.

WEBSTER MICHELSON AND CO.
Dudley. Electrical Engineers.

[97017.]—**Gas v. Steam.**—Taking Otto gas-engine as good type:—Revs. per minute 160·10, explosions per minute 78·40, mean initial pressure 196·9, mean effective pressure 67·90, I.H.P. 17·12, brake load net 177·40, B.H.P. 14·74, mechanical efficiency ·861. Gas per hour, main, 351·80; ignition, 3·50; total, 355·30. Gas per I.H.P. per hour, main, 20·55c.ft.; gas per I.H.P. per hour, total, 20·76c.ft.; gas per B.H.P. per hour, main, 23·87c.ft. Steam: 1lb. of good coal will evaporate 9lb. water raised to 212° Fahr. Total heat of combustion of coal is—

		Units of Heat.
Carbon 14,500 × ·80	=	11,600
Hydrogen 62,032 × (05 − ·08 8)	=	2,481
Sulphur 4,032 × ·0125	=	50
Total		14,131

The consumption of coal per I H P. per hour in first-class triple-expansion surface condensing engines is about 1½lb., in double-expansion condensing engines from 1¾lb. to 2lb., in single-cylinder condensing engines 2½lb. to 3lb., in locomotives 2½lb., in high-pressure non-condensing simple engines 3lb. to 4lb. By dividing the 14,131 previously given by units of heat to convert 1lb. water of 212° Fahr. into steam of same temperature (14,131 ÷ 966) there shows 14·63 units of evaporation, or 14·631b. evaporated from and at 212° Fahr., a possible aid. REGENT'S PARK.

[97017.]—**Gas v. Steam.**—I should strongly advise you to use a modern gas-engine, say, National, Crossley, or other good make, which would consume average about 15c.ft. per horse-power per hour, and require no further attention, is ready to start at a moment's notice, and has other obvious advantages too numerous to mention. With gas at price you mention, the steam-engine would cost about same; but from the commercial point of view, at end of twelve months you would be pounds in pocket by use of gas-engine. The Fielding new engine is another type that is giving excellent results for consumption and steady all-round working. For intermittent work a steam-engine cannot compare with gas for any size or power. MONTY.

[97019.] — **Wireless Telegraphy.** — To MR. BOTTONE.—If you can erect metal rods, both at the sending and receiving ends, to clear the tops of the intervening houses by about 10ft., a coil giving 1in. spark, with sparking balls about ½in. apart, will do nicely. You can make a coherer by procuring a piece of glass tube about 1in. long $\frac{3}{16}$in. bore, and fitting it with a well-fitting cork at each end, through which must pass a piece of silver wire. In the tube put rather coarse nickel and silver filings. Dry the tube carefully over a gas flame before introducing the filings. Then work up, taking care that the filings do not quite fill the tube, so that they can move freely. Seal up the ends with sealing wax. It would be better if the tube were exhausted and sealed with a blowpipe, but I am afraid you could not manage this. The vacuum prevents the filings rusting, but the plan given above answers very well, and for a long time. Besides it is easy to change the filings if this do rust. A good dry cell or two should be placed in circuit with relay wires and coherer. A 10ft., D 10ft., B two larger balls 2½diam., two smaller 1in. diam., C, already given, E, cores ⅜in. diam., 1½ long, wound with 2oz. of No. 36 silk-covered wire. S. BOTTONE.

[97020.]—**Dynamo.**—To MR. BOTTONE.—Using fields of the shape you indicate at B, standing about 5in. high, 4in. wide, with cores and yoke of about ⅝in. substance, with tunnel bored out in pole-pieces $2\frac{1}{16}$in. diameter by 2in. deep, you will get the best results from a tripolar laminated armature 2in. diam., 2in. long, fitted with a tripartite commutator. This will enable you to charge accumulators, &c., if shunt-wound. For the armature, use about ¼lb. No. 22 d.c.c., and for the field-magnets about ½lb. No. 24 d.c.c. S. BOTTONE.

[97021.]—**Bromide Printing.**—Try longer exposure. The print should be fully developed in less than five minutes, or it is greatly under-exposed. If you are a beginner you cannot expect to get on with ferrous-oxalate. Buy another packet of paper and develop a print on a fresh sheet. This will prove whether your developer is contaminated or not.

Earlsfield, S.W. SILVERPLUME.

[97021.]—**Bromide Printing.**—"Faineant" has succeeded in "fogging" his paper as one would a plate, or, even more probably, does not wash it properly before fixing. If paper is of good make and has not been stored in damp or over-heated place, age would make little or no difference. I am now using with perfect success, amongst other papers, some "Barnet" rough bromide paper which is five years old at least, and has been knocking about the world with me ever since. It has undergone a sea-voyage three times without special packing, which goes to throw doubt on "Faineant's" methods. At first I used to have the same sort of trouble, but a friend came along and said: "You lack the necessary forces"—i.e., four C's = double care and double cleanliness. After many trials I now work only with the following metol developer, with which any tone can be got at will.

Metol Developer.

(A)	Metol	400gr.
	Sodium sulphite	8oz.
	Potass bromide	50gr.
	Water	80oz.
(B)	Potass carbonate	8oz.
	Water	80oz.

Take 3oz. of A and 1oz. of B. The image should appear in a few seconds, and development will be complete in about two minutes. Rinse in at least three changes of water and fix in ordinary fixing bath (no acid bath is necessary with this developer). To produce softer results dilute with an equal quantity of water. After fixing, wash thoroughly in several changes of water for at least two hours, squeegee off the superfluous moisture, and hang up to dry. H. H. S.

[97021.]—**Bromide Printing.**—May be stale paper; expose fully, developing with a strong solution, so that the operation may be completed in a short space of time. Remove your ruby light only after fixing, then disperse stain or surface fog with a weak solution of potass ferridcyanide.
J. P. N.

[97022.]—**Metric System.** — "Inquirer" has only to multiply the number of square yards in the triangle by ·8361259, and the product will be its

area in square mètres. Call the sides A, B, C, multiply them by ·22 to bring them to yards. Thus—

A = 1,660 links = 365·20 yards
B = 1,454 „ = 319·88 „
C = 1,372 „ = 301·84 „

Add them together, divide their sum by 2, and call the result S. Thus S = 493·46.

From S subtract A, call result D = 128·26
„ S „ B, „ E = 173·58
„ S „ C, „ F = 191·62

Multiply S by D by E by F, call the product G. Thus, G = 2,105,153,211·391. Extract the square root of G, and call the root H. Thus H = 45881·9486 square yards. Multiply H by ·8361259, product = 38363·0856 square mètres = 3·8363 hectare. Note.—·8361259 is the new coefficient determined by the order of the Board of Trade in 1896. E. N.

[97023.]—**Engraving Tools.**—Two or three drops of alcohol to almost pure glycerine. Temper in mercury or lead; lead lessened about ¼in. Instrument made light red hot is pressed into cut; melted lead then surrounds it. REGENT'S PARK.

[97024.]—**Horse-Power.**—Nearly 1¼I.H.P. at 30lb., 3 at 60lb., and 6 at 120lb. boiler pressure.
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[97024.]—**Horse-Power.**—30—3lb., 62,000ft.-lb per min.; 66—3lb., 130,930ft.-lb. per min.; 120—3lb., 263,760ft.-lb. per min.; 3lb. allowed on boiler pressure for friction; 33,000ft.-lb. equivalent to 1H.P. Above approximations should be reduced by about 10 per cent. for clearance volume of cylinders and steam passages.
Sevenoaks. F. SEA.

[97027.]—**To "M.I.C.E."**—A chapter on the calculus of variations will be found at the end of Todhunter's "Integral Calculus"; in this there are other works on the subject named, should you wish to pursue the study. The "Calculus of Operations" is, I think, another name for the symbolic method, which you will find explained in Boole's "Differential Equations," Chapter XVII. The curve of sines must be represented by y = sin. x.
Bath. M.I.C.E.

[97027.]—**To "M.I.C.E."**—I do not think that an easy book upon calculus of variations exists, unless there should be an American one in Messrs. Ginn and Co.'s list. As to calculus of operations, the symbol *sin.* may be looked upon as an operator changing x into sin. x, and y into sin. y. D or $\frac{d}{d\,x}$ may be looked upon as an operator changing y into $\frac{d\,y}{d\,x}$, and so on. In so far, then, as these operators are found to obey the laws of algebra, they may be manipulated like algebraical quantities to the great abbreviation of certain sorts of work. Example:—Suppose we wish to integrate e^{mx} cos. $n\,x$—that is, we want $\frac{1}{D}$ (e^{mx} cos. $n\,x$) where D is the operator $\frac{d}{d\,x}$. Now this operator is clearly made up of the two operators $D_1 + D_2$. Where D_1 affects only e^{mx} and D_2 affects cos. $n\,x$, so that—

$$D_1\ e^{mx}\cos.\ n\,x = m\,e^{mx}\cos.\ n\,x$$
$$D_1^2\ e^{mx}\cos.\ n\,x = m^2\,e^{mx}\cos.\ n\,x$$
$$D_2\ e^{mx}\cos.\ n\,x = -\,n\,e^{mx}\sin.\ n\,x$$
$$D_2^2\ e^{mx}\cos.\ n\,x = -\,n^2 e^{mx}\cos.\ n\,x$$

and so on. Now what we require is—

$$\frac{1}{D_1 + D_2}\,(e^{mx}\cos.\ n\,x)$$

That is— $$\frac{D_1 - D_2}{D_1^2 - D_2^2}\,(e^{mx}\cos.\ n\,n)$$

That is— $$\frac{D_1 - D_2}{m^2 + n^2}\,(e^{mx}\cos.\ n\,x)$$

That is— $$\frac{e^{mx}}{m^2 + n^2}\,[m\cos.\ n\,x - n\sin.\ n\,x]$$

This takes some time to explain, but is easy in reality, and when once understood enables you to do in your head a most inconvenient piece of integration, and so affords a fair illustration of the elementary use of operational calculus. For curve of sines take a book of four-figure logs., such as Bottomley's, and write down three columns of figures as follows: The first column is headed *angle in degrees*, and contains the numbers 0, 5, 10 . . . . up to 360; the second is headed *angle* in radian measure, and contains the numbers found in the tables to correspond to those in column one; the third is headed *sine of angle*, and contains the sines found in tables to correspond to angles in first column. If, now, a curve be plotted on squared paper by points having the numbers in second column for abscissæ, and those in third column for ordinates, a part of a sine curve will be obtained. The complete sine curve is the unending wavy line made up of such parts tacked on one after the other, and its algebraic expression is y = sin. x. The use of radian measure is not all-essential, but it is the way to get the scale right. QUIVIS.

[97028.]—**Honey.**—In reply to "Merchant," Dr. Hassall gives the following as the results of the analyses of three samples of honey:—

	Per cent.	Per cent.	Per cent.
Water	17·48	16·88	13·63
Cane sugar	none	1·82	5·29
Glucoses	82·50	81·00	81·04
Insoluble matter	trace	trace	trace
Mineral matter......	0·02	0·30	0 04
	100 00	100·00	100·00

BAZIN.

[97028.]—**Honey.**—Honey contains three distinct sugars—sucrose $C_{12}H_{22}O_{11}$, glucose (dextrine or grape) $C_6H_{12}O_6H_2O$, lævulose (fruit-sugar) $C_6H_{12}O_6$. The flavouring (essential oils) will vary according to source—i.e., according to what flowers are most prevalent where the honey was obtained. Pure honey should answer to the following tests:—When incinerated it should not leave more than 0·25 per cent. of ash, the solution of which ash in water should yield, when acidulated with nitric acid, but a slight turbidity with a solution of barium chloride (absence of more than traces of sulphates). The same solution should yield no reaction with iodine (absence of starch).
Jersey. J. SINEL.

[97028.]—**Honey.**—A good sample may give thus: Water, 22·0; crystalline glucose (dextrose), 38·0; vitreous glucose (lævulose), 36·0; mineral matters, 0·2; wax, pollen, gluten, essential oil, colouring matter, 3·8; total, 100·0.
REGENT'S PARK.

[97029.]—**Pumping Boiling Water.**—How shall a pump lift "boiling water"? If the water is boiling it will fly into steam when the pump produces a vacuum, and how, then, can the pump lift water? What has a "farmyard boiler" to do with it? The principle is the same with any boiler. Boiling water must be forced, not pumped. How long the leathers will last depends on circumstances.
M. T.

[97028.]—**Pumping Boiling Water.**—Should think not much, but have valves fitted to pump such as brewers use. REGENT'S PARK.

[97029.]—**Pumping Boiling Water.**—An ordinary lift pump will pump the boiling water once, provided boiling liquid ran into pump—i.e., pump and valves must be on a lower level, as if on higher, vapour given off will destroy vacuum. You must substitute vulcanised fibre for the leather all round. After using hot water and allowing it to cool, leather would set like iron. MONTY.

[97029.] — **Pumping Boiling Water.** — To pump water is to lift it from a lower level. No pump in the world will pump boiling water—i.e., lift boiling water from a lower level.
WEBSTER MICHELSON AND CO.
Dudley. Electrical Engineers.

[97030.]—**Dry Cell.**—I have tried nearly every dry cell for this purpose, and find practically no difference. Any good cell that had long life with a bell, such as the Obach, the Hellesen, the E.C.C. (Burnsley patent), the I.E.C., and the "British" does well. Latterly I have been using the last named, and find them give me every satisfaction. I do not know the exact composition of the paste in the Obach cell. S. BOTTONE.

[97034.]—**Trellis.**—Should think there was less pressure per square when expanded than when closed. REGENT'S PARK.

[97036.]—**Position of Planets.**—A diagram of the position of the planets for the middle of November was printed by the British Chronological and Astronomical Association. From this "Neptune" can easily determine their positions at any other time. They are depicted in the signs of the Zodiacal circle. The diagram can be had gratis from Observatory House, Wanstead, E., on receipt of a stamped envelope. J. B. DIMBLEBY.
Observatory House, Wanstead, E.

[97037.]—**Copying Drawings.**—Soak drawing or tracing with benzine by means of cotton pad; makes it very transparent. Indian ink, colour, pencil take equally well upon paper thus treated. Any opaque drawing paper answers stretched over drawing to be reproduced. The benzine rapidly evaporates. REGENT'S PARK.

[97039.]—**Colouring Oil.**—Iodine and sulphur suggested. REGENT'S PARK.

[97040.]—**Solio Paper.**—The best thing you can do with them, if you can print fresh ones, is to throw them away and done with it. If, however, you can obtain no more, you may try leaving them in the hyposulphite solution all day; or until sufficiently reduced; but the result will hardly be satisfactory. Another method is to add two drops of a solution of potassium ferricyanide (poison) to a weak hypo. solution; immerse the prints one at a time, and take them out quickly when light enough and well wash. Be careful. Do not expect to get expect to get excellent results.
Earlsfield, S.W. SILVERPLUME.

[97041.]—**Motor Bicycle.**—I cannot waste the time over what I know to be a useless article—to wit, a motor bicycle. I have seen and tried four different ones and found them far inferior to a tricycle, and too prone to side-slip in wet to my liking. As to a motor for same, there is a Coventry firm advertising week after week in this paper sets of ¾H.P. Dion castings, everything complete about £4. These have cylinders 2⅝in. diameter by 2¾in. stroke, and should suit your purpose; but you will find there is absolutely no end to wants when you start to make one, so that I feel sure you could buy one cheaper if you advertised for one in any of the papers devoted to motors. At outside you could get one for £15, perhaps less from some weary individual. To make drawings of complete machine would mean ten or fifteen different drawings, and would take some time, which I have not at my disposal at present. MONTY.

[97043.]—**Flue Tubes, &c.**—All water contains certain amount of air, and consequently oxygen, &c., very active in corroding. It can generally be remedied by scraping and cleaning with solution of soda. Many lubricants decompose at 220° Fahr., and numerous cylinder oils at 33° Fahr., forming compounds which combine with mineral substances precipitated in boiler, and form soft greasy deposit containing from 60 to 85 per cent. iron oxide, lime, silica, magnesia, iron, zinc, and 15 to 40 per cent. of oil. Some of this forms scum, remainder settles at bottom as sludge. Deposit frequently carried into cylinder, forming black paste, gets baked on ends on piston, causes wear and scouring, &c.
REGENT'S PARK.

[97046.]—**Steam Exhaust.**—The only way is to surround the exhaust with a constant flow of cold water—in other words, take the exhaust steam into a condenser. It is a troublesome business, because if anything is done to condense the steam as it issues after doing its work there is "back pressure," which is an important "item" in steam-engine economy. Possibly the exhaust steam might be utilised in some way, for while water is in the condition of steam it contains heat, and that should not be wasted, if it can be utilised in any way. The querist must have a condenser if the steam is not to be seen. M. T.

[97046.]—**Steam Exhaust.**—Heat feed-water; by this water-heater you may save 10 per cent. See Hutton, "Steam-Boilers." REGENT'S PARK.

[97047.]—**X Ray.**—To MR. BOTTONE OR OTHERS.—Using the jars on, and taking the current from the outsides of the jars, the dischargers being set at about 1in. apart, you will be able to work nicely a tube that would require a 6in. spark from a coil to work it. There is no difference between the prices of a 3in. and 6in. tube. If of the old Jackson type, the price will be about 15s.; if of the bianodic type, 30s. A 3in. tube will show the bones in a man's leg. See my book on "Radiography."
S. BOTTONE.

[97048.]—**Fluorescent Screen.**—Procure some good crystallised calcium tungstate. Procure also a copper gauze sieve, or similar, having 60 meshes to the inch linear. Get a sheet of stout Bristol board, 12in. by 9in. Pin it flat on a drawing-board, and with a wide camel-hair brush dipped in good clear gum-water go carefully over the surface, so as to put on an even coating, without bubbles. Now sift over the surface, from some height, sufficient tungstate to cover evenly the gummed surface. When quite dry, shake off the superfluity, remove the pins, and mount the screen in a frame.
S. BOTTONE.

[97049.]—**Ohm's Law and Decrease of Voltage.**—J. Brown does not appear to have "grasped the principles of Ohm's law." How does he make out that "the voltage would remain the same if the current was transmitted one thousand miles or only one mile?" It is just here that he is wrong, as there is no known substance which will permit the electric current to pass through it without offering some resistance. Hence the formula $C = \frac{E}{R}$ is absolutely correct, and no further investigation can be needed. It stands to reason that the greater the distance through which the current is transmitted the greater is the resistance, consequently E may have to be divided by so many multiples of R as the case may be, and C diminished in corresponding ratio.
Clapham. J. H. WEBSTER.

[97049.]—**Ohm's Law and Decrease of Voltage.**—You are quite right, and Ohm's law still holds good, notwithstanding the muddle which some people make by talking of lost volts, &c. If your source of current had a voltage of 1 volt and your circuit a resistance of 1,000,000 ohms, the volts are still 1, but the current in ampères cannot exceed $\frac{1}{1000000}$. You must remember, however, that the word potential is very often used to indicate the working energy of the current. And, since this is

equal to volts multiplied by ampères, it follows that the potential differences at the farther extremities of a long circuit presenting much resistance must be considerably less than at any points nearer the source where, of course, the resistance is less.

S. BOTTONE.

[97049.]—**Ohm's Law.** — Assuming that the words "competent reader" are only meant to exclude—we all know whom—I will try to clear up J. Brown's difficulties, which are clearly those of a beginner. The earliest electrical notion is that of electrification, as the state of a piece of freshly rubbed amber or sealing-wax. The second in logical order is to make "electricity" into a measurable quantity by the help of the inverse square law. In this way the definition of unit quantity of electricity is implicitly involved in the statement that two unit charges concentrated upon tiny bodies separated by one centimètre distance in air repel each other with a mechanical force of one dyne. We then pass to the difficult conception of potential, which I shall not try to explain here. It is a quantity that varies from point to point in very much the same sort of way as that in which height above sea-level varies. All along a level road the height above sea-level is constant, and all over an electrical conductor in which there is no current the potential is constant. Further, just as it is much easier to find the difference of level between two inland points than the height of either of them above sea-level, so it is much easier to determine the difference of potential between any two points than to assign a value to the potential of either; the name given to such a difference of potential between two points in the voltage between those points—for instance, between the copper and the zinc of a Daniell cell the potential difference or voltage is about 1·1 volt. We are now coming to Ohm's Law. When two places at different potentials are connected by a wire, a current passes to equalise the potential; but only a transient one, unless some apparatus is at hand (such as a battery or dynamo) for maintaining a difference of potential. A current such that one coulomb of electricity passes each point of a wire in a second is called one ampère. Note that a coulomb is the ordinary practical unit of electricity, and is a very high multiple of the electrostatic unit mentioned above. Ohm's law expresses the experimental fact that the number of ampères that go through a wire is directly proportional to the voltage applied between the ends of the wire—i.e., if you put on twice as many volts, you get twice as many ampères, and so on. I think that if J. Brown can make out the above, he will see that the writers of books are not so muddleheaded as he imagines. At any moment the current must be the same all along a wire, or else the electricity would be heaping up in the middle somewhere, so the ampères must be the same everywhere; but as the potential in the wire has to drop from the high value one end to the low value the other, through the amount of the voltage, there must be a steady fall all down a uniform wire, and there is no meaning in saying that the potential always remains the same, and still less in charging Ohm's Law with supporting such a heresy. If $C = \frac{E}{R}$, shows that E remains constant. I suppose $\frac{1}{R} = \frac{C}{E}$ would show that C remains constant, and so on; but of course this is mere fooling.

QUIVIS.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96598. Self-Sustaining Gear for Hoist, p. 98.
96610. Motor Roller, 98.
96612. Silver Wash, 98.
96613. Motor Waggon, 98.
96617. Telephone, 98.

96779. Boiler, p. 192.
96780. Irish Degrees, 192.
96782. Magneto Ignition-Gear, 192.
96783. Motor, 192.
96784. Grate Front, 192.
96786. Motor-Car, 192.
96788. Railway Waggons, 192.
96789. Sundial, 192.
96795. Marine Condenser, 192.
96797. Motor-Tricycle, 192.
96807. Motor-Cycles, 192.
96811. Converting Objective, 193.
96818. Square Thread, 193.
96821. Ignition, 193.
96822. Flashlight for Interiors, 193.
96824. Pains in Head, 193.

THE total value of the gold production of the Transvaal in 1898 was £16,240,830, and the working expenses amounted to £11,489,752.

QUERIES.

[97053.]—**Carbon Paper.**—I wish to make a quantity of carbon transfer paper, as used for duplicating writing. Will someone oblige with recipe of composition, and method of application?—H. H. Z.

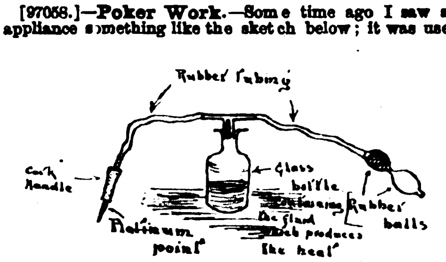
[97054.]—**Mandoline.**—Will some reader inform an amateur how to make the belly of a canoe-shaped mandoline?—F. SMITH.

[97055.]—**Californian Grape Growing.**—Can some reader give me any information. Yield, average, per acre of good selected vines of well-established growth? Number of plants per acre? Cost of raising, gathering, curing, and packing the fruit? Usual quantity contained per "box," as quoted in wholesale produce price lists of nearest towns? Price obtained on the spot per box? Whether irrigation is working successfully? And if grape growing is likely to be permanently established as at all a profitable industry? The British Consular reports are very feeble efforts. What reliable literature on the subject? I refer to existing vineyards, not to prospective ones on virgin soil.—LINCOLN FARMER.

[97056.]—**Xylonite.**—Would any reader be good enough to tell me how to polish xylonite? Also the best way to fix it on wood—whether glue would do or not, or whether there is any special cement for the purpose?—T. HENRY.

[97057.]—**To Mr. Bottone.**—I have an induction coil which is working very badly, and, I fear, leaking heavily. The length of the coil is 5½in. winding space, and the outside diameter is 3in. At present I can only get a ⅜in. spark when using three quart chromic acid cells. I think of rewinding it, and would you kindly tell me the gauge of wire for primary and secondary, and how much to put on, also the length of spark it should then give?—INDUCTION.

[97058.]—**Poker Work.**—Some time ago I saw an appliance something like the sketch below; it was used



for doing poker work. Could any reader inform me, in detail, how to make a similar appliance?—LITTLE WILLY.

[97059.]—**Celluloid.**—I should be pleased if any of your readers could inform me, or refer me to any book containing the information, as to how celluloid is prepared commercially, and how it is moulded into shape? also where I could obtain information as to the nature, properties, cost, &c., of vasco id?—NITRO-CELLULOSE.

[97060.]—**Alpha Orionis.**—Will readers kindly give me information about this star? Sir R. Ball writes as follows:—"The brightest star in Orion is known as α Orionis, or as Betelgeuse." Proctor, speaking of the spectra of variable stars, has the following:—". . . . Betelgeux, the singularly variable orange star, which is ordinarily the leading brilliant of Orion, but is sometimes surpassed by unchanging Rigel." Now, I have Peck's "Observers' Atlas of the Heavens," which contains a catalogue of stellar magnitudes, in which the two stars figure thus: β Orionis 0·8 and 0·9; and there is also a catalogue of variable stars which contains no mention of α Orionis as a variable. In the list of fixed stars in *Whitaker's Almanack* I read thus: α Orionis (Var) 1. Can it be that two such authorities as Ball and Proctor are mistaken? Or is Betelgeux in the course of a waning period? For, last night, in a clear, moonless sky, 10.50 p.m., Rigel was perceptibly brighter, though Betelgeux appeared many steps, perhaps half a magnitude, brighter than Aldebaran. This was before the rising of Sirius, whose surprising splendour seems to make more difficult the comparison of other neighbouring stars.—G. J.

[97061.]—**Tommy Atkins.**—Will some reader tell me the origin of this name, as applied to the private soldier?—E. L. H.

[97062.]—**Ether Freezing.**—Can any reader tell me how to make an ether freezing apparatus to use with an embedding microtome, and give sketch showing clearly how it works?—H. BAKER.

[97063.]—**Utilising Surplus Power.**—Having purchased one of the "B" oil-engines from Barker, Leyton, I find that I have got plenty of surplus power. Can any of your readers inform me of a way to fix a pump to the engine to lift 20ft. from a well 20ft. deep? I want, if possible, for the pump to be fixed on the engine, and driven direct from gearing. The engine is ½B.H.P., and gives 350 revs. per minute when driving my dynamo, and I can spare quite half of the power.—INKSPLASH.

[97064.]—**Mitre Blocks.**—Perhaps some of "ours" would oblige with their notions of the making of mitre blocks? How to make the blocks accurately would be a thing worth knowing. This is apparently not so easy as it looks. I have not been able to buy a ready-made one accurate enough to make an ordinary frame. Many of the articles appearing in "Ours" on carpentry and joinery generally instructed us to get a mitre-block, "which can be obtained in any tool-shop." These are chiefly a fraud, and, being of wood, make matters worse by warping. I suggest that a heavy cast-iron block, made on the three-sides-of-a-square pattern, and with the two cuts accurately made, and a special fine-tooth saw to fit the cuts, this would do away with the necessity of a shooting board for amateur work, which requires some skill to use. I feel sure that blocks so made, but, of course, accurate, would sell well, and, moreover, should not be costly. Most tool-shops have some elaborate mitre-cutting machines which make only an amateur shudder to look at. Perhaps some of your advertisers would take the idea up?—C. A. P.

[97065.]—**Whitworth Standard.**—Will some reader please give the calculation for Whitworth spanner sizes?—YOUNG ENGINEER.

[97066.]—**Observatory Lamp.**—Can any of your readers put me in the way of getting a good lamp for use in observatory—something clean, handy, and that will give a good light? I use one which burns colza oil, and am not satisfied with it. Horne and Thornthwaite used to list that sort of thing, but I understand they do not now keep them. I want something not too expensive—at the same time not too cheap and nasty. Can any of our electrical friends assist me?—NEMO.

[97067.]—**Bluing Steel.**—Is there any other way of bluing steel other than by heat? I wish to blue a pair of small rook rifles, as the original bluing has worn off. I tried the second and last recipes given by "Regent's Park" (No. 96366, Aug. 4), but with no success. The steel was perfectly clean and free from rust or grease in both cases. The only effect seemed to be a slight yellow rust. Will "Regent's Park" tell me why this is so, and how I can remedy it? Is the bluing on rifles obtained only by heat? If so, how?—ROOK RIFLE.

[97068.]—**Iron Moulding.**—What is the latest and best practice in melting the iron?—J. F. SEFTON.

[97069.]—**Formula.**—Will some contributor kindly arrange the following in the form of an algebraic equation? A compound contains so much per cent. of a certain element; how much of compound must be added to mass so as to make it contain as much per cent. of the certain element?—BAZIN.

[97070.]—**Oil-Engine.**—I have a ½H.P. gas-engine, with cylinder 2½in. bore, and would like full particulars as to how to convert it into a paraffin engine without coming into conflict with any patents? Will some of our correspondents oblige?—ENGINEER.

[97071.]—**Age of Violin.**—I have a violin labelled "A. Hardie Annan," which, from tone and appearance, is a good old instrument. Can any "E.M." reader give me any particulars of such a maker, as to the quality and age of his work?—HANDEL.

[97072.]—**Rotation of Shell.**—A shell fired from a rifled cannon rotates upon its axis during its flight. When the shell explodes (still in the air) are the fragments still under the influence of the rotative force? If so, how are they affected? If not, what has become of the force?—HINEL.

[97073.]—**Bleaching Horn.**—Could any reader tell me the quickest way to bleach the surface of dark-coloured horn? I want to bleach it in a few minutes.—OBLIGE.

[97074.]—**Water Power and Electric Light.**—I have available full 3in. pipe, water with a head of 50ft., about 100 yards piping that I wish to utilise for electric lighting. How many ordinary lamps could I have supplied with this power, distributed in a small district of cottages near by the installation? What size and price dynamo and necessary fittings? Also, what type of turbine or water-motor best to use, and estimate cost of the above complete?—INVESTOR.

[97075.]—**Small Motor.**—A small motor that could be used in an ordinary room would be useful for many purposes; say, for driving small dynamo, &c. I once saw, at an exhibition, a small hot-air motor, called, I think, "The Bee Motor." It worked by a gas flame. I wonder if this is made now, and what sizes are made, or, rather, up to what powers?—LANCASTRIAN.

[97076.]—**Medical Batteries.**—For medical purposes primary batteries are very unsatisfactory, and I speak from thirty years' practical experience. They are constantly varying in efficiency, and deteriorate constantly, but irregularly, whether used or not. If a dynamo could be devised that would give a constant indirectional current, suitable as to voltage and ampèrage for medical purposes, and workable by a small motor or by hand-power, it would be very useful to medical electricians. The dynamo current ought also to be able to work an induction coil suitable for the application of the so-called Faradaic current. Can Mr. Bottone or any of your experienced and learned electrical correspondents help me with advice?—LANCASTRIAN.

[97077.]—**Pronunciation.**—What is the current pronunciation in English society of Which, When, Why, &c.? Is the "h" aspirated before the "w" (hwich, hwen, hwy, &c.) as in Scotland and Ireland, or is it silent? Also, is "sure" pronounced "shoor," as in Scotland, or as "shawr"? I am familiar with the dictionary rulings. A reply from "F.R.A.S." would be valued by—E. N. R.

[97078.]—**Acetylene.**—When burning acetylene gas I notice a blue haze is given off by the flame. Is there any remedy? If so, please give particulars.—A. M.

[97079.]—**Wimshurst.**—Will Mr. Bottone or Mr. Wimshurst kindly state what is wrong with my Wimshurst machine, which I have made by the instructions given by Mr. Bottone in his book "Radiography," with the exceptions that the frame is of oak, driving-wheels pine, bosses and pulley-wheels box, and glass plates, which I have varnished with shellac varnish between the sectors. They never would excite very well, although I had larger brushes, and I could not get more than a ⅝in. spark. Since then I thoroughly cleaned them with strong soda water, methylated spirit, and benzine, but cannot get any effect at all, although it is in a room with a fire nearly all day.—L. A. K.

[97080.]—**Soap.**—Would any reader kindly tell me how to make a soap that will not lather, as I want the fat the soap contains in the water to mix with whiting, but not the air bubbles caused by the frothing? Can a soap be made with wax only, instead of grease?—EMBOSSER.

[97081.]—**Strongest Adhesive.**—Would Mr. Bottone, or any reader that knows, kindly tell me the strongest adhesive soluble in water and keep liquid like gum? Dextrine, gum arabic, liquid glue, &c., no good for the purpose, which is to make a strong distemper paint to dry quick. I have seen the adhesive I want, but cannot get to know the name (it being kept very secret),

It resembles seccotine nearer than anything I know, and it is readily soluble in cold water.—EMBOSSER.

[97082.]—**Dry Cell.**—To MR. BOTTONE.—Is the dry cell described by you in the last issue suitable for intermittent lighting? Is the zinc cylinder soldered together? Also, could you tell me the construction of the "Carsak" wet cell.—ONA IGSA.

[97083.]—**½in. Spark Coil.**—To MR. BOTTONE.—I have just finished a coil consisting of an iron rod, ⅜in. diameter, 6½in. long, primary ¼lb. No. 20 cotton-covered, secondary 6oz. No. 36 silk-covered wire. Upon connecting it to the battery, I just manage to see a very tiny spark upon touching secondary terminals together; in fact, I can bear them in my mouth without being "shocked." I notice when the secondary terminals are brought in contact, the contact-breaker stops working. I took great care to insulate each layer with paraffin wax and paper. Can it be that I have wound the secondary in the wrong direction to the primary wire? The secondary I bought new. It has several joins in it, with "kinks" innumerable. Would that make all the difference? If I wrap the tinfoil of condenser round outside of coil, would that improve matters? How are sheets of tinfoil cut so that odd numbers are joined, and even numbers the same?—E. D. WAYLING.

[97084.]—**Imitation Gold and Silver Paint.**—Will any of your readers let me know how to make these paints, ingredients, quantities, &c.?—DECORATOR.

[97085.]—**Spark.**—What length spark would be probable limit for a coil, whose core is 10in. long, 1in. diameter, No. 22? Primary: two layers No. 18 c.c. (½lb.) Secondary: 2lb. No. 36 s.c. Condenser: 100 sheets 8in. by 6in. Using two pint chromic cells. What weight of iron wire (No. 22) is needed for core? Finished bobbin: 3½in. by 8½in. diameter. Screens: Has any of "ours" tried the following formula? If so, kindly give results. "A new mass phosphorescent under the X-rays, and is said to be more sensitive for screens than all substances known or employed. Dissolve 1 gramme uranium nitrate in 4 grammes of boiling water in a porcelain dish, adding 1½ grammes am. fluoride, and boil the mixture for a few minutes. The solution should not contain precipitate, and is cooled off and crystallised, which takes place in an hour. The octahedral crystals deposit on bottom of vessel, and the pale yellow solution turns perfectly colourless. The liquid is poured off, and the sediment is washed repeatedly with cold water (to complete removal of am. nitrate). The crystals are insoluble in cold, but readily soluble in hot, water. For production of screens the dried preparation is mixed with collodion or gelatine. The quality of the preparations depends upon the perfect development of the crystals = (uranium ammonium fluoride = $U_2O_2Fl_4(NH_4Fl)$. Will Mr. Bottone kindly give date of probable publication of the 7th edition of "Instrument Making" (electrical)? and will he also state reasons why the Carré's dielectrical machine is not more used? To quote from his book: "Machine having plates 15in. and 19in. produces sparks 6in. to 7in. long, and, if pair Leyden jars attached, this can be exceeded." A Wimhurst probably could not beat this length, having pair plates, say, 19in. or 20in.—DIFFERENTIAL.

[97086.]—**To Mr. Bottone.**—I am much obliged for your reply to my query (96997) *re* faulty dynamo, and inclose a few particulars. The form of machine is overtype. Size of armature 8½in. by 6in., exclusive of commutator; field-magnets about 5½in. diam.; size of wire on field-magnets about ⅛in. diam., including covering. The machine runs at 1,300 revs. per minute, and gives 16 amps. at 110 volts pressure. I cannot tell whether the armature is solid or laminated. I do not remember the machine ever running cool. The word "casts" should read "coils"; it was a printer's error. The machine was built by Rosling and Matthews, Bradford.—M. S.

[97087.]—**Watch Jobbing.**—A lever watch goes well when not worn, but when carried in the pocket it often gets some minutes slow occasionally. What is the reason of this? In examining wheel and pinion depths, sometimes a pinion is found too large. How should the depth be pitched to get the best action, as sometimes the piece will not allow much alteration?—COUNTRY JOBBER.

[97088.]—**Motor.**—Can any reader give me particulars as to motor, &c. (using oil, not spirit, so as to be able to replenish at any out-of-the-way village) best suitable for driving pleasure van, weighing about 30cwt. loaded, at a speed of, say, three and six miles per hour? Allowing for hills and soft roads, would 6H.P. be sufficient? I should probably build new van if above is suitable.—TOURVAN.

[97089.]—**Pneumatic Covers.**—How is the rubber stripped off these? I find soaking with benzoline very slow?—REPAIRER.

[97090.]—**Salt-Water Ice.**—I should be very glad if some of our scientific friends would give me a little information with regard to the above. A friend of mine assured me that the ice resulting from the freezing of salt water contained hardly any salt at all, and if that be so I should like to know what becomes of the salt. Does it remain behind as a solid when the water is evaporated, or is it still present in the ice, only in some different form? I must confess I am puzzled, but it must be a question that could be very easily settled by anyone having the means of producing the low temperatures possible at the present day, for with alcohol frozen the very strongest solution of salt could hardly be expected to remain liquid.—F. M. M.

[97091.]—**Defective Circuit.**—Can any of our electrical readers explain (with a view to remedy) the following defect? I have in use an electric call between two rooms on three wires, which answers perfectly; but taken from each pole are short pieces of wire connected with a clock, which at a given time makes contact, and rings the bell in my room on the circuit to the other room. I have plenty of battery power—viz., two Leclanché cells, which perform all I want for a time, but occasionally bucks up as far as the clock is concerned, and although the contact is made, no current passes, and no bell rings, but as soon as I ring from my push to the other room (and having switched on the clock again), I get a current through to the bell, viâ the clock. All connections are perfectly clean, and wires sound, and as it is most important that the clock should actuate the bell, I should be pleased to find out the remedy for the failure, which is only occasional, but very annoying.—ELECTRIC.

[97092.]—**Cranberries.**—Can any of your readers help me to understand one of those curious paragraphs which appear in the papers under the head of "Week-end Prices." I read in one that "It were wise in the cook to make every use of such seasonable cooking fruits as cranberries and pears while they are with us. They are both cheap fruits." I may be mistaken, but I have a recollection that I could buy cranberries all the year round in London. When do they go out of season nowadays? I have a recollection that cranberries are always in season, and that in the pie-shops in London you could always get cranberry pies when the home-grown fruits were "out."—R. H.

[97093.]—**Motor Cycles.**—Would some reader kindly say if phosphor bronze, or some similar metal, is suitable for an air-cooled cylinder? It could be made thinner than cast-iron ones, and be less liable to get the cooling ribs broken off. Also, what are the objections to ball-bearings for the crankshaft?—MOTIST.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 15, and unacknowledged elsewhere:—

TECHNICUS.—E. G. Woodhouse.—Alex.—T. B. G.—C. A. Naylor.—Jack of all Trades.—W. F. Stanley.—Gavin J. Burns.—Rev. J. M. Bacon.—Alex. Smith.—Medical.—F. Mason.—H. A. S. Upton.—Himer.—W. Maclachlan.

PHASS.—Quite out of our line to advise as to practicability of inventions or chance of Government adoption. Better look up specifications of existing magazine-rifles at Patent Office, and form your own conclusions.

OPTICAL L.—Surely you and other readers know that Dr. Aveling, the author of the series, is dead?

MEDAL.—Must ask a dealer. We can't deal here with values of medals and other curios.

DANIEL HANES.—The query was duly entered in the list of "Unanswered" on p. 143, and appears again on p. 237. Only the number and title of queries are given in the list. Possibly the query asks too much, or is not to be answered.

ENGRAVER.—Try such a firm as Brodie and Middleton, Long Acre, W.C. There are several works which give designs for monograms.

H. J. TREMLETT.—Directions for making accumulators have been frequently given. See the index of the last volume.

HOUSEMAID.—If medical men fail to help, how can those who have never seen you? State the query to Dr. Allinson, through the *Weekly Times and Echo*.

W. H. BLAND.—Do not care for first subject. Descriptions of processes only to be carried on in large works are, as a rule, only of second-rate interest to amateurs. As to the second, much depends on the nature of the articles, but it sounds more in our line.

S.—No more risk than with any other grinding machinery. A respirator will prevent any of the consequences you refer to.

W. H.—The loss of taste or smell is a symptom of several maladies—not a disease in itself. It would be ridiculous for anyone but a medical man who had not personally examined you to offer an opinion.

C. W. CROSBIE.—Please see many replies in back volumes. The lenses are not suited for the purpose; but for directions as to how to construct the optical lantern see a series of articles beginning in No. 1377, Aug. 14, 1891. There are many hints on the subject in back numbers; but the series of articles mentioned practically exhausts the subject of the "magic" or optical lantern.

R. H. SPENCER.—The British Commissioner-General for the Paris Exhibition is Col. H. Jekyll, C.M.G., St. Stephen's House, Westminster, S.W.

A. T. M.—"Mineralogy," by J. H. Collins, published by Collins, price a shilling, will serve as a guide; then possibly the most useful work would be "The Geology of England and Wales," by H. B. Woodward, published by G. Philip and Son, Fleet-street, E.C. For general mineralogy, Dana's works.

G. B. ELLIS.—Thanks; but we gave not long ago an exhaustive series on the subject, and cannot spare more space yet awhile.

NEW READER.—It is impossible to answer your question without dimensions are given, and it is equally impossible to spare space for, and cost of, engravings of model dynamos, simply that the individual reader may be told how much wire they will take.

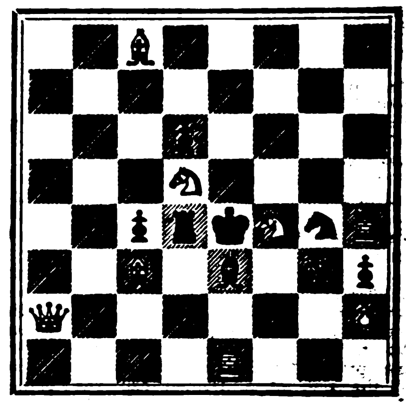
ARTHUR BRIANT.—These lectures are usually copyright. If we can publish them we will do so. If not, you will probably be able to get them later on in the *Journal* of the Society of Arts, but not till some months, as a rule, after their delivery.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1701.—By C. FARAFFINI.

Black. [7 pieces.



White. [9 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Nov. 27.*)

Solution of PROBLEM No. 1699.—By C. A. GILBERG.

Key-move, B-K B 6.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1699.—Correct solution has been received from J. E. Gose, Richard Inwards, A. Tupman, Rev. Dr. Quilter, Alfred E. Oxley, Quizco, F. B. (Oldham), T. Clark, J. Mason.

E. THOMAS, H. HILBRAND, W. H., P. H.—Only solution as above.

P. H. (Dundee).—With every desire to assist, it would still be impossible to give satisfactory explanations in problem-solving within the limited space at our command. From the nature of your questions, it is evident that you are in the very early stages of Chess, and a little personal advice from a friend would be the best at present.

J. H. BLACKBURNE'S "Games at Chess" have just been published by Messrs. Longmans and Co. in one handsome volume, and chess lovers have put before them a carefully edited and complete collection of this popular master's games. The editor, Mr. P. Anderson Graham, has written a sympathetic life of Blackburne, and has added a brief history of Blindfold Chess. The editor claims that the book presents a picture of the Chess of the whole world during the time of the present generation. Examples from the games of every great master, from the day of Staunton to that of Pillsbury, will be found within its cover; examples, too, from nearly every land, and culled from many different languages. Nor is this all that is claimed for the volume: There is scarcely a local club in the British Islands, scarcely a local champion who does not figure there, so that we cannot be wrong in saying that the book contains specimens of every extant style of play. With this claim we think there will be none to cavil after a slight perusal, and it will be found a source of continual pleasure to the numerous admirers of Blackburne's brilliant play. The only fault that can be found with the book is the price—viz., 7s. 6d., which, in these days of cheap production, is unfortunate, if not prohibitive.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, NOVEMBER 24, 1899.

INLAYING.—VII.

THE accompanying designs (Figs. 112, 113, 114, 115, 116, and 117) are mainly for creasing, by the aid of tracings laid upon the work, and creased over with the tools. Where straight lines are mainly in demand, it will be as well to gauge for widths, either from the outer edge of the work, if permissible, or resorting to a temporary fixture of some kind. We have made good use of thick cardboard or millboard. Much must be left to the student.

Where corners have to be done, cutting the design out of the thick millboard, and using the same as a guide for the creasing-tool, will certainly give the best results and exact form throughout.

It will be necessary to warm the iron tools so much that they indent the leather and polish it at the same time. If the leather should happen to turn up brown, then the iron is too hot. If there is no gloss, the heat of the iron is too low. Although we have advised the use of card or millboard, it does not follow that metal is not used as guides. In fact, where much has to be done, the use of metal gauges and straightedges will be the cheapest in the long-run. For narrow edges there are special irons made with a side lip, and for sharp turns narrow tools are much in vogue; and where circles are called for, different diameters and thicknesses of brass tubing will prove of value. If the tubes should happen to be short, they can be mounted on wood handles. Square drawn brass tube can also be purchased, and mounted as above stated, for squares of all sizes.

Just a few words as regards the gluing of leather work. If the work is of such a nature as to permit of quickly glue the same, then moderately thin glue, pure and simple, is only needed, not too hot. If the glue is too hot, it is liable to diminish the high relief or embossing that some leathers carry. In gluing leather of the above description, it


Fig 112

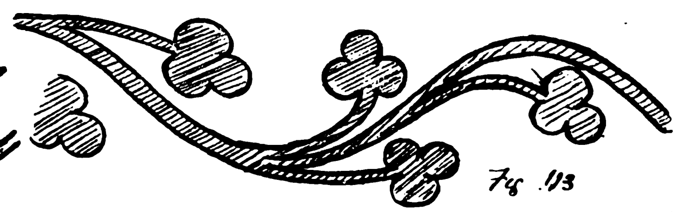


Fig 113

Leather work or wood with fine lines surrounding

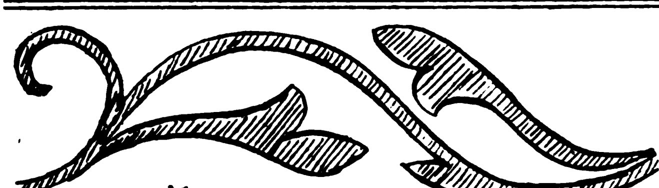


Fig 114

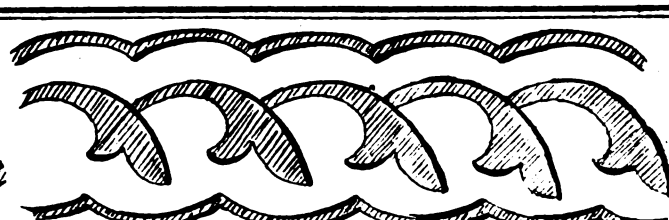


Fig 115

Repeat borders as above


Fig 116

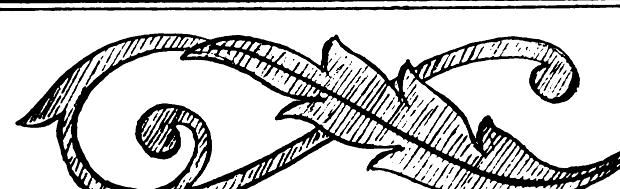


Fig 117

Chopping in designs
panels & corners

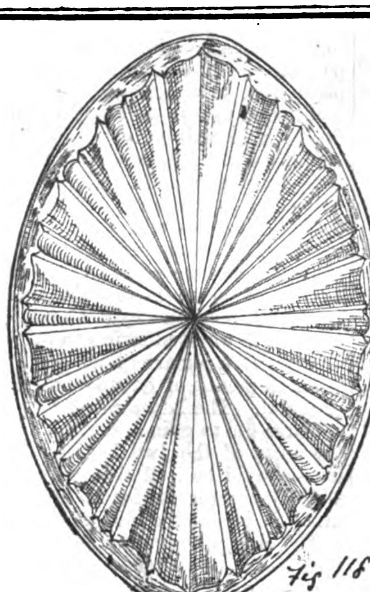


Fig 118

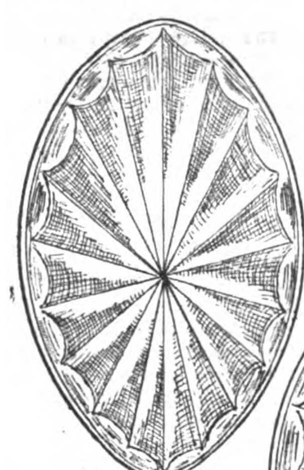


Fig 119

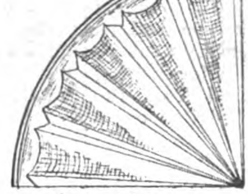


Fig 120

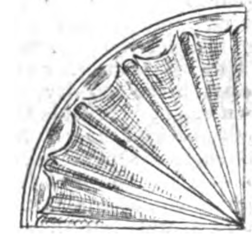


Fig 122

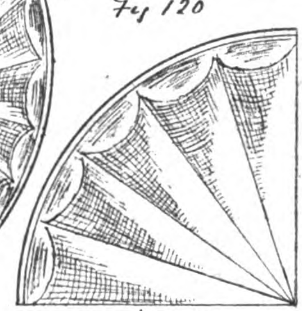


Fig 121


Fig 123

will be needful to lay the cut-out piece on a sheet of newspaper, and stipple the glue on to it. The groundwork must perforce be also glued. Too much rubbing down is not needed, in fact, a moderately stiff shoe-brush will be most useful with hard-grain leather; but where the leather is very thin and highly embossed, a softer shoe-brush must be used; but with morocco or seals, the use of a rolling pin of soft wood will help mat rially to gain perfect adhesion, and yet not injure the face. Where joints are required, whether on the flat or near the edges, paring must be done; otherwise unsightly ridges will be perceptible. When gluing the leather that lies face downwards, watch narrowly that no glue creeps under, and so on to the face.

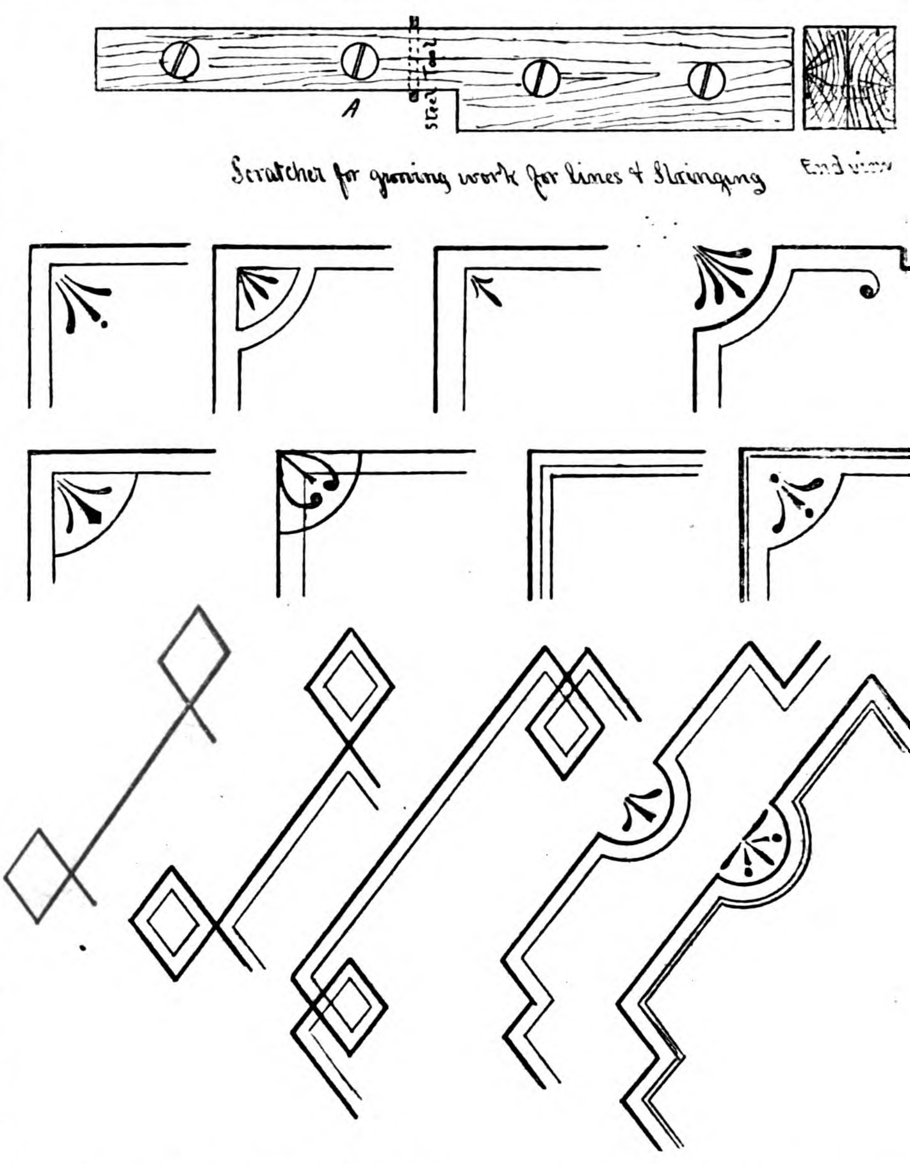
Creased work is greatly enhanced by gilding the lines; the process is simplicity itself. After a partial creasing, the surface of the leather is damped with diluted white of egg; narrow strips of gold leaf are cut on a gild r's cushion, and taken up with a tip. Providing the glair is not too fluid, or too dry, the gold leaf will quickly set itself, and sink into the indentations. The exact condition to be creased with the warm tools will be better determined on spare pieces for practice than from a whole page of written matter; but this may help to overcome any disastrous results. If the iron is too hot, it may work up the leaf if laid on a fluid glair; but that may be avoided by going over the work very gently, increasing the pressure as the gloss appears. But if the leaf ground is too dry it may possibly work up bodily, and be glossy with an entire absence of gold leaf.

When the ornamentation is of the nature of a border as well as lines, it may be advisable to add a little shoemaker's paste to the glue, about three parts glue to one of paste. Opinions vary with respect to gilding; some will maintain that good and bright work cannot be got with glue alone, others again will only use the above reversed—viz, three of paste to one of glue. Where the leather's face is brighter than wanted, a wash can be purchased that will tend to dull it, working the surface in the mean time with a soft shoe-brush. The above wash only applies to black leathers: it is not often resorted to where coloured leathers are varnished, such as writing tables, &c.

The wider the crease line the less is the preliminary creasing or indentation. For it must be borne in mind if the hollows made by the creaser be too deep, there is just a possibility of splitting the gold leaf; if that occurs, apply another narrow strip of gold leaf to cover the imperfection. That should be done before the glair sets; but if it should happen to be too dry, it must be damped down again. If that is attended to, a saving is effected with the gold leaf. After gilding, the surface should be cleansed from the excess glair, and if it is desired to have a slight gloss, then a thin coat of parchment size is passed over the surface of the crease lines; but that should be done quickly, and in a warm room. For panels, or hanging specimens, the after-sizing is a decided acquisition.

A flat piece of cork, with a piece of clean white rag tightly stretched over the face of the cork, when slightly moistened, will quickly wash off the above excess, and tend to preserve the leaf in the creasing. It will be patent to all that to preserve the width of the lines some practical method must be adopted. With a loose rag failure is almost certain.

Before proceeding to the next task, it will be as well to hark back a little, because we have omitted to explain the method employed to let lines, or, as is it generally termed "stringing," into our ground. Where the work is such that the carver's parting tool is not adequate, we resort to scratching them in with a stock and little steel tool of different widths to suit the different widths



of stringing. A rough sketch is given at A, and is simply two pieces of hard wood screwed together as marked, and cut away to form a shoulder or support to guide the tool in its passage of grooving out the channel to receive the lines. Its use will be readily understood. By shifting the piece of saw-blade, which, by the way, makes useful scratchers, any distance from the edge of the work can be obtained. In working round parts, great care is necessary, and that applies to the hollow sweeps as well; but it is invariably an easier task after a little practice. With straight work, rapid progress can be made without much trouble or forethought. Where the confidence is lacking to produce a clean-cut groove, a smaller tool should be used first, widening the groove with a tool the width required.

Where circles, or parts of circles, are required, a fairly stiff pair of compasses will be needed. One leg of the compass can be ground to the size and squared to form a cutter, the other leg can be pointed and used as made or ground to a finer condition. A pair of compasses with a shifting leg will permit of having a number of cutters to suit the different widths, as before stated. Another simple tool is like the above scratcher, without the angle-piece cut out. By using a round point and a square cutter, different diameters of circles can be gained, according to the position they hold in the stock (scratcher). There is one point of importance: If it is found necessary to use the pointed leg of the compass in any part other than a groove, or where a groove may be worked afterwards, then it will be necessary to glue a little piece of hard veneer to hold the centre, while the square leg of the compass works the circular groove. It is an easy matter to remove the veneer when all is done. Do not leave a mass of glue clinging to your work. The wisest plan is to wash the excess with lukewarm water. The better the cleaning, the easier the task of preparing for polishing. If a round dot is used to complete the ornamentation, then the above-mentioned veneer will not be needed. The centre hole will only require enlarging to suit the dot. All lines, stringing, or banding should be an easy fit. If too tight, breakage will assuredly follow. If too loose, it is just possible the lines will rise or bulge here and there. If such should happen, then the flat cauls, as in veneering, should be used, with a piece of clean newspaper intervening, so that when cold the caul should lift without any of the work adhering to it.

The above remarks hold good in the case of small pieces of cutting, whether of wood or metal. The latter must be roughed with a coarse file to gain a tooth, and thus assist the unity of the two bodies. Narrow brass lines should be well cleaned, and will bear a slightly tighter fit, for it must be borne in mind it is not the glue alone that holds.

The designs given under the sketch A are suggestive of either wood, ivory stringing, and can carry a different coloured material between the coarse and fine lines, and can readily be adapted for corners or panels, and can also be used as specimens of creasing, and will bear, also, different coloured leather between lines, or the little panels can be of different coloured leather and creased to suit the taste of the reader. Many others could be given, but the present should form a guide

to any future modification that may be thought of.

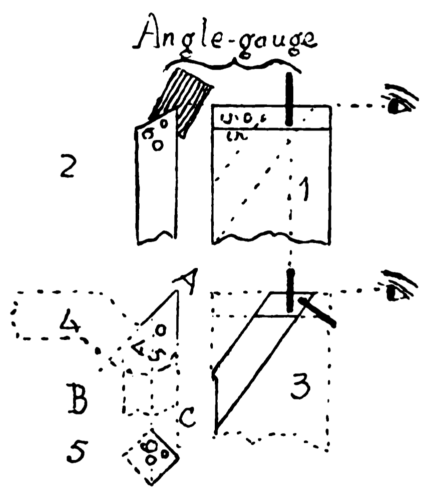
ERRATA.—Fig. 91 was unfortunately reversed; not that it makes much difference, but if it were designed as a hanging or suspended specimen, it would necessitate a slight alteration of the flowers, &c.

ON THE ANGLES OF THE EDGES OF SLIDE-REST TOOLS.—II.

By "D. H. G."

MISAPPREHENSION as to the true angle of an edge often arises from the accident of its shape, or from the position in which it is placed on its stem, or from the fact of one of the two facets required to form an edge being common to more edges than one. But the rule by which the angles of all edges should be measured is very simple, and admits of no exception. An edge, or any point in an edge, is a solid angle made by the intersection of two facets, and the inclination of these to each other determines the angle of the edge. The lines upon which this angle is measured should start from the same point in the line of the edge and pass at right angles to (or square with) this line on *both* facets. When any portion of an edge is rounded, the same rule applies to the *tangent* of any particular point in the curve that it may be desired to measure. For the present purpose this latter rule is sufficiently demonstrated by the foregoing illustration No. 2; for no two tangents to a curve can lie in exactly the same direction, and it has been shown that with a flat upper face no two adjacent points in the edge can be of exactly the same angle. If one facet of the edge were convex and the other concave, the result might be different. But whether the edge be straight or curved, its *shape* is no guide to its *angle*, and this may be experimentally demonstrated in a very simple manner by anyone who cares to do so.

Let Fig. 1 represent the wooden model of, say, a chisel, bevelled to contain an angle of 60°, as shown in the side view, Fig. 2. If it were required to judge of the acuteness of the edge by the eye alone, the chisel would be held sideways, as in Fig. 2, so that the eye might look along the line of the edge, as in Fig. 1. Suppose it were required to test this angle by any simple gauge, such as as a nick cut in a piece of tin or cardboard (shown in the position it would occupy in Figs. 1 and 2 respectively), care should be taken to make the gauge sit square with the lines of the edge on both facets; as, if the gauge were placed askew in any direction, it could not give the true angle of the edge. Now, if two saw-cuts be made obliquely across the face of the chisel, at an angle of 55° with the line of the edge and the same distance apart as the thickness of the model, the "shape" of the diamond-pointed graver will be cut out of the chisel without interfering with the angle of its edge. If it were correct to test the angle of the graver in the way described above, when it formed an integral part of the chisel, the same rule must be applied when it forms only a section of the chisel—viz., that the angle must be tested on lines square with the line of the edge on both facets, without regard to its "shape." To make the illustration more evident, Fig. 1 is repeated in Fig. 3, the only difference being that in Fig. 1 the outline of the chisel is drawn in full lines and that of the graver is suggested in dotted lines, while in Fig. 3 the order is reversed. The "eye" is repeated in Fig. 3 to show that, when the angle of the graver is estimated in this way, the tool should be presented to the eye in the same position which it occupied when it formed an integral part of the chisel; and in the same manner with all straight edges, however they may be formed on their stems. It will be observed that the division of the chisel in this way has given the graver a second cutting-edge on the lower side of Fig. 3, and the angle of this edge must be tested by the same rule as the first, as there cannot be two ways of testing an edge by actual measurement, and the position of the angle-gauge is changed accordingly. If the saw-cuts has been correctly made at an angle of 55° with the line of the edge of the chisel, this second edge will be found to be of the same angle as the first—viz., 60°. Thus the model of the graver will be completed with a square cross-section and two cutting-edges of equal angles. In order to estimate the angle of the *bevel* which has produced the cutting-edges of 60° each, turn the model sideways, as in Fig. 4, and it will be found that the "bevel" is 45°, thus making a difference of 15° between the angle of the bevel and those of the two edges so produced. The lozenge-shaped upper face of the graver being an accident due to facility of construction and convenience in use as a hand-tool, in Fig. 4 only that portion which supplies the cutting-edges is drawn in full lines, while the rest of the outline is completed in dotted lines, and the like arrangement is adopted in Fig. 5, giving the cross-section or "plan angle" of the upper face of the edge. "Holtzapffel" remarks upon the very close resemblance which the edges of V-shaped slide-rest tools bear to those of the graver. To make this more obvious, the stem of a slide-rest is suggested by dotted lines in Fig. 4 to the same cutting-edges as those of the graver, and it will be seen that not only the principle of construction, but also the "shape," are almost identical. If these edges are to work out corners quite square they must be pointed, and the angle on both sides should be of the same degree of acuteness, so that they may work (alternately) on either side of the corner. The angle required for clearance is so low in the case of cutting that it may be practically overlooked in tracing the resemblance. The only points of difference are



that the upper face, as seen in "plan," must be less than 90°, and the "bevel" must be less acute. Reference to the angle B A C in Fig. 4 will show that the so-called "cutting-angle" of the slide-rest edge and the "bevel" of the graver are one and the same thing; and in this case the model will have proved that there is a difference of 15° between the two terms. "J. H." quotes the "cutting-angle" of the Smith and Coventry V-shaped cutters as "embodying an angle of 68°." Here the difference would not be quite so great, for Prof. Willis has shown that in edges of this class the difference between the angles of the "bevel" and the resulting cutting-edges decreases as the "bevel" is made less acute, and *vice-versâ*. It is impossible to be exact without knowing both the *plan angle* and *bevel* of these cutters. But, judging from one of Smith and Coventry's illustrations, the "plan-angle" cannot exceed 70°. Referring to Prof. Willis's table, which shows the various combinations of the "plan" and "bevel" angle, which will produce "cutting-edges" of a given angle, I find that a "plan-angle" of 70° requires a "bevel" of 63° to produce cutting-edges of 75°; and as "J. H." quotes the "bevel" as 68°, it is certain that the edges must be less acute than 75°—probably about 78°. But exactness on this point is rather a question of curiosity than importance. The object has been to prove the fallacious nature of the so-called "cutting-angle" as the standard by which to estimate the angle of the edge employed, and, consequently, of all deductions founded on this basis. In the first example adduced by "J. H.," it has been proved mathematically that, so far from the term "cutting-angle," defining the "constant" angle of the edge, there is only *one single point* in the whole edge which corresponds to this definition; and in the second example it has been shown, on the authority of Prof. Willis, that there is a difference of about 10° between the angle thus described and the real angle of edges which do the work. An error may be stated dogmatically in a few lines which it may take pages to disprove, and this must be my apology for occupying so much valuable space. But if the reasons and references given have warned any novice to distrust such "books" as take the "cutting-angle" for the standard by which to estimate angles, the space will not be altogether wasted. With such a standard, "angles may exist in books, but *cannot* survive in practice."

Having endeavoured to show the fallacy of one theory, I am bound to suggest another if I should be challenged to do so, and in this case I will endeavour to explain the practical application of the principles enunciated by Prof. Willis in the treatise referred to above. I can honestly say that, during a period of almost 40 years, I have derived more practical advantage from the careful study of this treatise than I ever gained from the methods and practice of the machine-shop, though my advantages in this respect were perhaps unusually favourable for an amateur, as it gave the opportunity of practising on work of all diameters.

HOW SCENTS ARE CARRIED.

A CERTAIN vague suggestion of something disagreeable, but imperfectly realised, which has somehow been invading my sanctum, seemingly by the open window, has suddenly assumed definiteness and brought vividly to mind a scene associated with painful recollections.

A large tract of common is burning some three miles to windward, and, though the air without is clear of visible smoke, there assails my olfactory nerves the smell of charred, dry stems of furze. The odour of this wood when burning is utterly unlike that of any other that is to be found in an English faggot-pile, but it sufficiently resembles that of a firewood used extensively in India, and my first experience of the kindling of this was after a forced and fatiguing railway journey of a thousand miles. When arrived at Benares with nerves somewhat jaded, and while being, by way of relaxation, punted by native guides down the Ganges, I was brought up, all unsuspecting, within close range of the horrors of the Burning Ghât. The gruesome reality of that scene is now irresistibly recalled simply by the odour of the smouldering common.

And this opens up one or two interesting inquiries as to the propagation of that impalpable essence that "scents the evening gale." I have to a certain extent been able to carry out some practical investigation in this matter. It had occurred to me that as a distinctive smell may be carried for great distances across country, the same might be conveyed also to considerable heights into the atmosphere. Yet I have never come across any records gathered from balloon voyages confirming this idea, though it is certain that some of our best observers are to be reckoned among balloonists. Assisted by others, however, I have constantly at all reasonable heights endeavoured to notice if, say, the fragrance of the limes or a beanfield in full flower, or even the strong exhalations from gas or chemical works or a tanyard over which we may have passed, have been noticeable from above; but the result has always been negative, chiefly, as I imagine, because of the proximity of the great bulk of gas overhead, which even when not actually obtrusive, probably suffices to mask any other traces of odours in the atmosphere.

It may not be generally known that it is imperative that the neck of a balloon should be kept open as soon as an ascent has commenced, from the fact that as the balloon reaches higher levels the pressure of the external air is diminished, and the expansive power of the imprisoned gas thus being subjected to less constraint, would infallibly burst the balloon but for the open mouth, from which the gas issues to an extent sufficiently appreciated by the occupiers of the car.

A special experience of my own, however, may throw some light on the present question. I was engaged during three or four ascents in carrying out acoustical experiments by means of fog-signals fired at a safe distance below the car. These signals always consisted of one particular type of cartridge, composed of cotton-powder, presumably uniform in character, and were invariably let down to the same distance in the free air below by means of a length of twin wire, and then fired electrically.

On one occasion only was the smell from the powerful explosion detected; but this once it happened that, at the moment of firing, the balloon was descending rapidly, so that we were

almost immediately plunged into the atmosphere of the bursting cartridge, when it was noticed that the products of combustion seemed for a considerable length of time to hang about the car as a cloud of strong-smelling gas. And this, then, is really what the state of the case appeared to be—namely, that an odorous cloud or volume of gas was produced, travelling uniformly with the balloon, but not diffusing itself rapidly—at least, in an upward direction.

With respect to this same view, a correspondent writing to one of the scientific journals a few years ago, states an instance when a boat's crew, four hundred miles from land, had been enveloped in a dense wreath of wood smoke; while in his own experience he had occasionally noticed on the west coast of France, after a westerly gale of exceptional violence, a smell as of primeval forests, which he could only conceive as having been borne across the Atlantic entangled in the bosom of a cyclone.

The writer remembers an occasion early in the "sixties" when, while living at Old Charlton in Kent, he was an observer of a fire that had broken out at some oil-stores near London Bridge, from which the smell of burning fat was carried down the wind on the close air of a November night, so overpoweringly intense, as perceived at the distance of seven miles, that it must have been detected at many miles further away, yet the breadth of the ill-odoured stream was, comparatively speaking, very limited, proving that diffusion in a lateral direction was either very slight or very sluggish. Penetration to a distance was apparently almost entirely due to wind currents.

As lending colour to this view, I may be allowed to quote the laboratory experiments of Prof. Ayrton, by which he showed that when the space through which scent had to pass was screened from draughts, it diffused with surprising slowness. A tube 3ft. long, closed with a cork at one end, and having at its other end a plug of cotton wool saturated with oil of limes, was brought into an odourless room and uncorked, when a momentary smell was transmitted through the tube by the mere act of uncorking; but after this momentary whiff, an interval of eighteen minutes elapsed before the scent became definite and recognisable.

We have all had experience of the difficulty of determining, and yet more of locating, any feeble and ill-defined smell within a building, to account for which there seems a double reason. In the first place, just as the ear becomes quickly fatigued when listening intently for faint sounds, so in like manner does the acuteness of the nose become blunted in the quest of any very feeble cause that appeals to its sensibility. And again, the slight traces of any emanation seem (as in cases just cited of the smell of burning carried on the wind) to be borne on slender streams or currents that are always circulating about a room.

The case is well put by the author of a "Faggot of French Sticks" in a description of his lodging in Paris. He was joyously admiring his chamber when, as he says, "with great velocity there shot past my nose—to tell the truth, it actually hit it—an arrow of air about a foot long, but no thicker than a piece of packthread, that did not smell as it ought to do"; later, "there whizzed by another very little arrow. In less than the twinkling of an eye it had completely passed, and where it had come from, or where it had gone to, I was alike utterly ignorant." But again, "while lying down, there rushed past the uppermost feature of my face, not an arrow, but a javelin."

The author of this graphic, if painful, description: surely stated the case with much perspicacity. Lying awake in the early hours of a still summer morning, with broad daylight in the room, but while as yet there is no disturbance about the house, dust motes may be seen in the level sunbeams careering about the room in most erratic fashion, and if a winged seed of dandelion has been wafted in through the open window, its movements, though only of the same order, will become more definite. It may be slowly climbing down the opposite wall, when suddenly it will be minded to explore the ceiling instead, yet before it has reached this region it has been seized with a fresh freak, and shot out straight into the room after the fashion of the little arrows described above.

It is now easy to see how it comes about that the scent of hunted game is carried readily enough down the wind, though by its slow diffusion it continues to dwell about each spot where it has been once impressed. And it will be equally just to point out that in like manner the tainted breath from any unwholesome source tells its own warning tale to the winds, but at the same time does not otherwise spread itself with any uncontrollable rapidity. And this law as affecting the economy of life in many ways, is far-reaching.

The extent to which the sense of scent can intensify the enjoyment derived from the exercise of other senses can hardly be overestimated. It has long ago been noticed how the flavour of aromatic herbs or spices is largely due to the agreeable perfume belonging to them, and the same is also true in a modified degree with all that we eat and drink; so that, regarded from this point of view, the nurse is justified by sound scientific reasons in holding Master Tommy by the nose when she administers a dose of nauseous medicine.

But there is far more to be said. Who shall tell how much of the charm of some pleasing scene is not due to the fragrance we associate with it? The briny gale is an essential factor in our enjoyment of seaside scenery. The gorse, in our imagination, is the more golden for its perfume, and one half of the delight in all on which we feast our eyes in early summer is brought us by the breeze laden with the scent of hawthorn or fields of new-mown hay. In the self-same manner the murmur of the summer breeze across herbage is music to my ear largely because it reminds me of rambles on the downs, and in imagination I scent the wild thyme and the clover. I am not quite sure that it would be unreasonable to suppose that the feeling of wretchedness connected with a heavy cold is not in some degree due to the sense of smell being blunted, and other contingent enjoyments being impaired thereby.

As to the cultivation of the human nose we are not without suggestive facts. In a large biscuit factory known to the writer it was at one time the practice to test the large number of eggs used by the simple process of breaking them and allowing each palpably to declare its condition of freshness or otherwise. It was, at first, a painful thought that any man should spend all his working hours in this operation, so terrible to contemplate, but in point of fact there was no penance in the work, so instantaneously was each egg as soon as broken either acquitted or placed beyond reach.

It was difficult to conceive a sense more accutely trained and developed, yet we are told of a still more remarkable faculty in the savage. Thus Humboldt asserts that the Indians of Peru are able to determine in total darkness whether an approaching stranger be a European, American, Indian, or negro!

Coldash, Newbury. **John M. Bacon.**

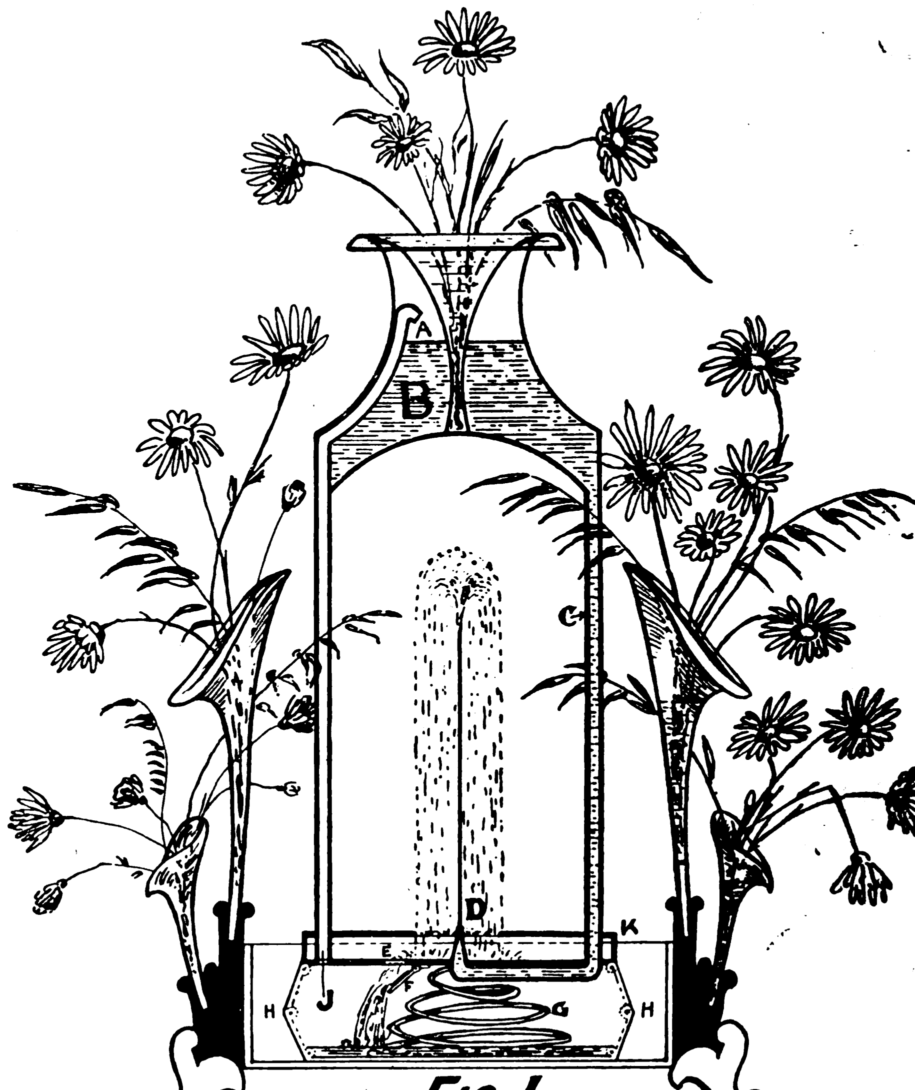


FIG. I.

PNEUMATIC FOUNTAINS.

PNEUMATIC fountains for decorative purposes may be adapted to various forms of epergnes with pleasing effect. The principle on which I construct this class of fountain may be gathered from the two examples illustrated in Figs. 1, 2, and 3. A vessel capable of holding a considerable quantity of liquid is elevated to the highest point in the epergne. Reference being made to Figs. 1 and 2, a vessel, B, rests upon a waterproof cushion, H. This cushion, which is made of rubber, is fitted in its interior with a pair of hinged supports, shown at the dotted lines H H. It has an inlet at E, which at the desired moment is automatically closed by the flap F. A powerful spiral spring, G, supports the vessel B, and at the same time retains the full expansion of the cushion. A pipe, J, is fitted to the upper surface of the lower receptacle, and extends upwards into the top vessel, where its extremity is bent over in the manner shown at A. Another pipe, C, of the same dimensions, is fitted

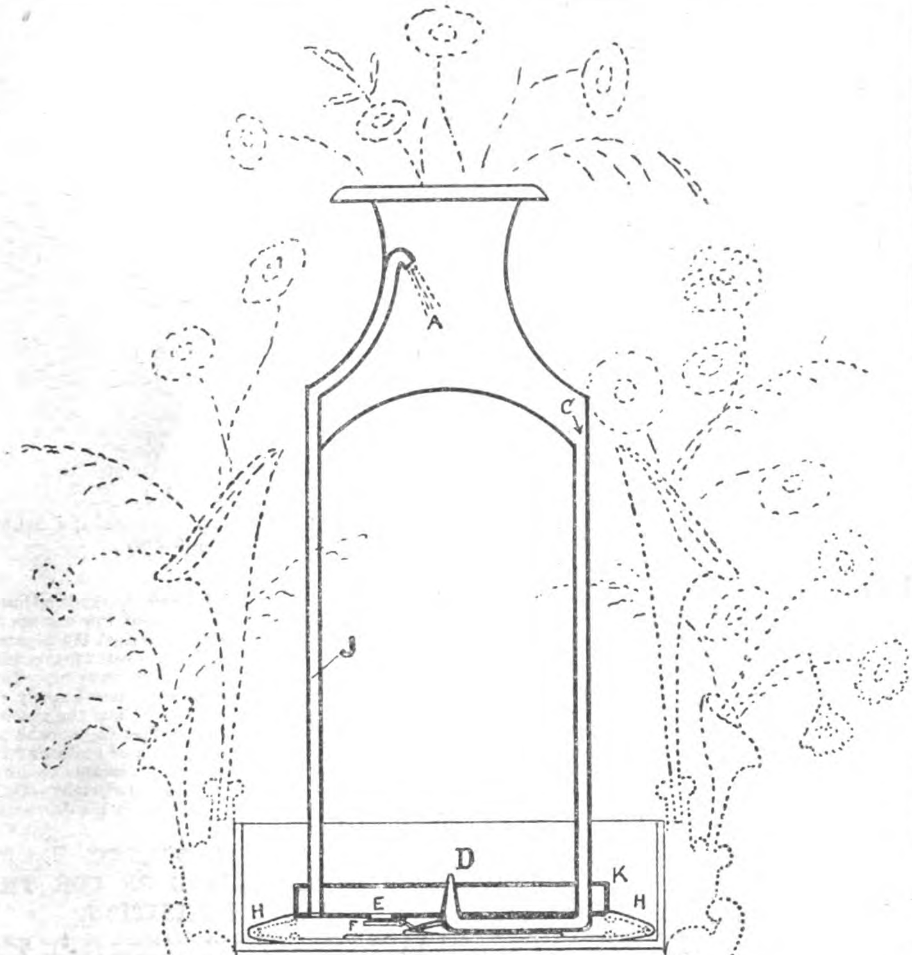


FIG. 2.

to the opposite side of the apparatus. The top end of this tube is flush with the bottom of the top vessel, and its lower end is twice bent at right angles, finishing off with a fine jet at D. The thick line at K represents a shallow basin, into which the water falls previous to draining off into the watertight receptacle through the inlet E. A fountain thus constructed is actuated in the following way :— A suitable quantity of ordinary or coloured water is poured into the basin K, when it will immediately run through E, causing the air to pass out through the pipe J into B, and from thence through C and out of the jet D. When the lower vessel is nearly full of water, the centre portion of the epergne is pressed downward, and the watertight cushion thus made to collapse, as shown in Fig. 2. It is now apparent that by the upward pressure of the water the flap F will be pressed against the inlet E, preventing the escape of water at that particular point; the liquid is thus forced through the pipe J, flows out at A, and is therefore deposited into the top vessel. The pressure of the hand is now taken off the centre portion of the epergne, the spiral spring G expands, forces open the waterproof cushion again, when the centre vase is elevated to its former position. The water deposited into the upper vessel will now commence to flow downwards through the pipe C, and by the force of its own weight spring upward at the jet D in the form of a beautiful fountain.

When the supply of water in the upper vessel is quite exhausted, and the liquid has found its way into the lower receptacle, the fountain is again set to play by applying pressure once more to the centre vase of the epergne. Another design in which the same principle is employed is illustrated in Fig. 3. It will be seen by referring to this figure that the construction of this epergne is somewhat different to that already described. The alterations, however, do not affect the essential method of raising the water from a lower to a higher level. In the present design the supply and exhaust tubes form the stem or support of the centre vase or vases, the upper vessel taking the shape of a globe. The supply-pipe C in this design terminates at the dotted lines A, and is bent over in the manner shown. The exhaust pipe B is of the same dimensions as C, but at its lower end branches off into two smaller tubes terminating on either side with a fine jet.

The accompanying illustrations are given merely as examples of designs to which my pneumatic fountains may be applied; but it is obvious

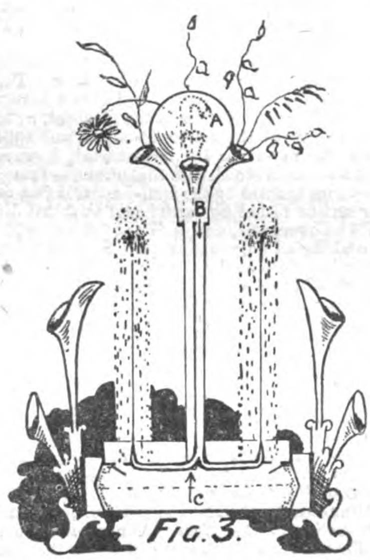


FIG. 3.

that the same principle may be embodied in more elaborate constructions, either for floral decorative purposes or for the aquarium.

Theodore Brown.

TESTS—tensile and crushing—were recently made in Bombay to ascertain the relative strengths of karri wood and teak. They resulted in favour of karri. It was also found that the cost of beams of karri would be rather less than rolled steel beams, while teak would be rather more, and that a solid timber beam 12in. by 16in. would make a more fireproof floor than light rolled beams.

IN QUEST OF THE LEONIDS: A RECORD BALLOON VOYAGE.*

ABOUT midnight on Wednesday we repaired to Newbury, where we were hospitably entertained during the small hours by the Guildhall Club, who kept open house on our behalf. The sky remaining overcast, we followed the advice given us, and shortly after 4 a.m. took our places in the car, and, amid a cheer from many hundred onlookers, quickly mounted to the region where a murky canopy hung overhead. This canopy proved to consist of a dense wetting fog 1,500ft. thick. In traversing it the balloon, which had remained captive in the still, warm air of a mild November night, became heavily charged with condensed vapour, and at the same time greatly chilled. The consequence was that it became necessary to discharge a great quantity of ballast to enable us to penetrate the cloud. Even the balloon again and again sank back into the mist. Only at my earnest entreaty that we should keep well above in view of the stars, and contrary to his better judgment, Mr. Spencer continued to throw out ballast till no less than seven bags had been discharged in twenty minutes. Our observations, which have already been recorded, continued till shortly before six, when, as though at a precise moment, the dawn suddenly flushed out with rapidly-increasing light; the stars paled and, our duties being quickly over, it remained only for us to descend.

But there was the rub. With the earliest beams of sunlight the moisture-laden silk began to dry off, and the gas to grow warmer, and, as though inspired with new life, the balloon began rising into space, mounting up by leaps of 600ft. in every quarter of an hour till, by nine o'clock, it had reached an altitude of 6,000ft., and was still rising. It will, of course, be understood that to have torn open the valve at this elevation would have been to precipitate us to earth. So the unwelcome fact had now to be faced that we were adrift simply at the mercy of the wind, and with not a cloud in sight above us to mitigate the rapidly-increasing power of the sun.

Time brought us no comfort. As breakfast proceeded, we began to hear loud reports overhead resembling small explosions, and we knew what these were. The moist shrunken netting was giving out under the hot sun, and yielding now and again with sudden release to the rapidly-expanding gas. It was, therefore, with grave concern, but no surprise, that when we next turned to the aneroid we found the index pointing to 9,000ft. and still moving upwards. Two miles up above the unseen earth! And was the region below us really earth, or was it already the open ocean? Presently the screech of a locomotive far down relieved our present anxiety, and for some little time the trains on some busy line told us that we must be in the neighbourhood of an important town or junction. Then the crash of big hammers broke in upon us. There are large ironworks at Westbury, but these were scarcely capable, we supposed, of giving out such noisy clamour. It was far more likely that we were approaching Bristol, and a glance at the map showed us that in that case our chances were growing desperate.

Then a brilliant thought occurred to us—let me say that it was due to the lady of the party. Surely there was possible help from people below, and there was a remote chance of communicating with them. We had a pencil, also a thick bundle of Press telegraph forms, ruled one side, plain the other. So with prompt despatch we devised and carried out a system of aërial communication untried in history. The following message was manifolded on some three dozen forms:—

"Urgent! Large balloon from Newbury travelling overhead above the clouds. Cannot descend. Telegraph to sea coast (coast guards) to be ready to rescue. Bacon and Spencer."

These messages were smartly produced and despatched. My daughter was clerk. The folding up of the forms into three-cornered notes was my own task; while each completed missive was labelled "Important" with red chalk by Mr. Spencer and then cast overboard. This busy and practical work afforded great relief to nerves that had long enough been on the stretch. But before it was finished we all suddenly paused and listened with all our ears, for a new sound was in the air. There was no need to exchange thoughts. We rose instinctively and listened over the car. There was the rhythmical plash of waves upon a shingly shore. Resist the thought as we might, it was unmistakable. And as if to end our suspense, up came the wail of a ship's steam siren.

This was repeated once and again, and then for a long space dead silence reigned. But by this time it was 12 o'clock, and on consulting the aneroid we were astonished to find that we had dropped more than 2,000ft., our height now being 7,000ft. only, and apparently we were still descending slowly. It may as well at once be said that it has since been made clear that at the moment just spoken of we were crossing 20 miles of the Bristol

* By the REV. J. M. BACON, in *The Times*.

Channel, and undoubtedly it was some cold current blowing up the estuary of the Severn that first gave the downward motion to the balloon. Moreover, the upper currents must from this point have greatly increased in speed, blowing stiffly up the sea-reach, and eddying in wayward courses above the mountains of South Wales. In half an hour the sounds of earth and open country had returned, and we had drawn down to 1,000ft. above the cloud floor below us, which was now breaking here and there into little black pits, like snowfields beginning to thaw.

Suddenly through one of these tiny openings was seen a far ruddy patch with a white thread running through it. This warm red colour was that of the fields of the south-west corner of England, and the white thread was a roadway. Hopes began to return; yet only to be mocked again and again. Each downward plunge was eagerly watched and timed and recorded, but each ended with a pause and then a re-ascent. Our monster balloon was dying very hard by sheer slow leakage of gas only. If it would but once dip into the cloud layer we knew its end would then be hastened; but, as though aware of this itself, it struggled manfully to keep aloft, and, as every minute sped, we could now watch the country through the openings sliding past us at an ever-increasing speed.

It was 1.30, more than nine hours from the start. The sun, clearly lower in the heavens, began to look at us more aslant. The silk above us, hitherto tense and glistening, showed signs of puckering into wrinkles. Then at last we dipped into the outmost fringe of cloud, and then rose and dipped again. The end was coming near, and it was with a feeling of intense relief that we finally plunged into the darkening mist.

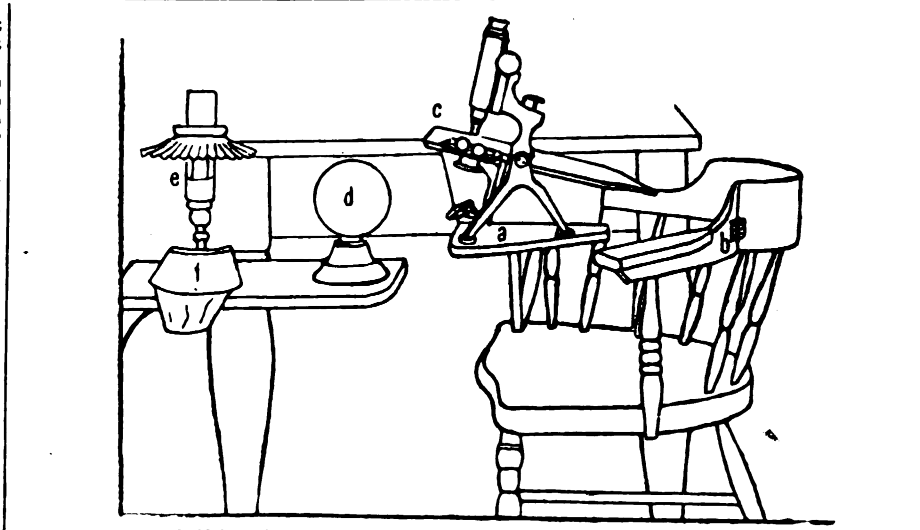
The cloud sensibly chilled the gas, and in less than five minutes we had fallen through below, and a wild romantic country broke upon our view, down on to which, as to a haven of safety, we were now swooping rapidly. But our adventure was hardly yet ended. The wind here was blowing stiffly, sweeping wherever it found egress through the valleys with great violence. This, in addition to our rapid descent, caused us to strike the earth with very considerable force, and the next moment we were breaking madly through all obstacles as the wild gusts caught the bellying silk of the now half-empty balloon. My daughter's forearm was broken with the first rude impact. Then we charged an ugly five-wire barbed fence, every strand of which we snapped like mere packthread. My nether garments were completely torn off my right leg, which, however, sustained only superficial injuries. Still we sped on unchecked till we caught in a dead half-grown oak, the head of which we carried right away entangled in our rigging. A few moments later, however, our anchor got good hold, and by this time help was hurrying up, kindly Welsh folks, cheery and willing and most handy to boot.

SOME HELPFUL LABORATORY APPARATUS.

IN the opinion of the writer, no conveniences are too elaborate for the microscopist who daily spends several hours of exacting labour in the minute and careful observation of details under high-power lenses. Any appliances that give ease to eyes or body not only render the work less arduous, but increase the efficiency of the investigator's powers of observation.

Realising this, the writer has, by degrees, accumulated a number of contrivances that, according to his experience, combine to render observation with the microscope easier and more precise. These different pieces of apparatus may not be new to many, but possibly an account of their combination into working series may suggest to others schemes for greater ease in manipulation, and thus prove of some value. In this hope, a description of the installation is here given.

The principal feature of it is a chair so modified as to carry a microscope and a drawing-board in positions that will require the least strain upon the body and arms. In constructing it, a large chair with the right arm broadened into a slanting writing-surface was employed. The hardwood writing-top was removed, and in its stead was placed a soft pine board of similar size and shape. Below this, at a distance equal to the height of the microscope stage above the table, was fastened a horizontal shelf just large enough to receive the microscope foot. This is sufficiently distant from the seat of the chair to allow the right leg of the observer to rest beneath it. This arrangement places the microscope nearly enough in front of the operator to render access to the eyepiece easy and convenient. At the same time this projection makes it difficult to enter the chair, and accordingly the left arm was cut away and suspended on a hinge so that it might afford a free entrance to the chair, and yet be in a condition to be swung back, to serve as a rest for the left arm of the operator. All the woodwork was then painted black, in order to do away with disturbing reflections.



Explanation:—*a*, shelf for microscope; *b*, swinging arm of chair; *c*, inclined drawing surface; *d*, balloon flask condenser; *e*, Welsbach light; *f*, eye-shade with cloth attached.

When it is desired to use the apparatus, the observer places the microscope on the shelf provided for that purpose, and inclines it until the stage becomes level with and parallel to the drawing-surface. He then swings out the left arm of the chair, seats himself, and returns the swinging arm to its closed position. Thus situated, he finds both arms supported at about the level of the elbows, and the ocular of the microscope at a suitable height for comfortable observation. When the camera lucida is employed, the image is traced upon paper fastened to the pine drawing-board by long, stout pins thrust into the soft wood. The right arm, meanwhile, rests in a comfortable, natural position, and the hand supports and guides the pencil, as in writing. The accompanying cut makes the various details of construction and operation plain.

Illumination.—Ordinary sunlight is, in many ways, unsatisfactory. For accurate comparative work, a more reliable and manageable source of light becomes almost necessary. The writer has found the Welsbach incandescent gas-lamp eminently suited to the requirements of the microscopist. A very excellent method of using it is to cast an image of the glowing mantle upon the mirror by means of a balloon flask filled with ammonio-cupric sulphate solution. The flask acts as a condensing lens, and by mutually arranging it and the lamp, the properly-sized mantle image may be thrown upon the mirror. A turned wooden base, bearing a hole in the centre for the reception of the flask neck, has proven the most satisfactory mounting, although improvised ones, in the form of tumblers or empty fruit-jars, have often served the purpose.

The final character of the light is entirely dependent upon the solution in the flask. This must be of such a nature that it will give a nearly white light, without the yellow of the gaslight, or the blue of an excess of the ammonio-cupric salt appearing. With the most careful adjustment, however, the light has a cold bluish cast that obscures some details in sections stained by the iron-hæmatoxylin method. The writer found by experiment that this difficulty could be overcome, and a beautiful soft white light secured by adding one or two drops of a saturated alcoholic solution of safranin to the litre flask of properly-diluted ammonio-cupric sulphate solution. It has been found necessary to renew the safranin every week or two, since it fades upon exposure. The light thus modified leaves nothing to be desired, and has served in the most delicate work with high powers.

In connection with the chair previously described, a shelf is used for holding the gas-lamp and the flask condenser. This projects from the wall, somewhat below the level of the microscope base, and with the bottom of the incandescent mantle at a height of 7in. from the table, needs to be from 20in. to 24in. long to permit the proper adjustments.

Protection for the Eyes.—Almost as important as the illumination of the object is the prevention of extraneous light from entering the eyes of the observer. Nothing is more trying to the visual organs, or more inimical to accurate observation, than a confusion of lights reflected from half a hundred polished surfaces, supplemented by a general glare from wall, ceiling, and floor. One needs only to protect the eyes for a short time from all light except that coming through the ocular in order to prove the facts stated. With the eyes shaded it will be found that very much less illumination will be required, while at the same time definition of a much higher order will be secured.

To profit by these obvious advantages, the writer adopted the simple device of wearing an eye-shade to which had been fastened a square of black cloth at the upper edge. This cloth is of such a length that when the lower edge is gathered around the top of the microscope tube and the shade adjusted on the head, the eye will be about low enough for observation. The cloth falls against the face and around the eyes, so that all light except that coming from the object is prevented from entering. Thus protected, the eyes can be used continuously for hours without becoming fatigued, and the vision is clear and distinct. I believe that no one who has once employed some such means of protecting the eyes will ever conduct further serious observations without thus conserving his eyesight.—C. E McClung, University of Kansas, in the *Journal of Applied Microscopy*, N.Y.

THE GREAT TELESCOPE FOR THE PARIS EXHIBITION.

WE have given some account of the great telescope which is to be an "object" at the Paris Exhibition next year (see p. 191, April 14, 1899, No. 1,777); but the following particulars from the *Scientific American* may be of interest to some readers:—

"It consists of a horizontal tube, 197ft. long, provided with an objective 4·1ft. in diameter. The image of the moon or stars will be sent through this tube by the aid of a Foucault siderostat—that is to say, by a movable plane mirror. The focal length of the telescope of the Yerkes Observatory is but 65·6ft., so that it will be readily seen that with a telescope whose focal length was 197ft., it would be almost impossible to build a dome and mounting which would carry it. It is estimated that a 210ft. cupola would have been required, so the use of a fixed tube and a movable mirror for gathering the image may be regarded as an excellent solution of a mechanical difficulty. The siderostat is undoubtedly the most interesting part of the instrument. It consists of a large cast-iron frame, and is provided with clockwork and devices for causing the mirror to follow the celestial object which is being viewed. The frame is now under construction at the establishment of M. P. Gautier, a distinguished manufacturer of instruments of precision. It is 26¼ft. long, and the height is the same as its length. It is provided with six levelling screws, which enter into sockets fixed upon a stone base 5·57ft. high. The hour axis is actuated by clockwork through the aid of tangent screws. The part of the instrument towards the south carries the mirror, which is mounted in a cast steel cell, lined with felt in order to prevent any contact of the mirror with the metal. The equilibrium of mirror and cell is obtained by means of levers and counterpoises. The base of this mounting floats in a reservoir 6½ft. in diameter and containing about 16 gallons of mercury. Owing to the application of the principle of Archimedes, the movable parts will be relieved of nine-tenths of its weight. The system of the levers and counterpoises is so well arranged that all of the movable parts can be actuated by hand, even without the aid of mercury. The total weight of the siderostat is 99,000lb.; the movable part weighs 33,000lb., of which the mirror and its cell weighs 14,740lb. A weight of 220lb. is sufficient to actuate the clockwork.

"The mirror has a diameter of 6·56ft., it is 10·63in. thick, and its weight is 7,920lb., and it was, naturally, the most difficult part of the apparatus to construct. The glass was cast at the Jeumont Works, and a special furnace was constructed, capable of holding 22·4 tons of glass. When the time for casting arrived, the mould, 6·72ft. in diameter and 12in. thick, was brought to the furnace upon a truck, and then, after being filled, was introduced into the furnace, which had been raised to a high temperature. It was then walled up in

this furnace, and the cooling required a month. Notwithstanding all the precautions, several of the discs that were cast broke in pieces with a loud noise. The transportation of such a huge disc of glass to Paris was a difficult matter, and a special train carried it there without stopping. A crane deposited the gigantic block on a waggon, and it was

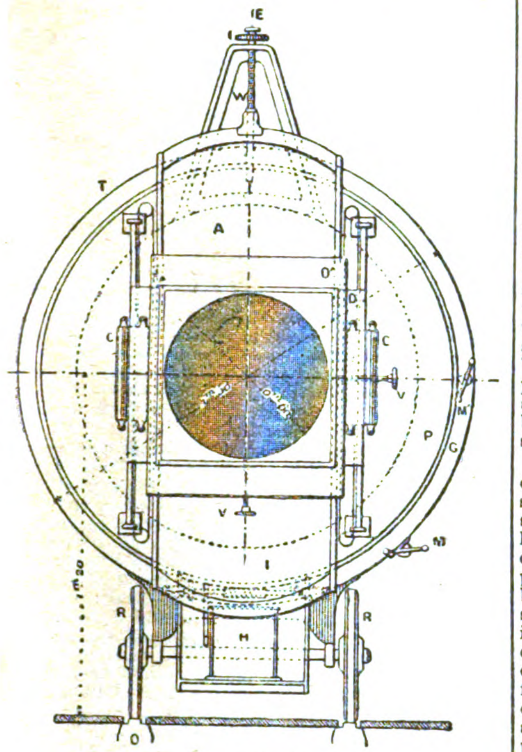


Fig. 1.

carried to the optical establishment at night, in order to have a clear roadway.

"To obtain a fine disc of glass of such dimensions was, of course, difficult, but to give it a perfectly plane surface was a much greater one, and M. Gautier is to be congratulated upon the success which he has attained in performing this difficult operation.

"The polishing-machine, shown in our general and sectional view, was placed in a special shop, protected as much as possible from variations in temperature by a double wooden wall. The grinding apparatus consists essentially of a large cast-iron plate, C, covered with an inch of flannel, upon which the glass disc A (Fig. 2) was carefully laid.

"This plate revolves slowly around a vertical axis by gearing, G, the whole being stepped in a cone. Above there is a stationary circular bronze rubber, B, 47½in. in diameter, which is given a reciprocating motion by a slider, I, thus passing across the face of the mirror travelling in a circle beneath it. The perfect revolution of the plate and the accurate adjusting of the slides and their parallelism resulted in the production of a perfect mirror. It required three months to adjust the slides alone. The grinding of the mirror was done with a mixture of emery and water. During this operation a workman always stood at a respectful distance from the apparatus so as not to change the temperature of it. From time to time he injected a mixture of emery and water by means of a syringe into a channel running through the grinding plate and ending at the centre. This work was carried on generally from 2 to 5 o'clock in the afternoon, the time of day when the temperature does not change perceptibly. The entire morning was devoted to the cleaning of the machine, and to the verification of the parallelism of the grinding plate with the surface of the mirror, an operation which was performed with four scales which were accurate to $\frac{1}{1000}$ of a millimètre.

"As the grinding proceeded, finer and finer emery was used, and the closer the grinding plate was brought to the surface of the glass. With the finest emery the distance between the plate and the glass was 0·008in. The grinding lasted eight months, and was followed by the operation of polishing, which required two months. The lower surface of the polishing plate was covered with a sheet of albumenised paper like that used in photography, but unsensitised. The workmen spread upon this paper a small quantity of the finest Venetian tripoli, and as much as possible was removed with a soft brush. The distance between the rubber and the surface of the glass was 0·0012 of an inch.

"This method of treatment, notwithstanding its delicacy, produces enough heat to render the mirror slightly convex and cause it to draw away more strongly in the centre, so that, upon cooling, it was hollowed at this point. In order to surmount this difficulty the slides were given a curve of which the pitch was 0·4 of an inch. The heat was diminished by operating the machine for a minute and then stopping for a quarter of an hour. When the hand is applied to the mirror, there occurs an extension of 0·0012 of an inch, which is sufficient to distort completely for four or five minutes the image of the flame of a lamp placed at one side of the plate, and observed from the other with a small telescope arranged for the purpose. The next operation to be performed is the silvering, and, of course, it will have to be silvered anew from time to time. The mirror protrudes 5·4in. from its tube or cell, which will be made to swing so as to bring the surface to be silvered underneath. The reservoir containing the bath will be lifted by means of a winch until the mirror enters it at a proper depth. When the operation is finished, the reservoir will be lowered, and the silvered surface turned upwards, and the mirror readjusted in its cell.

"The images of the mirror which are transmitted to the focus of the objective may be examined directly by means of an eyepiece or they may be thrown upon a sensitised plate or projected upon a screen placed in a hall set apart for that purpose so that several thousand people will be able to examine the celestial object at the same time. The tube of the telescope is a steel plate ¼in. in thickness and 5ft. in diameter. It is made up of 24 sections joined with the aid of bolts. These sections when all mounted will rest upon a cast-iron base supported by stone columns. It is arranged so as to slide to take up the expansion and contraction. The tube plays no part in the formation of the images, nor does it serve for supporting the objectives in the eyepiece; but it prevents dust from introducing itself between the essential parts of the apparatus.

"One of the objectives is designed for visual observations, and the other for photographic work. Both are mounted upon a carriage made to roll upon rails, so that either or them may be easily placed in position before the tube. The weight of either of these objectives without its mounting is about 1,295lb., and with the mounting 1,980lb. Each of the crown glasses is carried by rollers, so that it may be separated from the flint glass in order to render the cleaning of each disc easy. The lenses will cost 120,000dol.

"The discs were cast by Mantois, of Paris. Great attention was paid to the casting of the glass. Specimens of the glass were constantly taken out during the heating and examined with a lens under different conditions of illumination, in order to judge of the degree of purity which they have reached. After several specimens have been found to be free from bubbles the temperature is reduced, the glass thickens, the crucible is opened, and a certain portion of the surface is skimmed off to get rid of impurities. The glass is then stirred, and the cooling is allowed to proceed rapidly for five or six hours, until the surface of the glass emits a well-defined sound when it is struck with an iron bar. After this step it is necessary to proceed with annealing. The furnace is walled up and a cooling is allowed to proceed, which requires from four to six weeks. When the crucible is opened the glass is found to have been broken into pieces of varying sizes. In order to obtain a 792lb. flint glass lens it is necessary to find a block which weighs nearly 1,300lb., and such a block having been found among those in the furnace it is removed and placed upon a car. Slabs of glass are sawed from two parallel sides in order to obtain polished surfaces that facilitate a perfect examination of it. The striæ in the surface are removed, and if after this the block exhibits any defects situated at such a depth that they cannot be removed, it is submitted to a moulding which changes its form and brings the chief defects near the surface. The block is placed in a mould of refractory clay and put into a furnace and heated to 800° to 900° Centigrade. By this means it becomes slowly heated and softened until it assumes the form of the mould, but it must not become fused, or the whole operation must be gone over again. If the outcome of the process is successful, the glass is slowly annealed, and is then taken from the mould and examined anew. If any defects deep in the glass are seen, a second operation is begun with a mould of another form. Finally, when the glass is very pure and perfect, another and final moulding produces the plano-convex lens. After this comes another heating and cooling, which takes two or three weeks.

"At this point the glass discs are taken to the establishment of M. Gautier, where the surfaces are polished with a device like that used in polishing the mirror, except that the slides have the curve that is to be given to the disc. A long time is required in polishing out the small imperfections, and finally the lens is entirely corrected and ready for mounting.

"The tube which carries the eyepiece is supported by four wheels rolling upon rails, O. It is attached to the telescope by an adjusting screw, 4·92ft. in length, which serves for putting it in focus. In the interior of this tube another is mounted upon rollers. This inner tube is 3·54ft. in diameter, and is moved circularly by means of clockwork through the medium of a tangent screw which fits into the teeth of a circle fixed to its outer extremity. In this

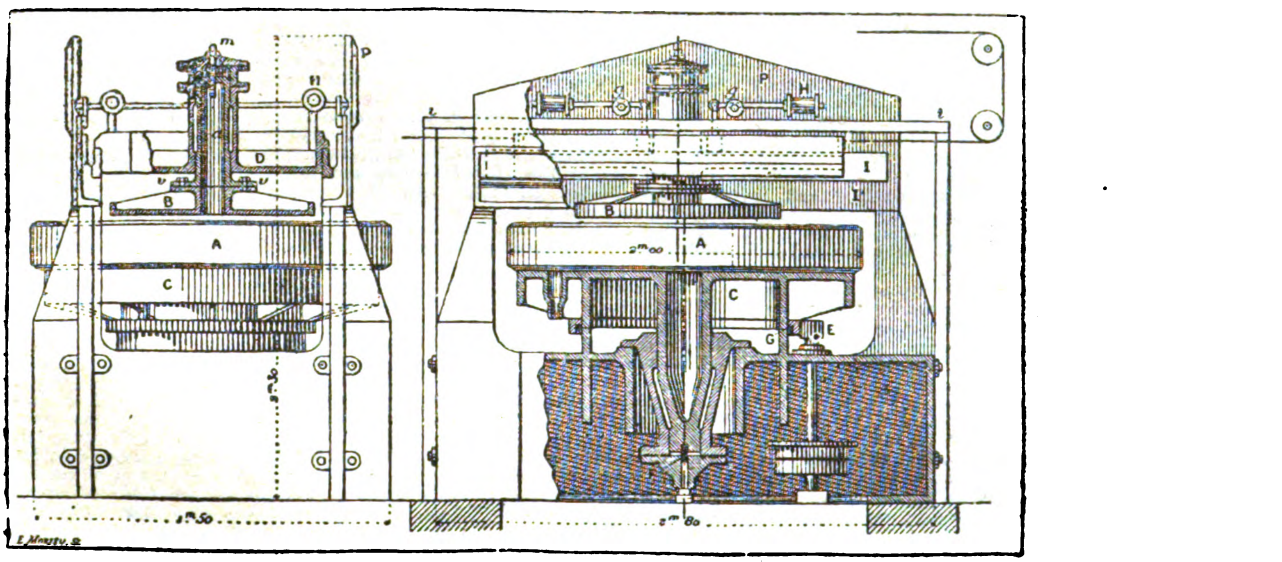
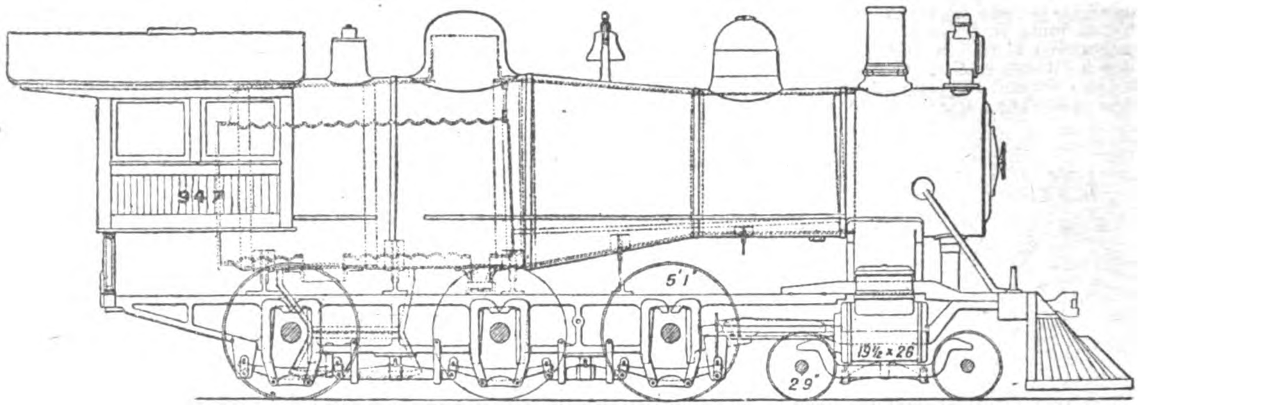


Fig. 2.



first circle, which moves upon four rollers, is a second circle, which carries two guides, and in which slides a carriage having a travel equal to a little more than two minutes of time. This is actuated by a screw, which causes the motion in another clockwork. This carriage is provided with a system of frames having rectilinear motion that permits of giving the eyepiece different positions. The upper frame is so arranged that it may receive devices for photography, micrometry, spectroscopy, or a projecting apparatus. The exact location of the telescope has not yet been determined upon, but it will be at the service of the Exposition, and will probably be placed somewhere where the atmosphere is purer than that of Paris. We are indebted for most of our engravings and for our particulars to L'Exposition de Paris, 1900, which has had an interesting and scientific series of articles upon the great telescope. The diagrams are from *La Nature*."

The particulars given are from the *Scientific American*, and Fig. 1 shows the eyepiece holder, the other illustration showing the mirror-grinding apparatus in section.

THE VANDERBILT LOCOMOTIVE FIREBOX.

ATTEMPTS have been made at various times to simplify the construction and increase the efficiency of locomotive boilers, by the use of a cylindrical firebox instead of the ordinary rectangular firebox, whose flat surfaces require so much staying, involving a great amount of labour and time in construction and repairs. For various reasons, however, only partial success has attended the experiments, and the system has never yet got beyond the experimental stage.

One of the latest and most promising attempts of this kind has recently been made in the United States. A goods engine of the New York Central Railroad has been fitted with a boiler of somewhat peculiar design, the special feature of which is a corrugated cylindrical firebox, like the furnace of a marine boiler, and having a clear inside diameter of 4ft. 11in. The boiler was designed by Mr. C. Vanderbilt, jun., one of the assistants to Mr. A. M. Waitt, the locomotive superintendent.

The boiler is 29ft. 3in. long over all. The smokebox is 5ft. 7in. diameter and 5ft. 6in. long, and the first barrel course is 5ft. 4in. outside diameter, and 6ft. 3in. in length. This course has plates 11/16in. thick, and fits telescopically into the smoke-box and into the second barrel course. Within it, and near the front end, is riveted the flanged tube sheet, which is slightly inclined backward from the vertical, as the boiler is inclined forward in order to clear the driving wheels. The second barrel course is conical, 5ft. 4in. diameter at the smaller end and 7ft. at the rear, its length being 6ft. 6in. The outer firebox shell is circular, 11ft. 3in. long and 7ft. 1⅝in. diameter, built up of two courses in length. The boiler is thus of circular section from end to end. The corrugated firebox is 4ft. 11in. inside diameter, and 5ft. 4in. diameter at the ends, while its total length is 11ft. 2¼in. It is of ⅝in. steel. In the front is a flanged tube sheet, while the rear end projects through the boiler head, and is riveted to the flanged back-plate of the outer firebox shell. The only firebox stays required are 28 sling stays, arranged in a circle around the front end of the firebox, these being 1⅛in. diameter, with forked ends fitting over T-bar studs.

The dome, 30in. diameter and 20½in. high, is directly over the front end of the firebox. At the back part of the bottom of the firebox is an 18in. opening to the ashpan, while at the front end, beyond the brick bridge wall, is an 8in. opening for cleaning out such ashes as may collect in this combustion chamber between the bridge and the tube sheet. The firebox is, of course, not concentric with the boiler, the steam space above the firebox being 1ft. 6in. high, while the water spaces decrease from 11in. at the sides to 3½in. at the bottom. There are two oval fire-doors, 16in. by 13in., side by side as in some of the wide Wootton fireboxes, for burning small coal of poor quality.

The longitudinal stays for the boiler are shown by dotted lines. In the boiler are 332 tubes, 2in. diameter and 12ft. 6in. long. They are set in vertical rows, staggered horizontally, and are spaced 2 11/16in. centre to centre.

The engine was built in the shops of the railway company, and is of the six-coupled bogie type, known in America as the "ten-wheel" type. It has six-coupled driving wheels, of which the middle pair are the main drivers, while under the smoke-box is a four-wheeled leading bogie. The leading dimensions are as follows:—

Cylinders 20in. by 28in., driving wheels 5ft. 1in., bogie wheels 2ft. 9in., driving journals 9in. by 12in., boiler (diameter of barrel) 5ft. 4in. to 7ft., firebox shell (diameter) 7ft. 1⅝in., firebox (diameter inside) 4ft. 11in., firebox proper (length) 8ft. 2in., firebox and combustion chamber (length) 11ft. 2¼in., steam pressure 185lb., tubes, 332 diameter 2in., tubes (length) 12ft. 6in., heating surface (tubes) 2,165sq.ft., heating surface (firebox) 192sq.ft., heating surface (total) 2,357sq.ft., grate area 34sq.ft., weight on driving wheels 113,300lb., weight on bogie 46,700lb., weight, total tons, English, 71·5.

The boiler steams so freely, or in other words, generates steam so rapidly, that the two 3in. safety-valves were found not to afford sufficient relief, the pressure several times running up to 195lb. when the valves were set to blow off at 180lb. A third valve has since been added. The engine made a trip of 143 miles on its first run, with a train of 50 waggons, and after a stop of three hours returned with a train of 67 empty cars—about 800 to 900 tons. It attained a speed of 25 to 30 miles per hour on this trip, and it was noted that very few cinders were thrown from the smoke-stack or funnel.

The use of corrugated fireboxes in locomotives is by no means new. They were invented by the late John Haswell, of Vienna, about the year 1870, or possibly earlier. They were in use on the Austrian Staates Bahn for many years. Probably most of our readers who are interested in locomotive design will recall the corrugated flue furnaces used in Mr. Strong's singular locomotive, which was tried about ten years ago in the United States, and was described in the *Engineer* at that time. Mr. Strong, however, used two furnaces, side by side, with their ends connected to a third corrugated flue, which formed a combustion chamber, and at the end of which was the tube sheet. This arrangement was specially designed for very long runs, and for inferior fuel, the fires being cleaned and fed alternately. The engine made trips of 440 miles with one train, but it required two firemen to keep the fires in condition. The three corrugated flues were 38½in. diameter, with a 5ft. boiler barrel, and a firebox shell, 5ft. by 9ft. The furnaces were 9ft. 6in. long, the distance from boiler head to tube sheet being 18ft. 6in. The tubes were 11ft. 6in. long, and the total length of boiler, from the back plate of the firebox to the front of the smoke-box, was 33ft. This type of boiler is evidently only adapted to engines of special design.

In 1890 Mr. Gustav Lentz, formerly managing director of the Hohenzollern Locomotive Works, in Germany, designed a locomotive boiler, having a corrugated cylindrical furnace. His boiler was of larger diameter at the middle than at the ends, and the rear part of the furnace was inclined downwards. This part formed the furnace proper, a brick wall with a semicircular opening being built at the end, and the horizontal portion of the furnace forming a combustion chamber. A six-coupled goods engine, with cylinders 17¾in. by 24⅞in., and wheels 4ft. 4⅜in. diameter, was fitted with a Centz boiler, the weight of the engine being about 32½ tons. The furnace was 3ft. 9in. diameter, with 6ft. of its length as a firebox, and 4ft. 11in. as a combustion chamber. The tubes were only 10ft. long. In 1892 a four-coupled bogie express engine, for the Prussian State Railways, was built according to the designs of Mr. Lenz. It had cylinders 17in. by 23⅝in., driving wheels 6½ft. diameter, and weighed 50 tons. This engine is said to have been successful as a steam generator, and for complete combustion of fuel, but was very wasteful of the heat. The smoke-box temperature, in fact, reached 768°, while in the ordinary engines it was about 526°.

The Vanderbilt boiler is of much simpler design and easier of construction than either the Strong or the Lentz boilers, and it appears to promise good results in service. Whether it will effect any practical change or revolution in locomotive design remains to be seen. At present the one goods engine is in regular service, and a record is being kept of its performance. The general results of one of the trips with a goods train were as follows:—

Distance 140 miles, total time 8 hours 15 minutes, running time 6 hours 51 minutes; speed, average for running time, 20 4 miles per hour; speed, maximum, 30·2 miles per hour; weight of train, behind tender (gross tons 2,240lb), 826 tons; weight of train, engine and tender (gross tons 2,240lb.), 940 tons; coal consumed 12,390lb., water consumed 107,571lb., water evaporated per pound of coal 8·60lb., water evaporated from and at 212° Fahr. 10·30lb., coal per car per mile 1·43lb., coal per 100 tons per mile 9·40lb. tons hauled one mile per pound of coal 10·40 tons, tons hauled one mile per pound of water 1·23 tons.—*The Engineer.*

THE COLOURING OF LANTERN SLIDES.

IN the *Bolletino della Soc. Fot. Ital.* Roster points out that in colouring slides the best results are obtained with aniline colours, and that it is important that the colours should not destroy one another, and he suggests the following as satisfactory. Blue: Indigo carmine. This is the best colour for the sky. Green: (*a*) Malachite green. This is very brilliant, and must be sparingly used, and it is difficult to spread it evenly on large surfaces, and it is not suitable for plants and foliage. (*b*) A mixture of tropælin O and indigo carmine is the best for foliage, and, according to the proportion of these two, a cold, a brilliant, or a yellowish green is obtained, and also the colour of dead leaves. Yellow: (*a*) Tropælin O for bright yellow, mixed with eosine it gives flesh tints. (*b*) Mixtures of tropælin O and orange for darker and golden yellow. (*c*) Orange alone. Red: (*a*) Eosine for a bright red. (*b*) Mixture of eosine and orange for brilliant fiery red. For brown: (*a*) Bismarck: brown or vesuvin; the former is to be preferred for warm brown tones. (*b*) Mixtures of Bismarck brown and indigo carmine for cold brown tones.

The separate colours, as well as the mixtures, may be kept in stock in stoppered bottles. A retouching desk should be used with a sheet of white paper as a reflector, and the plate slightly tilted. The reflector should be about 4in. from the plate.

The transparency should be allowed to thoroughly soften by soaking in water for half an hour, then blotted off with blotting-paper, and placed on the retouching desk. The colours should be applied with a camel's-hair brush in a very dilute state, and the operation repeated to obtain the necessary intensity. After every application the excess of colour should be removed with a sheet of blotting-paper. When colouring large surfaces, it is advisable to pass over it a broad brush dipped in plain water before blotting off; this evens the colour. In working up the sky the transparency should be turned upside down, and the colour applied from the landscape; a natural gradation will thus be obtained.—*British Journal of Photography.*

THE electric railway power stations in America use larger units than in Europe; 1500-kilowatt, 2000-kilowatt, 3000-kilowatt machines may now be regarded as common American practice.

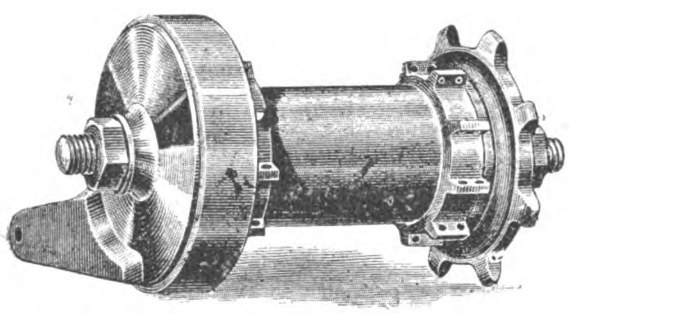


Fig. 1.

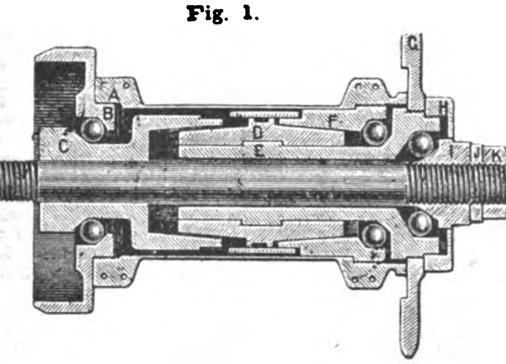


Fig. 2.

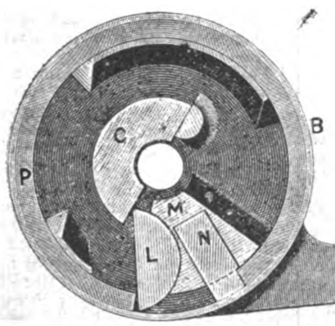


Fig. 3.

THE "NEW DEPARTURE" AUTOMATIC COASTER.

We have from time to time published descriptions of novel forms of bicycle devices. We take pleasure in publishing herewith a new form of coaster hub which possesses novelty of construction in several particulars. It will be noticed from the description given below that in going down hill the wheels may be allowed to run freely with the pedals remaining in a stationary position, while the brake may be applied by simply bringing the weight to bear upon the rear pedal.

The coaster uses 36 straight spokes, and can be furnished with any size or thickness of sprocket from 7 teeth by $\frac{3}{16}$in. up. No fitting or adjusting is necessary, for the hub, when it leaves the factory, is in perfect order, ready to be placed on the wheel. It has the advantage of being no larger than the regular bicycle hub, and has its coasting device assembled compactly and securely within the hub shell. Anyone can apply the coaster in a few moments to any form of wheel.

When the rider desires to coast, the feet are simply held still, thereby releasing the driving mechanism and allowing the wheel to coast freely. By a slight downward pressure on the rear pedal the brake is brought into action and adjusted as required. When it is desired to go ahead, it is necessary simply to pedal forward in the usual manner. There is no back-pedalling; the pedal cannot jump, either forward or backward; and there is no strain or twist whatever upon the machine.

What is probably the greatest advantage, and one peculiar to this device, is the fact that the rider always has a tight pedal under foot, which feature is of itself of paramount importance in any free-wheel device. The best rider will naturally feel nervous and insecure if the pedals hang loosely under foot; but in this improved device there is no point where the pedals are not in thorough contact either with the coasting or driving mechanism.

Second only to this point is the fact that the wheel may be trundled backward or forward, allowing easy racking, whether the coasting be on or off. In walking alongside of the machine the pedals may remain stationary, so that they will not interfere with the limbs or clothing.

The method of obtaining these advantages will be noted by referring to the cuts. Fig. 1 shows the coaster hub assembled as shipped from the factory. Figs. 2 and 3 show the manner of assembling the interior mechanism.

The chain, when pulled forward, causes the sprocket G to rotate. This sprocket, being fast upon the driver E causes it to rotate forward, thereby drawing the cone D over into contact with the clutch F, which, being fast in the hub, causes the hub to rotate and the wheel to move forward.

When the rider holds the feet still upon the pedals, the driver E stops rotating, thus drawing the cone D out of engagement with the clutch F, and carrying it across into the brake-clutch C. The brake is not yet applied; but the wheel is free to coast with the feet upon the pedals. If it be desired to brake, simply press lightly upon the rear pedal; and the brake is instantly in operation, and can be graduated to any degree desired. When it is required to propel the wheel, merely pedal ahead; the mechanism does all the adjusting. There is no "kick-off."

The device is manufactured by the New Departure Bell Company, Bristol, Conn., which is represented by John H. Graham and Company, No. 113, Chambers-street, New York, N.Y. — *Scientific American.*

STEEL CASTINGS.

At a recent meeting of the Manchester Association of Engineers, Mr. J. E. Fletcher read a paper on "The Manufacture of Steel Castings." The chief difficulty, he said, was in the manufacture of steel castings in connection with their contraction. The contractional coefficient being roughly double that of cast iron, very special means were necessary in order to release castings of large dimensions rapidly and successfully whilst cooling. With regard to hydraulic cylinders, Mr. Fletcher recommended that these should always be cast mouth upwards. By this means the weakest portion—viz., the closed end of the cylinder, was most likely to be perfectly sound, as it was subjected to the pressure of the whole of the cylinder body and casting-head above it. Again, the crystallisation of the steel in the cylinder base was regular, and the contraction more uniform. With regard to the casting of engine, boiler, and pipe connections, he said that in the Navy the introduction of the Belleville boiler had led to the use of steel castings of most intricate form, some of which had been produced successfully; but in the case of others, waster after waster had rewarded the founders' efforts. He believed he was perfectly correct in saying that on several occasions the completion of warships had been delayed simply on account of the difficulty in obtaining delivery of steel boiler castings of the intricate order above mentioned. From experience gained the following conclusions had been arrived at:—Pipes, tees, bends, and valve-bodies of over 4in. bore should not be less than $\frac{5}{8}$in. thick; under 5in. bore, $\frac{1}{2}$in.; 6in. to 8in., $\frac{3}{4}$in.; 8in. to 10in., $\frac{7}{8}$in.; 10in. to 12in., 1in. The holes in all flanges should be drilled; the junction of two boxes should be well rounded, and the coupling flanges kept as small as possible. In casting for locomotive purposes several articles had given considerable trouble, notably wheel centres, motion-plates, and bogie-frame castings of more or less intricate form. The greatest difficulty was in the production of wheel centres having heavy balance weights. It was true that steel founders, had overcome the difficulty partially, and such wheels could be cast free from flaw, but it was extremely doubtful whether they were ever free from the severe strains set up during contraction, however well the castings were annealed. Dealing with the casting of spur and bevel wheels for millwrights' use, Mr. Fletcher said the thickness of arms and rims should be as nearly as possible uniform. Wheels over 4ft. 6in. diameter should have their shaft bosses or eyes split, and afterwards hooped. The Continental plan of adopting an odd number of arms was recommended, such wheels as a rule being more truly circular than wheels with an even number of arms. Wheels in halves should be cast in one piece, afterwards being sawn or drilled apart at the rim. The arms of bevel-wheels should be of H section, and where the wheels had very flat faces the rims should be stiffened. Steel wheels with disc centres were not recommended, fracture in cooling being of constant occurrence. In conclusion, the author remarked that in considering various representative castings, the question of crystalline structure played an important part. In fact, wherever in a casting, weak zones of crystallisation occurred, there was a risk, to a greater or less extent, of fracture. The risk might be minimised by annealing only, and he was strongly of opinion that all steel castings should be well annealed. The demand for very mild steel castings giving high ductility had in some cases been carried too far, intricate forms of rapidly changing section, when cast in steel of this character, being very likely to fail; indeed, it might be taken as certain that mild qualities of steel developed cracks more readily than the harder ones. The production of steel castings would be carried on more successfully as the laws of cooling in relation to crystalline structure became more widely known, but steel founders, with all other metal founders, were seriously hampered by the appalling general ignorance—on scientific subjects—of the moulder.

In the discussion

on the paper, Mr. James Saxon agreed with the author as to the advisability of splitting the bosses of wheels for millwrights' use, and also the advantage of having an odd number of arms.—Mr. Parry said the most difficult locomotive casting to deal with was the radial axle-box.—Mr. Whittaker expressed the opinion that 25 per cent. of bad steel castings were due to the steel being badly melted in the furnace.—Mr. Alfred Saxon said that, for certain classes of engine-work, engineers would not adopt steel castings unless they were produced lighter than cast iron.—Mr. Mitton thought there was no virtue in having an odd number of arms in wheels for millwrights' requirements.—Mr. Hodgson said the foreman moulder ought to be taken more into confidence by those who were designing the work.—Mr. Daniels considered hydraulic castings were best when cast with the head down.—Mr. Whitehead thought a good deal of trouble in steel-casting arose from the hard sand or compound of which the mould was made.—Mr. Fletcher, in replying, said the different results obtained in castings when they used the same method of moulding, casting, and releasing, were largely due to the difference in the temperatures at which the castings set. In the case of large or vital defects, he would not recommend electric welding; but in making good small defects that could be readily got at, it was perfectly satisfactory.

TEMPERING COPPER.

The art of tempering copper and bronze tools is supposed to be a lost art; but announcements are frequently made about the discovery of a method of putting a hard edge on copper. They are generally misleading; but this seems definite, and, as a patent has been applied for, the truth will soon be known:—

Martin L. Shevlin, of Elizabeth, Pa., employed at Lohrey's pork-packing establishment, on East-street, Allegheny, is the inventor of a process for

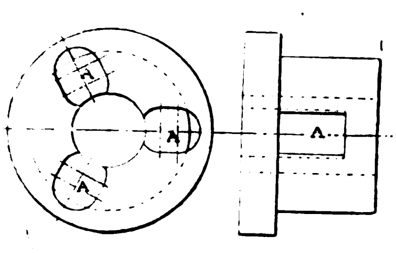


Fig. 1

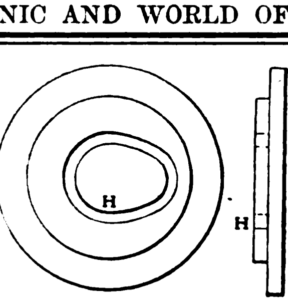


Fig. 3

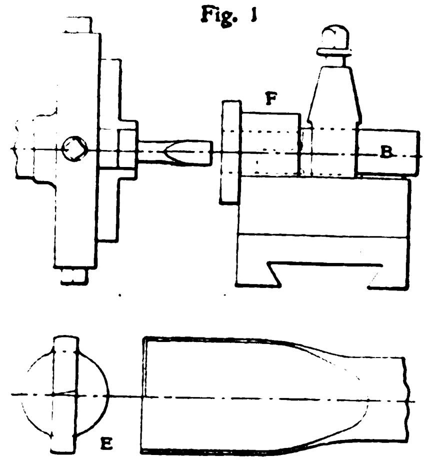


Fig. 2

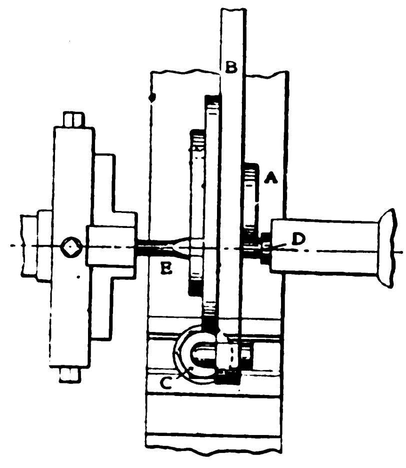


Fig. 4

tempering copper which he is confident will revolutionise the use of metals. Mr. Shevlin has already applied for a patent for his formula, which has been pronounced a valuable discovery by experienced mechanics, who have learned something of its results. The inventor has shown a reporter several tools made of copper which have been successfully tempered by the process. One was a knife, the blade of which was hard and sharp as steel, and as pliable. Another was a chisel, which had been tested by hard usage. Mr. Shevlin says he has worked on this formula for five years. He says the process is very simple, and can be utilised very economically. He states he is satisfied it will undergo successfully the most rigid scientific test. He says he can temper copper until it can be employed for the same purposes as steel and the harder metals, in cutlery, tools, and machinery, and states that it has an advantage over other metals, as it will not corrode, rust, or soften when subjected to the most intense heat.—*Pittsburg Dispatch.*

JOBBING WORK.

USEFUL hints are often found in places where they are not expected, and the following by Mr. S. A. Betterman, in the *American Machinist*, may be deemed interesting:—One of the various jobs which I noticed passing through the Judge's hands was making occasionally one or two tube-expanders of the Dudgeon type. The interesting feature was the making of the three oblong holes A A A in the body, Fig. 1, of the expander. This piece was held as at F, Fig. 2, in the tool block of the "rise and fall" rest of the lathe, and clamped by the stump of a boring tool B, tightened by the tool-post screw. The flat drill, shown enlarged at E, was held in the chuck, and by feeding the carriage towards the head-stock, the two outer circles of the oblong hole were drilled, and then by using the cross-feed the sides of the hole were milled straight. The piece was reset for the second and third holes, which were drilled and milled in the same manner.

This flat drill, ground with reasonable care by hand, can be made to cut nice short keyways, holding the drill in the lathe chuck and clamping the shaft to the tool block. It can be made to bore or mill holes or grooves considerably larger than itself, adjusting the size by setting it out of the centre with the independent chuck jaws and cutting with but one lip. As a makeshift it is sometimes very useful.

The heads of covers, Fig. 3, for the cylinder or casing of a rotary engine having the groove H to be finished came to the Judge. Hand work was useless, so a former A, Fig. 4, was made, the shape and size of the inside of the groove H, Fig. 3, and screwed to the side of the lever B, the screws passing through the lever and tapped into the cylinder head and holding the three pieces firmly together. A piece of ⅝in. round iron was bent at a right angle and the shank threaded and held fast in the lathe tool block, as at C, by the two nuts. This formed a fulcrum for the lever B. A worn-out lathe centre still had stock enough to make a stud D, the width of the groove H in diameter. The flat drill or mill E, ground carefully, was chucked true, and a helper at the end of the lever B held the former firmly against the stud, while the carriage and tail-stock spindle were fed toward the head-stock till a hole was drilled the depth of the groove intended. Then, by feeding slowly forward and backward with the cross-feed screw, the former at all times held firmly against the stud while following around it, a very fair job of profiling was accomplished. Five days' hand work wouldn't have made as good a job of those two heads as five hours, making the rig and machining the grooves, did by this method.

INTERNAL COMBUSTION MOTORS.

THE high economy which has been demonstrated to be possible in the case of the Diesel motor has attracted much attention to internal combustion motors of all sorts during the past year, and there appears to be little doubt that much better results can be attained from various forms of such machines than had hitherto been thought practicable.

Among those who have devoted attention to this subject is the chief engineer of the well-known firm of Ganz and Co., of Budapest, Prof. Donat Banki, and a very complete discussion by him of the principles involved in the economic performance of internal combustion motors is given in a recent issue of *Le Génie Civil*, being a translation of the original paper in the Hungarian review *A Magyar Mérnök*.

Assuming that the phenomena in the cylinder of a motor of the internal combustion type may be considered simply as those belonging to the variations in pressure and volume of a given mass of air under varying conditions of temperature, Prof. Banki proceeds to investigate the influence of various modes of introduction of heat in the cycle. This he does, as others have also done, by the study of various curves, constructing what are practically indicator diagrams for the different conditions assumed. By comparison of these curves he then seeks to determine which one, for a given compression, may be expected to give the highest degree of efficiency.

By a similar analysis Herr Diesel concluded that the greatest economy would be secured by isothermic combustion, the loss of heat by conversion into work exactly corresponding to the generation of heat by combustion, the temperature during expansion therefore remaining constant, and these conditions he sought to realise in his motor. This method involves a continuous combustion, and not a very rapid or almost instantaneous explosion, and Diesel has designed his motor so as to feed the combustible gradually into the cylinder, where it is slowly and completely burned.

Prof. Banki, however, deduces that the highest economy is attained when the terminal temperature is the lowest, assuming in each case the same quantity of heat, and demonstrates mathematically that this is secured by a motor of the explosion type, the combustion being practically instantaneous.

This conclusion is based upon the same degree of compression in each case, and a further examination is then made into the influence of compression upon economy. Here some interesting deductions appear. The compression may be either isothermic or adiabatic, and Prof. Banki shows that the latter should theoretically give the best result. The degree of compression, however, has an important influence. For moderate pressures it appears that the indicated and mechanical efficiency is greater for explosion motors than for combustion motors, while for high degrees of compression the two varieties approach more nearly in efficiency, and for very high compressions the advantage is on the side of the combustion motor.

In the case of high compressions it is necessary to compress the air separately from the fuel, in order to avoid premature ignition, and this is the practical method adopted in the Diesel motor.

The conclusions of Prof. Banki might readily be checked by experiment, and, in fact, such tests as have been made with motors of the types discussed confirm his deductions. For motors operating with slow combustion the compression should be as nearly adiabatic as possible, and there should, therefore, be as little cooling of the cylinder as possible, only sufficient to prevent injury to the cylinder and piston being employed.

If the combustion can be controlled, the best result should be expected by providing an isobaric combustion, the pressure neither rising nor falling until the fuel is consumed, and this with adiabatic compression will give a high degree of economy if the compression is sufficiently high. If the compression reaches 30 atmospheres the thermal efficiency may reach 40 per cent., a degree not yet attained in actual practice.

Prof. Banki is most ready to give Herr Diesel full credit for the work he has done in indicating and applying the correct theoretical principles to internal combustion motors, and considers his work to be as important in petroleum motors as was the introduction of the four-cycle compression gas-engine by Otto in its line.

Prof. Banki has himself devised a motor in which high compression may be employed in connection with the simultaneous admission of the combustible without danger of premature ignition, by using a sprayed injection of water into the working cylinder. The presence of the moisture delays the ignition to any desired point, while after, or rather during, the combustion the spray is converted into steam, the motor practically becoming a steam-engine using superheated steam generated in the cylinder itself. Several engines of this design have been constructed, and show an efficiency equal to that of the Diesel motor, a consumption of only 208 grammes of petroleum per horse-power-hour being required, with a mean effective pressure of 10 atmospheres.

In these circumstances it appears as if it were only a question of a very brief time before petroleum motors designed upon the principles demonstrated by Diesel, Banki, and others will come into general use, not only for small powers, but also for general service.—*The Engineering Magazine.*

THE NATIONAL CYCLE SHOW.

THE National Cycle Show was opened at the Crystal Palace on Friday, and the whole of the nave is devoted to up-to-date exhibits of the principal firms in the trade. The chief novelty is the introduction of the free wheel and various rim-brakes, while a considerable space is devoted to motor-cycles and cars of every description. A new feature which is likely to prove a special attraction will be the electrically-driven machines for manufacturing the component parts of a cycle. Our readers who are acquainted with the well-known "Juno" cycles will find a varied assortment on show at the stand of the Metropolitan Machinists' Co., with all the latest improvements at a reasonable price for cash or credit; and the Dunlop Tire Co., whose exhibit is appropriately the largest in the show, have an interesting display of their various rubber goods. Messrs. R. Melhuish and Sons, of Fetter-lane, who are known to our readers as the best makers of tools of every description, have an interesting exhibit of lathes, drilling and planing machines, wheel-cutting and dividing apparatus, brazing forge and lamps, cycle stocks and dies, vices, dies, shop tools, and general engineering supplies.

WHAT is said to be the largest rope cable in the world has been in use for some time for the Glasgow District Subway. It was manufactured by D. H. and G. Haggie, of Sunderland, and its weight is about 55 tons. Its life has proved to be 14½ months, the previous record being 10½ months, and during this time it has run 85,000 miles, whilst the previous best record was 61,000 miles.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE opening meeting of this Society for the present session was held on Wednesday evening, the 15th inst., at the Institution of Civil Engineers; Mr. F. C. Bayard, LL.M., President, in the chair. Mr. R. Curtis read a paper on "The Diurnal Variation of the Barometer in the British Isles." The principal features of a curve exhibiting the diurnal march of barometrical pressure are two minima and two maxima—the first minimum occurring early in the morning, and the second in the afternoon, while the first maximum falls in the forenoon, and the second not far from ten o'clock in the evening. In the Tropics, the oscillation may amount to as much as a tenth of an inch; but its amplitude decreases as the latitude increases, and the greatest amplitude in the British Isles amounts to not much more than three-hundredths of an inch. The author discusses the mean hourly readings of the barometer from 25 years' observations (1871-'95) at four observatories maintained by the Meteorological Council—viz., Kew, Aberdeen, Falmouth, and Valencia. The author is of opinion that the primary cause of the diurnal oscillation of the barometer is solar radiation, and that its amplitude is chiefly determined by the temperature of the lower strata of the atmosphere. The relative magnitudes of the different phases of the barometer oscillation, as observed, depend largely upon the geographical position and physical surroundings of the place of observation, in so far as these are capable of modifying its temperature conditions, and especially the relative distribution of temperature over the regions immediately surrounding it.

Mr. G. J. Symons, F.R.S., described some experimental observations which he made during the hot weather in July with two thermometers 1ft. below the surface of the ground, with the view of ascertaining (1) the influence of slight shade, (2) the amount of daily range, and (3) the approximate curve of daily fluctuation.

QUEKETT MICROSCOPICAL CLUB.

THE 372nd Ordinary Meeting of this club was held on Friday, Nov. 17th, at 20, Hanover-square. Dr. J. Tatham, M.A., President, in the chair. A series of photographic reproductions of the plates in Ehrenberg's "Radiolaria from Barbados," published many years ago as a supplement to the "Mikrogeologie," and now scarce, was presented by Mr. Mottram. Messrs. Baker exhibited Leitz's new travelling or portable microscope, with folding base and removable stage, coarse adjustment by rack, fine adjustment on the Roberval plan, Abbe condenser and Iris.

Mr. A. Earland read an elaborate paper on the "Radiolaria or Polycystina," dealing with their classification, morphology, physiology, and distribution. The next meeting will be held on Friday, December 15th.

IN designing a system of town sewerage, a flow of 3½ft. per second should be the minimum velocity permissible in a small sewer, and 3ft. per second in a large sewer.

Life and Immortality.—"We know that of late years," says Sir E. Fry, continuing his account of the Mycetozoa in the November issue of *Knowledge*, "many interesting theories and questions have been propounded in relation to the great fact of death, and that the entrance of death into the great chain of organic life has been watched and studied. One view, to which Prof. Weismann has given great prominence, is that unicellular organisms possess an unending duration, or, in other words, that though susceptible of death by external force —as, e.g., by fire—there is no natural death, but on the contrary a potential immortality. . . . Another view put forward (not by Weismann but by Götte) holds that death is always connected with reproduction, and is a consequence of the latter in the lower animals. Lastly may be noticed another view, also propounded by Götte, that the first form of death is to be found in the phenomenon known as encystment, which occurs when an organism which has been alive and exhibiting the phenomena of motion becomes stationary, develops a cyst or coat around it, and after a period of rest and suspended animation again revives when the favouring circumstances occur. . . . In the higher organisms we know of death in two forms, the death of a part cast off, as when we shed a hair or lose a tooth, or as when a tree casts off its dead leaves; and, secondly, the death which affects the whole organism; and further that reproduction is in a great majority of the higher organisms accompanied by the casting off of some parts of the organism which have been devoted to the nutrition and protection of the young offspring. In plants we know how the floral envelopes drop off, and how the seed vessels are allowed to fall and decay when their duty is done; and corresponding phenomena exist in the animal world."

SCIENTIFIC NEWS.

THE elaborate preparations made in some places for observing the meteors seem to have met with little recompense, for although some observations have been made in America, fogs generally prevented the "seeing" in this country and on the Continent, even if there was anything to observe. The authorities of Vienna Observatory sent a party to Delhi, and others to elevated positions such as the Kahlenberg, near Vienna, and the Schneeberg and the Sonnwendstein, from which positions considerable numbers of meteors were noticed, but nothing to be compared to what was expected. A violent snowstorm burst over the Alpine region, and seems to have prevented the view of any meteors that were to be seen. From Treptow Observatory there is a report that falling stars were seen in "large numbers," and from Madrid Observatory a note that a "number of the Leonids" were seen.

Mlle. Klumpke, of the Paris Observatory, who was sent up in a balloon by the Meudon Observatory and the Aërial Navigation Society to observe the Leonids in the region above fog or cloud, alighted at Saint Germain-sur-Ay, near the Channel. She saw only twelve shooting stars, seven of them of the 1st magnitude. She saw more on a following night. M. de Fonvielle thinks that the greatest display was on Tuesday night, when 80 were counted by another balloon observer.

It is announced that at Yale Observatory a dozen photographs were secured; but, taken altogether, the reports received indicate a "failure."

It appears that three more small planets have been discovered by Dr. Max Wolf and Herr Schwassmann, of Königstuhl, Heidelberg, in addition to those mentioned last week. Two of these were noted on Oct. 31, and the other on Nov. 4. They require verification, especially as one of them had been photographed some weeks earlier than the date given.

The death is announced of Sir John William Dawson, M.A., F.R.S., &c., Emeritus Principal of M'Gill University, at the age of 79. Born at Pictou, Nova Scotia, in October, 1820, he studied in Edinburgh, returning to his native land with a youthful love of natural history, strengthened by a sound scientific training. He soon became an authority on the geology of his native province. He devoted himself at first to general educational work, and by 1850 had come so well to the front as to be appointed Superintendent of Education in Nova Scotia. Five years later he was called to a yet more responsible position. In 1813, a citizen of Montreal—James M'Gill by name—had left his property for the foundation of a college in that city. But it was not till 1821 that the institution received a charter granting it University powers. Dawson was appointed Principal in 1855, and during his long rule did much to raise M'Gill to its present prosperous condition. He was not only a teacher and administrator, he was also a diligent worker at more than one branch of geology, the author of several books and of many contributions to scientific journals. He was knighted on the occasion of the visit of the British Association to Montreal, having received a C.M.G. two years before. He was a Fellow of the Royal Society of England, and first President of that of Canada, President of the American Association in 1882, and of the British Association in 1886.

Prof. Johann Carl Wilhelm Ferdinand Tiemann died last week at Meran. He was born at Rübeland in 1848, became a Ph.D. of Göttingen in 1870, and in 1882 was appointed professor of chemistry in Berlin University, undertaking from the same date the editorship of the *Proceedings* of the German Chemical Society. Prof. Tiemann was the author of numerous important researches of the most abstract nature in pure chemistry, having for their object the discovery of the constitution of the camphors, the terpenes, and other organic bodies. That branch of chemistry, owing to the expense, is much neglected in this country; but now and then a "discovery" is made which produces enormous profits. Prof. Tiemann, for example, discovered methods of making artificial flavouring matters and artificial scents—notably ionone—and he was recently in this country defending successfully an attempt to obtain a revocation of his patents.

Dr. Henry Hicks, F.R.S., who had been hon. sec. and president of the Geological Society, is reported to have died at his residence in Hendon at the age of sixty-two years. Dr. Hicks was an M.D. of St. Andrew's, and a specialist in mental diseases; but he was most widely known as an expert in geology, a subject he made a special study, as he showed by numerous papers presented to the Geological Society and to the British Association.

Dr. Sophie Torma, one of the few women who have distinguished themselves as antiquarians and anthropologists, died last week in Transylvania at the age of fifty-nine. With her sister she made excavations at Tordos, in Transylvania, and was a correspondent of Dr. Schliemann, Prof. Sayce, and other well-known antiquarians.

The death is announced of Mr. Alexander McDougall, who was known about 60 years back as the inventor of what was termed an atmospheric railway, and has been associated since then with a long succession of mechanical and chemical appliances. He was born 90 years ago, at Coldstream, and for many years was in high repute as a schoolmaster at Chorlton Hall, and also at the newly-founded Mechanics' Institute and other establishments, Manchester, where some of the more prominent local men of the present and previous generation gained, as they acknowledged, much benefit from his teaching. He studied under the famous chemist, Dr. Dalton, and among his local friends he then numbered Playfair, Joule, and Angus Smith. He eventually entered into the business of a manufacturing chemist, and produced some important results in the making of disinfectants, baking powders, and aërated bread.

The death of Dr. Camara Pestama at Lisbon on the 15th inst. adds another name to the list of martyrs to science. He caught the plague while studying the disease at Oporto. Dr. Pestama was chief of the Bacteriological Institute at Lisbon, a man in the prime of life, an ardent and most accomplished bacteriologist. It was his verdict on specimens sent to him from Oporto for examination that conclusively established the existence of the plague there in August last. He paid several visits to Oporto to study the outbreak, and was present when the foreign representatives of science visited the city. His contributions to bacteriology are of great value, but being, unfortunately, written in Portuguese, they have attracted little attention.

Sir Richard Moon, Bart., the famous manager and chairman of the London and North-Western Railway, died last week in his 86th year. He has lived in retirement since he left the chair in 1891; but practically he spent the whole of his life on the railway—the "biggest" in all senses of the word—which first commenced the modern system of travelling.

We have already announced that the Copley Medal of the Royal Society is awarded to Lord Rayleigh (p. 312), and it can be stated now that the council of the Royal Society have awarded the Royal Medals this year to Prof. George Francis Fitzgerald, F.R.S., and to Prof. William Carmichael Macintosh, F.R.S. To the former for his contributions towards the advancement of physical science; and to the latter for his work in connection with marine zoology and the establishment of a marine laboratory at St. Andrew's. The Davy Medal is awarded to Mr. Edward Schunck, F.R.S., for his researches into the properties of madder, indigo, and chlorophyll.

The Goldsmiths' Company has, it is stated, made another contribution of £1,000 to the expenses of the investigations which Prof. Dewar is carrying on at the Royal Institution in connection with the liquefaction of hydrogen. Recent discoveries in connection with liquid air point to the possibility of reaching the absolute zero of temperature, and it is not impossible that we may hear soon of the solidification of hydrogen. (See p. 395, June 16 last.)

The first scientific meeting of the Zoological Society for the present session was held last week, Dr. Albert Günther, F.R.S., in the chair. The secretary, Mr. P. L. Sclater, F.R.S., gave an account of his visits to geological gardens on the Continent, and of his explorations in S. Africa, whence he has brought some antelopes and birds that will help to fill gaps in the society's collection. Mr. Smith Woodward exhibited for Dr. Moreno, Director of the La Plata Museum, the skull, jaw, and nasal bones, with some droppings,

of the Ground Sloth, which is said to be extinct so far as Patagonia is concerned. M. Ameghino expressed an opinion that the specimen from which the bones come is the Neomylodon listai, described by him last year. The subject will attract much attention.

The duplicates of the collection of marine zoological specimens brought home by the *Challenger* expedition are now being distributed among the scientific institutions of the United Kingdom —at last.

At a recent meeting of the Royal Horticultural Society, attention was drawn to the injurious effects of fogs. Grapes of the Muscat class have been severely injured at the gardens in Chiswick, and Prof. Church said that at one time the fog was so "pungent" that a hundred buds of a camellia fell in one day. The real cause of the injury is attributed to the presence of sulphurous acid in the atmosphere and to the accumulation of sooty matter.

Some well-known plants have been recognised in the Egyptian Museum at the Louvre, Paris, by MM. Loret and Poisson. They found the remains of the White Lily (L. candidum), the cedar of Lebanon, the citron, and some other plants. There is nothing specially remarkable in these discoveries, as there is no reason to suppose that plants of the kind were not known to the ancient Egyptians, who very likely had a good collection of plants more or less indigenous.

According to a report issued by Reuter's Agency, Dr. Carl Peters will arrive in this country about the middle of December. His expedition was mainly based on an old atlas published in Amsterdam in 1705 with French text, the author being unknown. In this atlas it was stated that "near this place (south of the Zambesi and near the river Manzoro, now Mazoe) is the great mountain of Fura, very rich in gold, which some people regard as a corruption of the word Ophir." This view was also held by the Portuguese writer Couto, who was quoted by Theodore Bent in his "Ruined Cities of Mashonaland." With regard to Fura, Couto said: "The richest mines of all are those of Massapa, from which the Queen of Sheba took the greater part of the gold which she went to offer to the Temple of Soloman, and it is Ophir, for the Kaffirs call it Fur and the Mons Afur." Dr. Peters states that no traveller had visited this region within the last 200 years. He has now rediscovered ancient ruins of Semitic origin, including fortifications, and what he regarded as a temple or storehouse. The whole region is practically uninhabited. He also claims to have found distinct traces of ancient gold-working there.

It is stated that the Board of Trade is communicating with some of the Government departments as to the official recognition of the metric system in contracts. The Standards Department have in preparation a set of "educational models" of weights and measures, &c., for use in schools, which presumably will be introduced soon into the elementary schools.

At Cambridge University an Isaac Newton student in astronomy and physical optics will be elected next term. The candidates must be B.A. and under the age of twenty-five. The studentship is of the value of £200 for three years, and applications should be sent to the Vice-Chancellor between Jan. 16 and 26, 1900.

According to the will of the late Mr. Cornelius Vanderbilt, Yale University will have a legacy of 100,000dol., and Vanderbilt University just half that sum.

THE overhead electric tramway system is about to be adopted in St. Petersburg.

MR A. H. AVERY, of Tunbridge Wells, has just issued a new catalogue for 1900, the special feature of which is the prices for the Avery-Lahmeyer dynamos and motors, which are in favour with those who require appliances of the kind. The machine can be had finished, or parts can be obtained by those who would like to "build" for themselves.

THE wheel-pit of the Niagara Falls Power Company is recessed at a level of about 120ft. below head water, with four large arched chambers cut in the rock. One of these is occupied by the oil and air pumping auxiliaries of the turbines and generators above, and the others are to be occupied by 6,000,000-gallon water pumping-engines, for the service of the Niagara Falls Water Company, which is allied to the Niagara Falls Power Company. This will do away with the steam plant formerly used for pumping the water, and occasion a considerable reduction of the cost.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

**** In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

IS THE UNIVERSE FINITE?

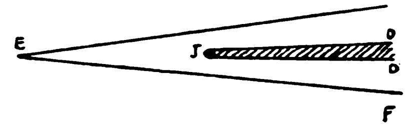
[43041.]—I THINK Mr. Dormer's reasoning on this subject is invalid. In the first place, even the light of the sun is made up of light coming to us from spaces too small to be separately visible. I do not suppose, for example, that the millionth part of a square inch of the sun's surface would be separately visible. It is the putting together of a great number of these small parts that produces a visible effect, and a million of stars, none of which were separately visible, ought, if pretty nearly in the same direction, to produce a visible effect. This is pretty much what occurs with the "Milky Way," with distant clusters, and probably with the Zodiacal Light. Secondly, the telescope makes visible a great many stars that cannot be seen with the naked eye, and the same thing is done by photography, while a further extension of both methods may be expected. Surely it cannot be thought that the objects thus discovered have no effect on the general illumination of the sky. If the distribution of the stars is at all uniform, as the stars become more remote, their number will more than compensate for their remoteness, and the stars whose average distance is 100 times that of a first magnitude star will contribute more to the general illumination of the sky than the first magnitude stars do.

"F.R.A.S." points out that there is nothing like uniform distribution among the stars. True; but the very roughest kind of uniformity would give the results which I indicated. It is only necessary, for example, that a sphere with the earth as centre, and a radius represented by two, should, on a general average, contain eight times as many stars as a concentric sphere with the radius one, and that the brightness of the stars in the two spheres (seen from the unit of distance) should be the same. We are dealing with wide averages extending all over the sky. Now as soon as we abandon the idea that the earth or the sun is the centre of the universe, the natural assumption is that this rough average uniformity will be found to exist equally at all distances from the Solar System, there being no reason why the distribution of the stars should depend on the distance from the sun. But though the sun is not the centre of the universe, he may be one member of a great cluster of stars, and there may be a great thinning-out of the stars when we go to such a distance as to get clear of this cluster. Beyond the limits of the cluster there may be a vacuity or a more sparse scattering of stars, or perhaps other clusters at a very great distance. But the ether which conveys light to us may not extend to infinity. It may be of the nature of a very fine nebulosity, beyond the limits of which neither the telescope nor the photographic plate will carry us.

A finite universe as regards space would seem to indicate an origin in time also, for otherwise we should expect to find it in the final state of equilibrium where no further change could take place. But I see no impossibility in a physical system of limited extent whose changes might recur for ever in very long cycles, and which would not, therefore, tend to any final condition.

With regard to Leonid meteors, while the sky here (Dublin) was very unfavourable, it cleared considerably near the critical period, according to Drs. Stoney and Downing, on the morning of the 16th, all the brighter stars in that region of the sky being visible. I only saw two meteors, one of which did not seem to be a Leonid. I do not think there could have been any considerable number after five o'clock on the morning of the 16th. Several persons appear to have seen bright meteors in Ireland on the morning of the 13th. W. H. S. Monck.

[43042.]—I DO not think this matter is possible of solution by the method pursued by Mr. Gavin J. Burns (42995). It is a great marvel to most men that the distant stars are visible to us, seeing the vast extent of gaseous nebulæ which we know to exist, the certainty of meteoric dust largely prevailing in space, and the certainty of the presence of planets or dark bodies accompanying our sun or stars, and the possibility of dark stars in space. With regard to a star it will probably shine through all space, but we cannot suppose it to occupy 1000 millionth of the space its disc covers, therefore we may assume its light-giving angle will diminish in great distance until the optic nerves have no power of recognition. At this point if a million star images fall on the retina they will all be equally invisible. Further, the interference of the dense matter is absolute; therefore it entirely cuts out all the light beyond. This may be shown by a simple scheme diagram. Let E be the earth or point of



vision, E F, E F¹ the field of view, J a planet, say Jupiter; then the angular space represented by J D, J D¹ will be cut out from light-illuminating space;—every dense body throughout space will act in similar manner. And as regards gaseous media, evident in the spectra of nebulæ, these must refract the light of stars beyond or diffuse their rays to invisibility to us. Wm. F. Stanley.

[43043.]—I DO not see how we can logically assume the stars to be infinite in number. Space—or, to put it more in accordance with metaphysical language, infinite extension—exists of necessity, and matter may be infinitely extended, and the stars may be distributed, but not infinite in number. G. Calver.

THE LEONIDS, ETC., 1899.—II.

[43044.]—THE results of further watches kept here for the Leonids and other meteors are *nil*. The skies have almost constantly remained obscured, either by cloud, fog, or mist. Indeed, at no hour of the nights of November 13, 14, 15, or 16 was there a sufficient space of clear sky to render the observation of a meteor likely.

An observer at Dawlish saw a meteor pass over Perseus from the direction of Leo on November 7. Whether this was actually a Leonid or no cannot, of course, be decided.

From the Surrey hills near Croydon seven meteors (perhaps all Leonids) were seen on November 14, 12h. to 16h. I have received several accounts of watches, but all others record negative results. Walter E. Besley.

Clapham Common, Nov. 20.

[43045.]—THE writer kept watch at intervals from 10th till present date; but almost without result. He is satisfied that if any large meteors had appeared in the open patches of sky which were sometimes available, he should have seen them. Two Clino-Leonids only were observed—one on 10th and one on early morning of 19th—both strong, swift, flash-like streaks, latter from near Gamma Leonis, say, at 155° + 20°. On morning of 14th he had Leo well under view from 5.15 till 6.30, and again from 11.0 to 12.15 midnight, without seeing anything particular. On morning of 16th at 8.35 he noticed a strong reddish flash; but on going out of doors nothing further was observable in direction of radiant. Heavy dense clouds overhead nearly all the time; open spaces and moonlight only at intervals.

Belfast, Nov. 19. W. H. Milligan.

[43046.]—ON Wednesday morning, the 15th inst., between the hours of 4.30 and 6, I, with others, witnessed from 40 to 50 Leonids under the most favorable conditions from Hampstead Heath. During the greater part of the night Hampstead, as in other parts, was enveloped in a fog; but about 4.30a.m. it lifted on Hampstead Heath, and from that time until dawn (the moon setting at about 4.50) we were favoured with one of those very clear nights so rare in this country. The stars were exceptionally brilliant, and the air very steady. Most of the meteors witnessed radiated from the constellation Leo. They were characterised by their swiftness, and the vivid and persistent train they left behind them—they were of a bluish tint. There was one near the radiant point particularly interesting, it burst out into a blaze of light of fully a quarter of a degree in diameter, and after going out left a haze somewhat resembling a comet, and was four or five seconds before it had quite faded away.

Some of the meteois were very short and very swift, so much so that they were merely flashes of light leaving no discernible train. Three of those witnessed were Orionids, these were characterised by being slower and leaving no train.

I may add that there was never anything approaching a "shower," in fact never were two seen in the heavens at once, but the 40 or 50 witnessed were seen during the space of about 40 minutes.

Wm. H. Daw.

9, Belgrave-road, St. John's Wood, N.W.

THE EXPECTED METEOR SHOWER.

[43047.]—WATCH was kept here with the following results:—

Tuesday, Nov. 14, 14h. 30m.—17h. 0m. G.M.T.: Sky completely overcast.

Wednesday, Nov. 15, 15h. 0m.—16h. 30m. G.M.T.: Sky brilliantly clear; not a single meteor observed.

Thursday, Nov. 16, 15h. 0m. G.M.T. onwards: Sky beautifully clear; one or two sporadic meteors; no trace of Leonid shower.

I think the period will prove to be 33½ years, and we shall have the pleasure of seeing the shower next year under much better conditions than obtained a few days ago, owing to the absence of moonlight. Charles L. Tweedale.

Ormskirk, Nov. 20. Curate of St. Paul's.

AMATEUR'S OBSERVATORY—THE LEONIDS.

[43048.]—IN reply to the first question in letter 43018, I am unable to state whether an observing house as a fixture becomes the landlord's property. My own observatory is erected on War Department land, and, that being so, I am under an agreement to remove it at any time if the site is required by the War Office. On change of station I should probably remove the house, and re-erect it elsewhere, having had it made so that the woodwork comes to pieces pretty easily. With regard to the chair, I do not take any precautions against neck-ache, and sometimes suffer a little of that complaint if an object is very high. That is one of the disadvantages of the refractor—the difficulty of bringing the eye normal to the axis of the telescope. I observe in one of three positions generally. 1. Standing if an object is not very high in the sky. 2. Using the before-mentioned chair placed on a wooden stool about 6in. high, when an object has intermediate altitude. 3. The chair alone for high altitudes. On the whole I get on very well with the chair at present in use, which is one of the Austrian bent-wood pattern, light and easy to move. While on this subject it is to be observed that a tripod stand has one great advantage in that one can place one's legs directly underneath it when watching an object pretty high in the sky. A pillar would prevent that to a certain extent. On the other hand, a disadvantage of the tripod is that the slope of the legs prevents the telescope being pointed near the zenith. But this is not of much consequence, for it is practically impossible to observe with a refractor at such an altitude without a specially-designed observing chair or couch.

The Leonids appear to have been a failure this year, so far as a brilliant display is concerned. On Nov. 14 I watched from 12h. 7m. to 14h. 57m. During the greater part of that time the sky was unusually clear. Fifteen meteors were seen, of which twelve were Leonids, none above 2nd mag. in brightness. Nov. 15 again a very good sky on the whole, but flooded with moonlight. Watched from 12h. 48m. to 14h. 47m., and again from 16h. 43m. to 18h. 28m., at which latter hour dawn was rapidly coming on. Seventeen meteors observed, of which twelve were probably Leonids. Particulars of the individual meteors will be sent to Prof. Pickering, in accordance with his request. These are more or less negative observations; but seeing that the sky was very clear, they are of a certain amount of use in settling that there was during the period of observation most certainly no "display," in the popular sense of the word.

The hourly rates of the meteors I make roughly as follows:—

	12 to 13h.	13 to 14h.	14 to 15h.	17 to 18h.
Nov. 14 ..	2	5	8	—
Nov. 15 ..	-	4	1	10

Devonport, Nov. 18. **E. E. Markwick, Col.**

THE LIGHT OF STARS NOT DIMINISHED BY ABSORPTION.

[43049.]—IF an intercepting medium exist, there appear to me to be only two hypotheses tenable as to its constitution:—(1) It may be a gas. (2) It may consist of particles of sensible size, or "cosmical dust."

(1) Modern researches show that a substance can only exist as gas when it is above a certain temperature. At absolute zero all things are in the solid state. A body isolated in space will absorb heat from the surrounding stars, and will radiate the heat received into space. Its temperature is determined by the equality of these two quantities. Now, assuming that radiant heat is proportional to radiant light, the total heat emitted from the stars may be put at $\frac{1}{3000000}$th of the heat received from the sun at the distance of the earth. If this heat were to be absorbed by a body having an area of 1sq.ft., it would raise the temperature of one grain of water 1° C. in about three hours. It is incredible that this exceedingly small supply of heat can raise a body more than a fraction of a degree above absolute zero (or −274° C.) It is certain that no substance can exist as a gas at this low temperature. If it is asked how a nebula can exist at a high temperature, the obvious reply is that the temperature must be maintained from some internal source. The source of energy which supplies heat to a nebula is in all probability the same as that which maintains the heat of the sun—viz., the mutual gravitation of its parts. The most likely way in which the energy of gravitation is converted into the energy of heat is by the continual collision of clouds of meteorites.

(2) There remains the hypothesis that the intercepting medium consists of cosmical dust. Now, I believe it can be shown that the amount of cosmical

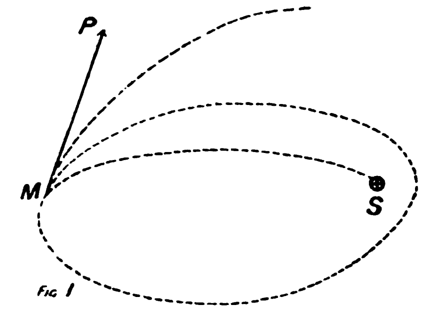


FIG. 1.

dust now existing in interstellar space must be excessively small, if we grant that the stars have existed for an indefinite number of ages past. This can be proved in the following manner:—

Suppose that at some given epoch in past time all space was comparatively full of cosmical dust. Then it is evident that if the dust were at rest it would speedily (as time must be reckoned in the evolution of a sidereal system) be gathered by the power of gravitation into any larger masses that might then exist, whether such masses were lucid stars or not. It follows that the cosmical dust that now exists must have been in motion, and we have to show that the ultimate result would be the same as if the particles were at rest.

Let S be a star (or other large mass of matter), and let M be a particle having an initial velocity in the direction M P. Then one of three things will happen—the particles will fall into S, or it will move in an elliptic orbit round S, or it will move in hyperbolic orbit, having S as a focus. (For the present purpose a circle is regarded as a species of ellipse, and a parabola as a species of hyperbola.) It depends on the initial velocity which of these three things will happen. We shall first show that the particle will move in an elliptic orbit round S only in very exceptional circumstances. In the first place, the initial velocity, v, of the particle must not exceed a certain critical velocity, V (which is independent of the direction M P), in order to describe an elliptic orbit. In the second place, for a given point and a given direction, there is a certain velocity, U, which must be exceeded, otherwise the particle will fall into S. It is evident that the particle can only describe an elliptic orbit round S when V exceeds U. The following table gives the actual values of V for the sun:—

Distance N.S. Earth's distance = 1.	V in miles per second.
1	26
10	8·22
100	2·6
1,000	0 822
10,000	0 26
100,000	0 082

It will be seen that an elliptic orbit of large dimensions is only possible when the aphelion velocity is small compared with planetary or stellar

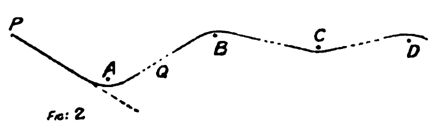


FIG. 2.

velocities. Again, only those orbits whose perihelion distance is greater than the sun's semi-diameter are admissible. Then, again, an elliptic orbit is only possible when the attraction of the central body predominates over all neighbouring bodies throughout the orbit. Taking all these things into consideration, it appears that an elliptic orbit must be the exception, and not the general rule, in the case of cosmical dust.

We have next to consider the case of hyperbolic orbits. This is illustrated in the above diagram. P is a particle of cosmical dust moving in the direction P R with a velocity v. A is a star lying near (but not in) the direct path of the particle. Then there is a certain velocity U_a, which v must exceed in order to escape A. U_a will become greater with the mass and volume of A, and will become less as the distance of A from P R becomes greater. If v exceed U_a, P will move round A in a hyperbolic orbit. At Q, where A Q = A P, its velocity will be v, as at first. It will then move in a practically straight line, at a nearly constant velocity, till it approaches some other star, B. It will again escape, provided v exceeds a certain velocity, U_b. It will thus describe a series of hyperbolas round A, B, C, D, &c., until it at last falls into Z. That this will ultimately happen is obvious, if time be unlimited and the number of stars indefinitely great. It is also evident that the greater the initial value of v, the longer the particle will escape.

Returning, now, to elliptic orbits, it appears that particles moving in them would by degrees also be eliminated, but in a somewhat different manner. Suppose a particle to be moving round A in an ellipse whose major semi-axis is comparable to the distance that separates one star from another. Then, owing to the proper motion of neighbouring stars, some other star, B, might approach near enough to the orbit of the particle to overcome the attraction of A and divert it towards B. As the velocity of the particle must be small (relatively to A), the probability of its falling into B will be comparatively large. It is obvious that the larger the orbit the greater is the probability of the particle being picked up by a neighbouring star.

Taking everything into consideration, it appears that the quantity of cosmical dust in interstellar space cannot perceptibly diminish the light of such stars as are visible to us.

Gavin J. Burns, B.Sc.

TELESCOPE HOUSE.

[43050.]—COL. MARKWICK'S description of his telescope house (42996) interests me very much, because having had a long experience of sliding roofs, and knowing how small improvements are sure to keep suggesting themselves from time to time, I can foresee that his present structure is destined sooner or later to develop into something more worthy to be called an observatory. But, in the mean time, there is really no necessity for the Colonel to march backwards and forwards along that plank shoving the roof before him, when it may be so easily avoided. If he will adopt the following simple plan, he will find that he may not only give up his walk along the plank, but that he—or even the little assistant whose face peers out between the legs of the telescope—may stand perfectly still and draw the roof off and on with the utmost ease. He has only to screw two pulleys about 2in. diameter on to the woodwork of the building close under the roof, as near together as possible, and exactly in the centre at the end where the roof draws off. Over each pulley pass a light rope, fasten one to a ring screwed into one end of the roof and the other to a ring at the other end. One pulls it off, the other pulls it on, that's all. It is quite simple, and, what is better, it is efficient.

I see that Col. Markwick makes his roof to run upon small brass rollers. I should have preferred large ones if I used them at all. They may answer for a time with a very light roof, but with a roof of any weight I should not at all like to try them. I never did, and have always used small cast-iron flanged wheels 2in. diam., which run upon iron bars ½in. square screwed down to the woodwork. These run beautifully, and there is nothing to wear out or go wrong. However, we need not say any more about these until the Colonel is building his next house.

I notice that Col. Markwick has taken precautions against the possibilities which might happen in a gale of wind by clamping his building to a wall. He does not mention whether he has taken any special precaution about the roof. Very likely he has; but if not, I hope the necessity for it will not be impressed upon him in the way in which it was upon me. In the first observatory I erected, which was a rather more ambitious structure than the Colonel's, the roof of that part which covered the telescope was flat, and covered a space sufficient to work comfortably a 4¼in. equatorial in, and being boarded and covered with zinc was, as I thought, sufficiently heavy to take care of itself, the situation not being an exposed one. My feelings, therefore, received a rude shock one morning on looking out of window during a gale of wind, and seeing the said roof lying in the middle of a flower-bed some 12 or 15 yards off. I thought, once of this sort of thing was enough, so I got four strong pins, which I fixed to the woodwork in the four corners of the observatory, arranged so that they ran home into four corresponding eyes when the roof was closed. After this, I was able to regard all gales of wind with perfect indifference.

It is going, perhaps, rather into the development period, but I may add that in my present observatory, the space being larger than before, the roof is in two parts, each half running off in the opposite direction and meeting in the middle. I find this very convenient, as I can open just as much or as

little of the roof as I want for observation at the moment. This roof is ridged and is tolerably heavy, but it runs quite easily and each half bolts itself as it runs home.

If there is anything I have not made clear in the above, I shall be very glad to give Col. Markwick any further information that he may wish for.

I see in this week's issue of the "E.M." that a correspondent (43018) asks Col. Markwick two questions. To the first question I believe it may be replied that a wooden erection, such as the one alluded to, if raised from the ground—as, of course it should be if it has a floor—merely on loose bricks, can certainly be removed by the tenant, not being fixed to the soil or to any other building. The second question I leave to Col. Markwick to answer. One could hardly expect to find a Dawes observing chair in an edifice of such humble pretensions!

Crewborough, Sussex. J. H. Jenkinson.

SODOM DESTROYED BY THE LEONIDS.

[43051.]—This was a view I took up in 1866 when the connection of the Leonids with Tempel's comet of that year was established by Schiaparelli, and the more I have considered it the plainer does it seem to me that, not only did meteors destroy the cities, but these particular ones. The date of the event is correctly given, in Ussher's notes to Genesis, as 1896 B C., and it was a more important event than readers commonly infer. It cleared Palestine of all its inhabitants, the Amorites, who fled in all directions, as we should avoid, in a room, the place where a bit of ceiling had fallen. Though four cities perished, we are told it was only on two, Sodom and Gomorrah, that the fall took place. Lot and his daughters fled to Zoar, but dared not stop in its ruins. Fearing another fall of sky, they took refuge in a bomb-proof cavern, and believed themselves the only human beings left in the world. While Lot's wife lingered looking back, a fragment of one of the meteors of salt fell on her and instantly buried her. The heap of salt was shown to her grandsons, and thus arose the saying that "she became a pillar (or monument) of salt."

The comet of the Leonids, we must remember, has only twice been seen: in April, 1366, and in January, 1866. The interval was 499 years nine months. This, divided by 15, gives for an average period 33·316 years. Before this was known, a period of 33·18 was reckoned from the single appearance alone. This was a wonderfully good approximation. But when Leverrier computed from this a date 126 A.D. for the comet's approach to Uranus, the error became prodigious. It was 52 periods (or rather 52½) ago. The difference between 33·18 and 33·316 is ·136 of a year. Fifty-two times ·136 make full seven years, during which Uranus moves about a twelfth of his orbit. So Leverrier's origin for the Leonids in A D. 126 is utterly disposed of.

Now multiply 33·316 by 113, and we get 3,761 years, the exact number to carry us back from 1866 to 1896 B C. The interval is one year less, remember than 1866 + 1896, because from 1 B.C to 1 A.D. is not two years, but only one. The catastrophe at Sodom was the right year out of 33. Again, it was at the right hour, sunrise, and the latitude of 31° answers to the declination of the radiant, so that the fall would be vertical, not sloping, but so that it might be said "the Lord *rained* upon" the cities.

The geology of the "Sea of Lot" has to be considered too, because there is no other valley on earth, I believe, to which the strata descend on both sides, as if it were punched in by a blow. We read in Genesis xiii. 10, "That all the plain of Jordan was well watered everywhere before the Lord destroyed Sodom and Gomorrah, like the garden of the Lord, like the land of Egypt as thou goest unto Zoar." The present barrenness is entirely due to the salt and not to the bitumen, which already existed, xiv. 10, for the vale of Siddim was full of bitumen pits, which nowise interfered with fertility. The water of the sea is now deepest near the north end; but the chief hill of salt is at the south end, a rivulet of salt water issuing from a cavern at that end. The alluvial deposit is declared to be deeper under the Jordan north of Jericho than under any part of the sea. I would suggest that the lake was, before the catastrophe, north of Jericho, and received rivers from the south. It was lower than general sea-level, but not so low as at present. The meteors fell on these southern streams and depressed them, bringing the lake 40 or 50 miles southward.

If it be thought unlikely that huge meteors fell only at that point, we must remember that Herodotus describes remarkable hills of salt in different parts of Africa. One of these is near Biskara, in Algeria, that is described as appearing exactly as if fallen from the sky. Why may not all of these have fallen the same day as the destruction of Sodom? Similar falls may be expected whenever the comet's appearance is deferred till October, or, still worse, till the first half of November. When we arrive at the node very shortly after the comet, these exceptionally heavy showers may be expected.

E. L. Garbett.

PHOTOGRAPHING A "SPIRIT," AND THE SOCIETY FOR PSYCHICAL RESEARCH.

[43052.]—As on former occasions, "F.R.A.S." has rather disparaged the Society for Psychical Research. I think it fair to mention that it is they who, in their *Journal* for November, have taken the trouble to correct his statements.

So far from the society being devoted to superstitions, it is really devoted to their study, the necessity for specialisation in which is shown by the present instance. "F.R.A.S.," having into the very natural error of publishing such matter without laborious verification, now announces that in future he shall reject all similar stories without examination.

I write to point out that these are precisely the errors that have hitherto prevented any exact knowledge in these outlying departments of psychology. The whole region of folk-lore, whether superstitious or supernormal, will never be either exploded or explained without plenty of hard work. And whatever the outcome of the society's work may be, its subject-matter, the human mind, is, as Stanley Jevons said, of more importance to mankind than all "F.R.A.S.'s" stars and nebulæ.

I have heard a leading physicist object to biological work as "messy," and "F.R.A.S." objects to this sort of psychology as "full of rogues and dupes," just as an ordinary pedestrian would object to rope-walking. Psychical research is the slack-wire of the sciences, and if "F.R.A.S." would become perfect in all the scientific virtues from agnosticism to suspense of judgment, he cannot do better than engage in psychical research. He will need them there as nowhere else.

A Fellow of the Geological Society.

[43053.]—I hope "M.I.C.E.," in letter 43036, p. 320, does not wish us to believe that the particles or weights in his diagram are in stable equilibrium. The centre of gravity must surely lie to the right of the vertical line which passes through the axle or centre. Again treat the particles as being supported on incline planes, find the resultants acting at right angles to the planes, multiply each resultant by its distance from the centre or axle; add the moments of those to the right of the vertical line together, and also those to the left, and compare the moments.

If that does not satisfy, take a straight steel wire, bend it with equal arms to contain an angle of 45°, hang it with the angle across a fulcrum, place a 1lb. weight on each arm but at different distances from the fulcrum, and note the position of equilibrium. Compare this with his diagram, and see if it is not composed of a number of similar appliances.

William E. Tanton.

[43054.]—If Mr. G. will get Dircks's "Perpetuum Mobile" from the nearest reference library, and will diligently study the numerous designs submitted of this wheel-and-weight idea during the last century and a half, he will see the futility of spending his time on this side of the subject. If after reading this book he will look through back numbers of the *Scientific American and Supplement* he will find several other and more modern developments of this idea—all to the same purpose—non-success.

If, then, he is not convinced, let him pull his coat off and construct a model wheel, say 12in. diam. Let him make this go (if he can), and then send you, Sir, an untouched negative of it for your process man to make a block from, and let Mr. G. add full particulars as to size, &c. Then he will have have some grounds for speculating about a wheel 88ft. in diam., and might have some success if he approached the proprietors of the Blackpool Big Wheel with a view of giving it a gigantic trial.

Hightown, Manchester. W. Ainsworth.

[43055.]—With reference to the design of a perpetual-motion device on p. 320, will any reader explain the difference between that and the practically identical device shown on p. 48, of Dircks's "Perpetuum Mobile," which is really about five centuries old (known; how much older, I should like to know). As to hearing "speech 500 miles off," and so on—no one has, unless there was some "energy" about, and that's the "screw" the perpetual-motion machine wants.

P. M.

[43056.] — May I make a suggestion to Mr. Gibert, who writes letter 43035? I do not wish to make it in any carping spirit, but in order to be of some slight assistance when he comes to make his machine for exhibition at the 1900 Paris Exposition.

I would suggest that instead of fixing a brake to prevent his machine racing or running away with machinery it was driving, he should dispense with roller bearings, using plain bearings in place of them; these would not only be much cheaper to make for a machine the size proposed, but would also act to a certain extent as a brake by their increased friction. This, to my mind, would probably be a quite efficient brake without anything more.

The spectacle of a machine (model or otherwise) driving a dynamo lighting glow-lamps without any power beyond what power it gained from *its own mechanical parts* (with or without a brake), would certainly be one of the wonders of the Exposition, if not *the* wonder, and I am sure Lord Kelvin, our greatest scientist, as well as all our lesser scientists, would gladly pay to see it, and would hail the proud discoverer as the greatest scientist of them all.

Martin.

STONEHENGE.—TO "F.R.A.S."

[43057.]—Is there any other possible cause for the change in azimuth of the sun's rising point at the summer solstice than *the change in the obliquity of the Ecliptic?* If not, I certainly cannot see how the data to be obtained at Stonehenge can help to determine *its* date.

I know Stonehenge well, and have witnessed sunrise there at the summer solstice. The sun, as viewed from the "altar stone" so-called, may be said to rise at the point indicated by the "pointer stone," but the means of observing are not accurate enough to decide whether the sun's centre or northern or southern limb is in line with the pointer.

The change in azimuth due to change in obliquity of the Ecliptic must be but slight; and the above means of observation *much too coarse* to detect it or measure it with accuracy.

I hold that Stonehenge dates from far earlier than any Annus Domini.

Peasmarsh. F. B. Allison.

[43058.]—The letter from "F.R.A.S.," in your issue of the 17th inst., refers in very kind terms to my estimate of the date of Stonehenge—viz., 476 A.D. A subsequent and more accurate calculation gives 425 A D. But I wish to state that, as the change of the obliquity of the Ecliptic is very slow, I think that we should allow a margin of a century or two on either side of this latter date. It should also be borne in mind, as "F.R.A.S." points out, that we have to assume that the original orientation was accurately directed to the solstitial summer sunrise, and that we can exactly recover that orientation. Prof. Petrie's date, founded on the astronomical evidence, is 730 A D ± 200 years, with a possible date of 400 A.D. This estimate points to the ruin being post-Roman. The problem of the date of Stonehenge is a very difficult one, and, when all the available evidence is taken into account, it seems not unlikely that the structure is partly pre- and partly post-Roman. C. T. Whitmell,

President Leeds Astronomical Society.

Leeds, November 17.

DENSITY AND SPECIFIC GRAVITY.

[43059.]—Your correspondent in letter 43037 seems to be puzzled as to the meaning of density and specific gravity. The specific gravity of a solid or liquid is its weight volume for volume, as compared with the weight of water, which is taken as unity. A liquid half as heavy again as water will be 1·5 s.g. With any kind of a gas air is taken as the standard of specific gravity, and is also unity. The s.g. of nitrogen being lighter than air is ·97, whilst oxygen being heavier is 1·1 specific gravity. The "density" of a gas is its weight volume for volume compared with hydrogen, and cannot be looked upon as having anything to do with compactness. As to molecules, the "Law of Avogadro" says: "Under similar conditions of temperature and pressure equal volumes of all gases contain the same number of molecules." But from this fact, all gases are not of the same density, as your correspondent must know. "The molecular weight of any gas is the weight of that volume which occupies the same space as do two parts by weight of hydrogen." As the molecule of hydrogen weighs two, the density of any gas, whether elementary or compound, is identical with the half of its molecular weights. As the molecule of hydrogen weights two, and that of hydrochloric acid = 36·37, the density of HCl gas is 18·18.

Handel.

REDUCING INTENSITY OF LIGHT: TO MR. ELLISON.

[43060.]—May I be permitted to thank your correspondent just named for his much-too-flattering references to the "depths of mathematics" to which he supposes me capable of descending in trying to solve the very shallow problems connected with "dark-glasses"? He appears, however, to imagine that I have added complications to the conditions. The "conditions (I) introduced" were precisely his own. Indeed, the very terms of his own counter-criticism on mine upon his former letter refer to the *ordinary use* of dark-glasses—viz., to look at the sun. (Who uses them to look at stars?) His thanks to me as expressed in letter 42948 were in these words: "for his criticisms on *my* various proposed devices for reducing the intensity of the *sun's* light and heat" (italics mine).

Already I have commented on his use of the word

my (see 42997), and I now draw attention to the fact that the dark-glasses I criticised in that letter were for use under the identical "conditions introduced" by himself—viz., the conditions present in solar observations, where, of course, the image is anything but a mere axial point, and these conditions have in no way been complicated by anything added by me, as is inferred in 43029.

For the mere axial point of an image, as with a star, your enthusiastic correspondent allows there can be no disturbance from such dark-glasses; but who would ever dream of this application of dark-glasses, even with very large aperture telescopes?

Therefore, after all, my contention and reasoning concerning the disturbing effects of dark-glasses so placed upon all the transmitted rays other than those coming to focus at the axial point of the solar image was upon precisely the same conditions (solar) introduced by himself, and I am curious to see how I should be blamed with introducing "complicated conditions" of my own (see 43029).

Again, in that letter, Mr. Ellison says, "my plan was for a plane glass behind the eyepiece" (meaning, evidently, in front of it), forgetting, perhaps, that his plan, as just given to us in 42948, was to employ a glass concentrically *curved*, not a *plane* one, the centre of both curvatures being at the axial point of the solar focus.

As stated already on several occasions in "Ours," my own copy of Webb is of the third edition, 1871, and I find I have quoted correctly. The acquisition of newer editions of such works has not been rendered necessary by my astronomical pursuits, as I get all the information I require *scientifically* respecting such "objects" from the various standard catalogues, societies' memoirs, &c., and I fear I must confess I do not find any loss to science in the absence from these works of the many ornate passages, transcendental comparisons, and abstract reflections upon the "objects" there enumerated, which abound in works of the previous class.

H.

HABIT OF AMUSEMENT IN ROTIFERS: A REPLY.

[43061.]—Dr. Weir's note, on p. 311, on the remarkable sportive habits of Melicerta might be supplemented with other more wondrous feats of this wonderful rotiferon. Anyone who has seen this helpless, awkwardly swimming creature when it has had the misfortune to become detached and to be driven out of its tube, will be much interested to hear that it can dart about, in and out of its house, hide behind grains of sand with one eye over the edge or round the corner, and do other frisky gambols. Dr. Weir might well have added that, with a little perseverance and a grain or two of imagination, Melicerta can be seen to use its foot as a prehensile organ, in fact, like an elephant his nasal trunk. When a small rotifer of the genus Rattulus or Mastigocerca comes by, Melicerta will seize it, break off its long pointed toe, and use it as a tooth-pick to clean its teeth, of which it has quite a number, quietly sitting the while on the above-mentioned grain of sand.

The eyesight of Melicerta, with its vertebrate retina of rods and cones, is so powerful that it often tries to look at the observer through the other end of his (the observer's own) microscope, and, no doubt, succeeds. A wonderful creature is Melicerta, and, in order to observe all these and other marvellous habits, a good microscope and a little imagination only are required, such as Dr. Weir seems to possess in so high a degree.

C. F. R.

PROF. BONNEY ON GEOLOGY.

[43062.]—"Silverplume," in p. 417, thinks Prof. Bonney, writing on "Our Planet," had nothing to do with comets. Nevertheless, Comte, the inventor of "Positivism," found nothing so closely bearing on geology as comets, the only class of bodies that can encounter our earth, or that ever have done so.

In his "Positive Polity," Vol. I. of English edition, p. 410, he says, "Scientific knowledge of planetary relations destroys the sense of absolute security from all possible risk of disturbance." . . . . "Collision with a comet, for instance, is a danger from which it can never be proved that we are really free. This final view of our true astronomical position adds energy and dignity to the human character, teaching us that it is from ourselves that we must draw our chief resources against the evils that surround us. It should not fill our minds with useless terror; but it should check the tendency to exaggerated forethought, and to presumption which is inconsistent with the true happiness of man or of society."

P. 411. "Abandoning the ill-defined aim of studying the heavens, it must now propose to itself [astronomy] the study of the earth; regarding the other heavenly bodies simply in their relation to the human planet."

P. 412. "But now that the earth's motion is known to us, it is not necessary to study the fixed stars, except so far as they are required for purposes of terrestrial observation."

P. 413. "And thus we are brought back at last, on theoretical as well as practical grounds, to the old view, adopted from the earliest rise of astronomy, of the preponderating importance of the sun and the moon—the central body round which we move, and that which, in turn, is dependent on us."

P. 414. "Unless this restriction (to sun, moon, and comets) be carefully maintained, we shall be as much encumbered with digression on the planets as we have been with those on the fixed stars."

This was written about 1850, ere any of the 400 asteroids, beyond the four, were discovered, and is more prophetic than anything else in this century I have seen.

E. L. Garbett.

MEAN-TIME DIAL.—TO "F.R.A.S."

[43063.]—The objection made by "F.R.A.S." (letter 42973) is, of course, perfectly correct in itself; but I am sorry he did not give the amount of error due to the proposed mode of marking the dial.

If distances were set off according to a table of the equation of time for a year half-way between two leap-years, and if, through the extremities of such off-sets, hour-lines were drawn, we should get the same result as by the method I gave in my former letter.

As the equation of time differs but little from year to year (it was 14m. 55s. in 1871, and 14m. 51s. in 1898 on this 17th November), it seems as if the error would be inappreciable (allowing for the indefiniteness of the edge of the shadow) until the lapse of a long period of time.

As "F.R.A.S" doubtless knows, the reverse case of making a clock show apparent time was contrived 200 years ago; but, then, one can set a clock right, but not, I suppose, a sundial. I am, however, not sure that an adjustable support *might* not be contrived to secure even this.

As "E. L. G." promised to tell us how to make a mean-time dial, no doubt it is possible to do it.

A. S. L.

STATIC MACHINES FOR X RAYS.

[43064.]—A week or two ago a correspondent stated that static machines required an exposure of three-quarters of an hour for the thickest parts of the human body. That this is not the case with the best machines is shown by the statement of Dr. Pitkin in the *American X-Ray Journal*, that radiographs can be taken through the body at a distance of 1ft. to 2ft. in from one to five minutes.

M.

LATHE MATTERS.

[43065.]—Before purchasing a lathe get a price list from Mr. Milnes, Ingleby Works, Bradford. He advertises in this paper. His 4½in. screw-cutting lathe will turn 16in. in the gap, and 3ft. between the centres. With the back-gear on the pulley revolves nine times to one turn of the spindle, and it is more powerful than most 5in. lathes. You will find it quite large enough for foot-power. You will not do much work sitting down. A seat is very well for ornamental turning.

Willes's tool-holder is the best; you will find a drawing of it by Mr. Evans on page 145, English Mechanic, April 6, 1894.

If you live in London I shall be pleased to let you inspect my lathe, if you will advertise your address.

Metal Turner.

PERAMBULATORS AS "CARRIAGES."

[43066.]—I cannot answer either of "F.R.A.S.'s" queries (letter 43015, p. 313), as I am not aware of any such decisions. My reply (p. 278) is certainly open to his interpretation; but what I intended to convey to "Rota" was that bicycles and prams differ in this respect—viz., that bicycles are *expressly* made "carriages" by the 1888 Act, while prams are not. Their inclusion as such, under the words following in the section: "Bicycles, tricycles, velocipedes, and other similar machines," is a point of legal construction. In my opinion, "other similar machines" means motor-cars, or prams and Bath chairs propelled in a similar manner to velocipedes. I think that had it been thought expedient to class prams and Bath chairs as carriages, they would also have been specified in the above Act; but the Legislature considered the Police Acts against pavement obstruction were sufficient in their case. If these articles are considered "carriages," then must baby and grandpapa duly light up an hour after sunset or be fined 40s., and I have not heard of a case of the kind yet. There is no definition of "carriage" in the Acts of 1835 or 1888 that I know of.

B. H.

THE LIGHTNING FLASH.

[43067.]—I am very pleased that my letter on the above subject elicited that of "C. S. H.'s" on p. 297, because I feel that the inquiry has advanced a step forward. It appears to me, in order to make headway in what is a new line of physiological investigation, the first thing necessary is to clear away all, it may be, preconceived or accepted notions about "epiblastic" or "mesoblastic" origin, and to begin *de novo*—that is, to trace the science or knowledge over again, and to see if it cannot be built up upon simple, plain, and undoubted facts.

May it not be that the principle at work in the system of animal economy of cold-blooded creatures, such as the frog, snake, and lizard, produces its comparate rate of oxidation? Every animal substance, of course, the same as every known substance, must have a chemical nature. Some have gone so far as to assert that crystals live; but I fail to see the evidence of any such thing, but clearer evidence of the affinity of nature acting in accordance with mechanical force. Are there not distinct indications that magnetism causes the contractions and relaxations of our muscles, and that this mysterious power is subordinate to the tension of the will power? After death, if applied soon enough, the circulation of the blood, the digestion of the food, for a limited time, can be carried on by magnetism. It will make the dead kick, strike out the biceps, grate the teeth, roll the eyes, but it cannot make the dead feel or think. These experiments can be carried on even after the brain has been removed. I have never tried them myself, but I have often read this is so. I accept it on the evidence of my fellows who have. I cast about me in a vain search in any or every scientific book, for any other force which is capable of doing anything similar in regard to the animal economy. I cannot but conclude that magnetism must be the mechanical force or *connexus* between the acting will power and the body. I should like very much to hear that someone who has the necessary apparatus would investigate the magnetic and liquid air theory of hot and cold-blooded animals. How comes it that a certain proportion of charcoal in our system is necessary for the support of our life, and that our life ceases when our system gives up its charcoal—the black sweat preceding death? Is it because the charcoal in a healthy human being is as necessary for its dynamo action as are the charcoal or carbon points of an electric light? When the dynamo action of the system stops, the physiology gives out its charcoal in the death-sweat. There is then no further pain, because the magnetism, or æther, or liquid air, has ceased to flow along the nerves, and the system dies. That animal economy is often to be met with capable of generating sufficient magnetism to produce the electric flash will be at once admitted, as in the electrical eel.

In reply to the last question, how do I consider the nerves to be a continuation of the venal system? Look at a decayed bone, you see it is like a piece of lacework throughout. What might be supposed to be solid when fresh proves by decay to be a mass of fine tubes. The next time "C. S. H." has a tooth drawn let him mount the nerve for his microscope. Then let him put the tooth, without extracting the nervous pulp, in a small bottle of nitric acid. Let him watch the tooth dissolve in bubbles. Let him look at the tooth with a magnifying glass while it is dissolving, and he will come to the conclusion that not only the tooth, but the enamel also, is of the same structural formation as the bone. Let him examine a portion of the nerve after it has been acted on by the acid without being entirely destroyed; ditto the remains of the tooth in the nitric acid after it has stood for a day, so that the acid has lost its power of acting further. Use ½, ¼, $\frac{1}{16}$, and $\frac{1}{25}$ obj. glass.

Respecting the frictional resistance of the æther on the ether, and the atmosphere reducing all celestial motion to an ultimate stand-still, I am afraid that is just what is really taking place. Hence, we are mortal. Hence, death. Hence, what is called the "Coal-sack" on the heavenly chart or map. Hence, the order of all things—birth, growth, maturity, decay, and then comes the great question of "to be, or not to be," death, and whether it is a change into something better? It cannot be much worse for some of us, and whether the change is to take place immediately, or the whole universe pass away as the "Coal-sack" increases, and to be succeeded by another universe of immortal love, beauty, and life—for the latter is not worth having without the former?

I see nothing unreasonable in the same law pervading the whole universe; but the clock of the universe and the terrestrial dial, although obeying the same law, must be totally dissimilar in application. To make my meaning more explicit: You know how many divisions of time (months, years, &c.) there are in our centuries. Now suppose a world of such a size that every minute of their 24 hours was made up of a century of our time. What adequate opinion could a human being who lived, at best, a painful life of 74 or 80 years of our little century, form of the events of such a dial of time? Manifestly he could have no conception capable of embracing the events of an hour.

Many leading scientists have held the opinion that there will come a time when time will be no more; the clock of the universe will have run down; the sun will roll a cold black ball, having devoured all the planets. Where will our life be then?

"Infinitude of past time." What is time?

Away in space, away from any revolving world or globe, there can be no past and no future, only the ever "present"—duration. This is simply, time begins when a globe begins to revolve. Otherwise, as there is an equally long eternity in the past to what there is in the future, how did we ever get through the time without end? What has preceded and ended in the present? "Æther and ether." Exactly so. The higher you go the colder it is, and the lower the thermometer sinks. I do not look upon the liquid air, pellucid cold air, as being in its first stage. Depend upon it, that pellucid liquid being in such a hurry to get back to the atmosphere shows that it is itself in a state condensed from a still finer condition, and it strikes me further experiments will elicit the proof of its primitive condition being that of the æther pervading all space; the *æther fire spirit*, the cause of all things.

This world, big as it is, is really but a *mote* in space, so small, that Göthe says: "I greatly wonder it holds a place in thought omnipotent," and when we come to discuss "elements," our intellect comes to a sudden *halt*. I can conceive the idea of an interstellar æther becoming the cold ether surrounding our atmosphere like a cloak, and permeating all the elements of earth of which it forms a part, even to the creation of fire in this succession:—Æther, magnetism, oxygen and æther or ether, electrical fire, oxygen and other elements, ordinary fire, oxygen frozen, liquid air or æther, and the final change back again into æther and electrical fire.

If I could answer "C. S. H.'s" questions, I should be possessed of the definite knowledge that my letter on the lightning flash was written with the hope of eliciting.

A Constant Subscriber.

SAILING BIRDS.

[43068.]—On p. 311 you reproduce a very interesting paper by Mr. L. Hargrave on sailing birds, wherein that gentleman gives a clever explanation of the manner in which some sea-birds sail with motionless wings in the wake of a ship. In the cases he mentions, wave motion is no doubt the prime motive power, communicated through the air to the bird's wings; but it is not applicable to the soaring of land-birds. Some of these can be observed almost any windy day sailing in all directions, against the wind, with it, or in circles. The only motion of their wings seems to be an occasional quick change of angle or a solitary flap, apparently to accommodate itself to the gusts. We know that the wind is anything but a steady forward movement of the air. It varies in force from moment to moment; it blows in "gusts," and swerves in its course continually. Now can it be that it blows in waves or vertical undulations, And the birds take advantage of these in the same way as the sea birds instanced by Mr. Hargrave? I write to ask if there is any evidence of such waves in the air, at the height that soaring birds are usually seen.

The subject of bird-soaring is one that does not seem to be yet explained, and Mr. Hargrave's paper is certainly the best attempt at an explanation I have yet seen. **F. J. G.**

FLYING MACHINE.

[43069.]—In reply to letter 43038, Mr. Maxim and others have shown that it requires at least 1H.P. to fly every 100lb. in weight, so it would require quite 2H.P. to fly the machine as per sketch by Mr. R. D. Hall, taking it to weigh 60lb., as stated, along with the weight of the man. As a man can exert only ⅛H.P. for continuous work, he cannot fly a machine without extraneous power. The difficulty with all flying-machines is to get a sufficiently simple and light motor. As soon as this is done, the design for the machine is a secondary consideration.

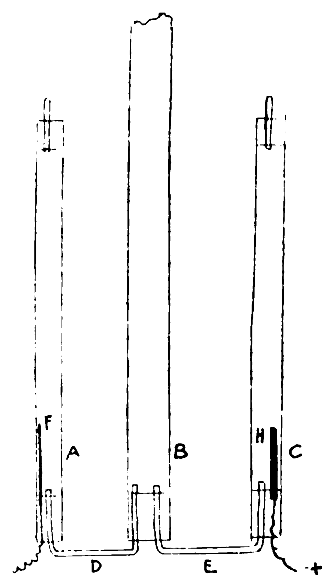
Thornton Heath. **R. F. Moore.**

LONDON SUMMERS.

[43070.]—"F.R.A.S." asks (p. 314) whether the summer of 1899, during a minimum of sunspots, has not been hot and protracted enough. I might point out that this summer is included in my curve (p. 295), being the fifty-ninth of the series; and that, from the point of view adopted, it is not one of the excessively hot ones, in the sense of having 24, or more, very hot days (80° or more). It had 21. Is it not, further, premature to assume that we have reached the turning-point of the sunspot curve? **Alex. B. MacDowall.**

ELECTROLYSIS OF HYDROCHLORIC ACID.

[43071.]—I want to show that when hydrochloric acid is subjected to electrolysis, hydrogen and chlorine are given off in equal volumes. Being unable to get a proper Hofmann's tube, I rigged up the inclosed arrangement. A, B, and C are lengths of ordinary glass tubing. A and C are about ½in. bore, whilst the centre tube B is about an inch. These are connected together by means of quill tubing passing through corks. As nascent chlorine attacks platinum I fitted tube C with a piece of graphite from ordinary carpenter's pencil, wrapped the lower end round with copper wire, which passed through the cork. I then covered the copper



wire with melted paraffin, so that no copper was exposed, but about 3in. of graphite. In the tube A I placed a piece of platinum foil; the upper ends of A and C fitted with glass stopcocks passing through corks. I filled the apparatus with pure concentrated hydrochloric-acid solution, and found joints tight; connected graphite electrode of apparatus with carbon of Bunsen six-cell battery, and platinum with the zinc. Hydrogen given off freely at once from platinum electrode, and this I allowed to escape until the chlorine had thoroughly saturated the liquid in tube C, or until it had become of a deep greenish-yellow colour. But I cannot get much chlorine—never more than half the quantity of the hydrogen. I kept up the operation for five days, changing battery when necessary.

The next week I tried again—this time with as much common salt as could be dissolved in the acid; but, after another five days' operation, could get very little chlorine.

Will Mr. Bottone or other gentleman point out the cause of my failure? I thought perhaps the small size of my quill tube connections might have something to do with it (about one-eighth bore), the small section of liquid offering a high resistance. But as I obtained hydrogen freely (the tube filled in an hour), the chlorine must also have been liberated. Where did it go? Surely a week was enough time for it to saturate the acid in that tube? Further, how is it that the water does not also split up, giving, with the acid, three volumes of hydrogen to one of oxygen and one of chlorine?

Technicus.

ALDEBARAN: CORRECTION.

[43072.]—In my letter 43018, page 314, line 4 from below, please read 3¾in. Gregorian," instead of "3¼in. Gregorian." **C. H. Stielow.**

The output of coal in India has increased from 2,562,000 tons in 1894 to 4,569,000 tons in 1898. Of this amount the railway companies consumed 1,452,000 tons.

Pyro Stains on the Hands.—Pyrogallic acid is still mostly used for development. The objection most people have to it is that it stains their hands. This to a great extent is their own fault, as it may easily be prevented by wearing some of the thin guttapercha finger-stalls now on the market. If before developing the fingers are well rubbed all over with vaseline it will prevent the pyro, or any other chemical, soaking into the flesh. A pair of old gloves is another good preventive, but it takes some time to get used to them, as they feel clumsy at first. A duster should be kept handy while developing, to wipe the hands on and prevent the pyro soaking in. This will to a certain extent prevent staining. If there happens by any chance to be stains on the hands they may easily be removed by making a 10 per cent. solution of sulphuric acid, dipping a piece of cotton-wool in it, and well rubbing the stains. The hands must be examined before using the above solution to see that there is no cuts on them, as the acid will make them smart. —O. T., in *Photographic News*

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96577.]—**Seltzogene.**—Possibly a cement like this will do. Dissolve five or six bits of gum elastic, size of large or small pea, in as much spirits of wine as will render it liquid. Separately. Dissolve as much isinglass (previously softened in water, though none of the water to be used) in rum or other spirit, to make 2oz. phial of very strong glue, adding two small pieces of gum ammoniacum, rubbed or ground till dissolved, then mix whole with heat. Keep in phial closely stoppered, and when wanted set the phial in boiling water—is said to stick glass to polished steel. Regent's Park.

[96583.]—**Tips.**—Soak pulverised gum shellac in ten times its weight of strong ammonia, when a slimy mass is obtained, which in three or four weeks will become liquid without the use of hot water. This softens the rubber, and becomes, after volatilisation of the ammonia, hard and impermeable, and sticks rubber to wood or metal.

Regent's Park.

[96597.]—**Paint for Hot-Water Cisterns.**—Clean metal with turpentine or benzine. Put on two coats of mixture of white-lead, spirits of turpentine, and carriage varnish. Follow immediately with a thick coat of carriage varnish and white-lead. Regent's Park.

[96712.]—**Lantern Slides.**—In my reply on p. 322, for "detected" read detached.

Earlsfield, S.W. Silverplume.

[96765.]—**Bagatelle.**—The player who wins the lead takes the nine balls and plays them one after the other up the table from baulk, first striking at the red ball which is placed on the spot about 1ft. below the first hole (see *Enc. Britt.* Vol. III)

Regent's Park.

[96856.]—**Emery Wheels.**—This report of a committee must have been misunderstood, or there is something wrong about it; for emery wheels are not made with shellac or indiarubber. The idea of using corundum as a "substitute" for emery is rich: it is practically the same thing. Not having seen the report of the committee, I cannot say what the passage quoted means; but, judging from similar reports that I have seen, I should say that probably the committee did not understand the subject. The best emery wheels are made with cement, and are moulded under high pressure.

C. M.

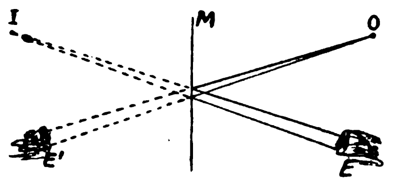
[96857.]—**Test for a Diamond.**—I am much obliged to "Regent's Park" for kindly noticing my query on this subject; but, unfortunately, his reply on p. 236 has nothing whatever to do with my query, which is plainly stated on p. 215. Will some reader who has a little knowledge of the subject read my query, and give some explanation, if possible? I am doubtful if the "dot" method of testing is of any use at all. Dubitans.

[96858.]—**Doublets.**—The simplest way of detecting a doublet is to place it face down on the back of the hand, and observe the light through it—if possible. The difference of refraction in the two stones is sufficient to detect the "doublet." A little experience may be necessary, but that is soon acquired. The reply on p. 236 seems to have been written by someone who is in a bit of a fog.

Sinjins-square.

[96871.]—**Image in Mirror.**—If Mr. Ewer had read my reply to this question in No. 1804, I think he would not have made use of several of the statements which appear in his reply to the same query. He states the fact, that if an object be placed on a mirror and viewed through a telescope from such a position, that the sun's reflected rays are also received by the telescope; if the paper be focussed sharp the sun is out of focus, and, conversely, if the sun be in focus the paper is seen as a blurred image. From this fact he draws two conclusions: First, that there is no image on the glass, and second, that there is no image behind the mirror, through the earth and beyond. To the first of these I can only say that I have never come across any statement to the effect that an image is formed on the mirror, and, therefore, do not see the necessity of proving something which must be obvious to anyone who has studied optics. I will now say something with regard to his second conclusion. In my last letter I stated that the image has no actual existence, but is a virtual one. I now give a fuller explanation of the formation of the image. Let M represent a plane mirror, and O an object in front of it. From O rays of light diverge in straight lines in every direction; but it will suffice if we follow the course of two of them. These two divergent rays travel straight until they reach the mirror, when they are reflected, but still continue to have the same divergence with regard to each other that they had previous to reflection. Thus they reach the eye as if they diverged from I, and, as the mind

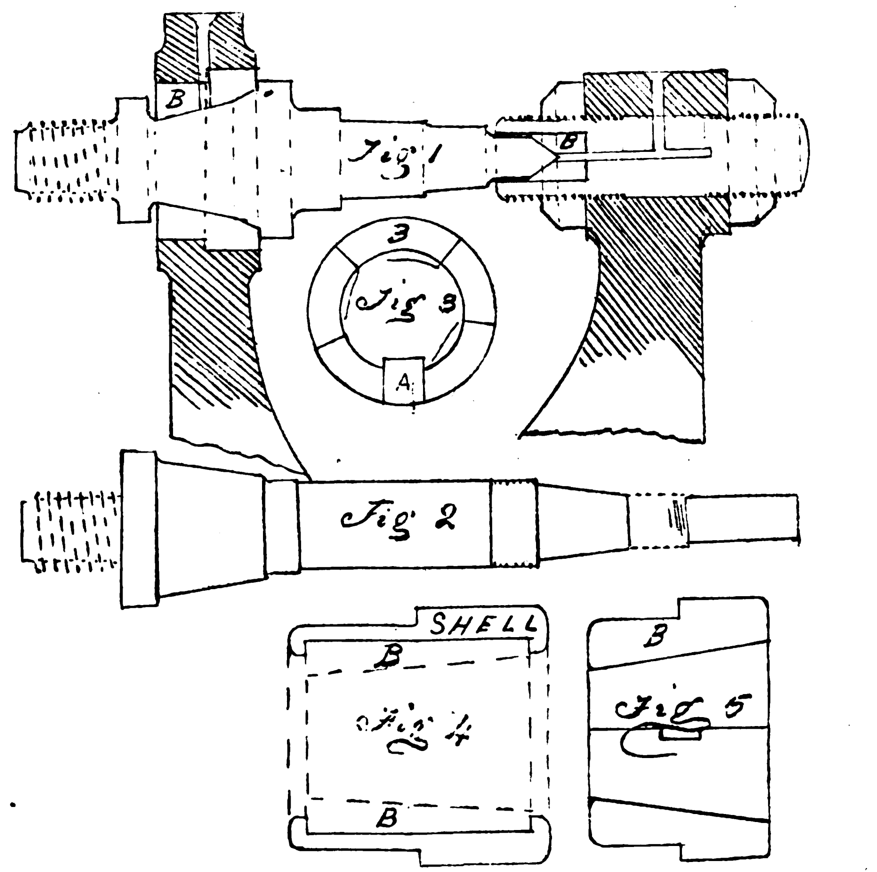
always refers any impression formed on the retina to the place from which the rays appear to come, we see a virtual image at I, which appears to be as far behind the mirror as the object is in front, but which does not really exist at all. The rays enter the observer's eye in precisely the same way that they would do if he placed his eye in the position shown at E[1], that is, as far behind the mirror as he now is in front of it, and removed the mirror so as to view the object direct. The course of the rays would then be as shown by the dotted lines. Mr. Ewer says there is no light outside the eye. Where, then, is it? There is certainly no light inside the eye, except that which enters through the cornea, and where does it come from if not from outside? But, unfortunately for Mr. Ewer's statement, there is light outside the eye. Light is composed of vibrations of luminiferous ether of such frequency as to excite the sense of sight, just the same as heat is composed of vibrations of ether, but slower than those of light. It would be just as reasonable to



say that there is no heat in a fire a mile away, because we cannot feel it, as to say that there is no light because it does not enter the eye and we do not see it. Perhaps Mr. Ewer is confounding light with sight, which is the mental appreciation of external objects by means of visual organs. He says that if the incident and reflected rays make an angle of 60° with each other, and the reflected rays came from a point as far behind the mirror as the object is in front, the angle would be 30°. What angle? An angle of 30° would be formed if the rays from the object went straight through the mirror until they got to a point as far behind as the object is in front, and then turned round and came straight back to the observer's eye, which is absurd. In no other way could they possibly form an angle of 30°, and I have shown above that they do not come from behind the mirror at all, but only appear to do so. With regard to the experiment he suggests of looking through a telescope at a person's eye on which a light is allowed to shine, any image which might be seen in that eye would be seen by reflection from the cornea, and not from the retina, for the reason that under ordinary conditions no light is reflected out of the eye which can enter an observer's eye. This is the reason why we see the pupil as a black spot, and it is only by the aid of the ophthalmoscope that we are able to see the retina. But no such experiment as this is necessary to prove what Mr. Ewer is trying to prove. An inverted image of any external object is formed on the retina in just the same way as it is formed on the screen of the camera. This can be shown to be the case by taking a dead eye and carefully cutting off a portion of the sclerotic at the back of the eye so as to expose the choroid. If it be now directed to an object an inverted image will be seen through the semi-transparent retina. Here again Mr. Ewer seems to be confunding light with sight, for he makes a distinction between an image being formed on the retina and the vibrations reaching the retina, whereas light consists of vibrations, as I have explained above. Undoubtedly it is the vibrations that give nervous impulse to the retina; but there is actually formed an inverted image as in the camera. This, however, bears no relation to the image formed in a plane mirror, because in the eye the image is real, and in the plane mirror it is virtual. C. A. NAYLOR.

[96875.]—**Armour Plating.**—It is not easy to find an explanation of this blunder—for blunder it certainly is. For 1½ mètres it might be possible to suggest that "feet" was meant; but, then, in a technical paper it would more likely be put as 18in. I would suggest that it is an error of the types, and that it should be 12c.m., meaning 12 centimètres. I do not think that any ship has armour thicker than 2ft. A mètre and a half would be close on 5ft.
M. T.

[96886.]—**French Verbs.**—The following taken from Brachet's "Public School French Grammar," would largely contradict "G.'s" answer (p. 300) to "W. B." The imp. is *ais*, &c. in all the conjugations. The Latin 1st conj. imp.—*abam*, became *avam*, then—*auam*, then (as *au* changes to *o*, and *a* to *e*) became O. F. *oe*, as *chantoe*, softened in 11th century into *oie*, as *chantoie*, *chantoit*; 16th century, *oi* became *ouè*, *chantouèt*, soon shortened to *è*, *chantèt*, the same in pronunciation as the present *chantait*. "This change of pronunciation of *oi* into *ai* was not at first expressed by spelling, and Voltaire is the first author who wrote '*chantait*,' &c., adopted by the Academy in 1835. A century before Voltaire, in 1675, Nicolas Berain had already



asked for this reform." Voltaire was thus right, and had very good reason to spell the words as they had come to be pronounced. GOSSIP.

[96935.]—**Motor Cylinder.**—I see in my former answer to the above I have not given enough information to enable you to make a job of the above. You must not use any clamps or carriers to hold the tube, because you cannot do so without distorting it, and when grinding it it gets warm and slips in jumps, and by so doing carries the distortion round with it. You must proceed as follows:—Make your tube hot enough to burn all grease off, and then while hot give it a dressing of good shellac varnish, and roll in or dust it over with some hot floor sand. When cold get about four yards of the jute clothes line; take the strongest strand out, and, twisting it tight, take a dozen turns round your tube, as near equidistant from the ends as you can—i.e., central—and pull as tight as you can, securing both ends, and shellacing the ends. When that is done take the other two strands together, twist tight, and take a dozen turns in the opposite direction, pulling them on as tight as you can. Let thoroughly dry —that is, the shellac on the first coil's ends, put none upon the latter layer. When grinding see that you hold it the right way—that is, the way that will have a tendency to tighten up outer coils. Watch that closely; if you twist it the other way or wriggle it about, you will have to go over it again. Having done the above, you will want nothing but your hands to hold it with, and by so doing you will be enabled to feel your work, and should be able to make a thorough good job of it.
JACK OF ALL TRADES.

[96996.]—**Bone Bearings.**—There is no preparation necessary for ordinary small bearings, but just select your marrow-bone or shank-bone. But if you cannot get the size you require, then put your bones into a good quantity of water, so that the fat will float off them. Let get cold, then take out and dry in some sawdust, or wipe them dry, and place them in a box full of dry ashes—clean ashes from under the grate—and put them in a warm dry place until they are thoroughly dry. If you are going to make a lathe with a tale pin as Fig. 1 (see sketch, Fig. 1), B, bush and back centred in bone, B. If the other at Fig. 2, and you have to build bush for large cone (see Fig. 3), segments of bone fitted upon a piece of wood with glue, gelatine, or isinglass. Any unequal pieces will do—never mind about shape inside. File the wood down, and fit a key-piece, A, in. When dry, turn up true upon the outside. Make a shell like Fig. 4 out of a gas-socket; turn bone down the length, then take off the wood and rebuild inside the shell, putting the key in and driving it home; then chuck true, and bore out for cone; then you can put cone on and true up upon mandrel. The mandrel should be turned up in dead centre, and the bush finished upon the same if it is a flat shank bone. These run a great width. Sometimes they are semi-elliptic on one side. Then take two pieces and fit together, as Fig. 5, with glue, and bore and turn as for Fig. 1. I fitted a lathe, 6in., up for a millwright in the "forties" like that with a steel bush, bored the head-stocks out under a drill press with a crank brace; made a couple of brackets out of a piece of old waggon tires, and my two centres was a pair of old bedstead screws case-hardened; these were fixed upon a plank mounted upon a couple of posts; an old dilapidated waggon-wheel, plugged up, and stuck to a post with a large-headed pin; another pin driven into the nave for my crank, with a rough piece of elm driven upon my job for a pulley. I did all my turning between these dead-centres for the job, and it far exceeded my expectations or the party that I made it for. Fitted the same as Fig. 1, and bush as at Fig. 5. If you have to build your bushes, you must get rid of the grease. There is nothing to equal it, for it is everlasting and clean. There is no case-hardening required. The bearings must be got up true and well burnished. No fear of your bearing being galled. If pulled up, the slightest drop of oil and you are off again. No trouble.
JACK OF ALL TRADES.

[97010.]—**Spectroscope.**—The missing part is an ordinary telescope. You can easily get one, and, having focussed it on some distant object (the moon is handy at night), put the object-glass on the open end of your spectroscope, and look through the prisms and collimator. It is essential that the sharp edge at the end of the set of prisms should be parallel with the slit. I shall be pleased to give any information if "E. S." will state what. The aperture in the collimator tube is, I expect, merely a stop to prevent stray light getting into the telescope.
GEO. W. COBHAM.

[97012.] — **Accumulators.** — If of the pasted grid type, these might be safely discharged at 29 ampères for five or six hours. The sp.gr. of the electrolyte when mixed should be 1·185. Note that when first put into the cells it will fall to 1·150 or thereabouts, and then rise to about 1·200 at full charge. It is very detrimental to the plates to use acid of too low or too high specific gravity.
A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97021.]—**Bromide Printing.**—I should like to add a few words to replies on p. 323. "Expose fully" and similar expressions are too vague to help a beginner very much. The usual rule for contact work is: 4sec. at 18in. from an ordinary old-fashioned fishtail gas-burner. But with up-to-date burners a better effect is got at 2½ft. to 3ft., with a minimum exposure of 5sec., and an average of 10sec. to 15sec. Length of exposure depends on force of light and sensity of negative, and the exact exposure in any particular case can only be settled by experiment. Always work by

seconds, with your watch in front of you, and do not be tempted into "counting ten," and that sort of thing. Before development thoroughly wet paper with clean water and examine for bubbles. Flood on the developer from a measure, well rocking dish at the same time. When development is complete, pour off the developer and thoroughly wash, and then fix for ten minutes. Developer given on page 323 may be used indefinitely if carefully filtered into a stoppered bottle after use, and refreshed when using again with about 1 part in 5 of fresh developer. A clean workman has very rarely need of ferrocyanide or or other fakement. H. H. S.

[97034.] — **Trellis.** — The wind pressure is practically the same when open as when closed, but when open your trellis will be weaker as the wind gets more leverage on the supports. No; upon second thoughts there will be more pressure when open, as the total surface to the wind is then nearly doubled. GEO. W. COBHAM.

[97034.]—**Trellis.**—If "O. J. L." will reverse the conditions, and try to fan himself with a gridiron, he will get a practical answer to his question. WIMBORNE CRICKET.

[97036.] — **The Planets.** — What "positions" are required? If the "heliocentric," they will be found in the *Nautical Almanac*, if the "geocentric," in "Raphael's Ephemeris of the Planets' Places," 1s. each year. If the latter, and not obtainable, I can furnish querist with any "position" and date for the present century which he may particularly require. TEMPUS.

[97049.]—**Ohm's Law and the Decrease of Voltage.**—One cannot help being rather amused at Mr. J. Brown's decided expression of opinion. Poor Ohm! If he were in the land of the living no doubt he would instantly retract his iniquitous formula, and apologise for its shameless inaccuracy, after being subjected to such wholesale condemnation from a master mind. Can it be, however, that the querist has not quite grasped the fact that some of the energy which is being transmitted, say, along a line wire must be expended in overcoming the resistance of that wire, and since the current is a constant value throughout its length, it consequently must be at the expense of the volts. Otherwise how could there be a potential difference of say 100 volts between the two terminals of a dynamo with a closed circuit or battery? If there were no volts lost in the circuit there would be no potential difference between any two points, and current would not flow. A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97053.]—**Carbon Paper.**—Melt lard 10 parts, wax 1 part; mix with sufficient of fine lampblack. Saturate unglazed paper with this, remove excess, and press. REGENT'S PARK.

[97057.]—**Leaking Coil.**—To MR. BOTTONE.—If your coil is giving ⅜in. spark with three cells, it is working fairly, and it is doubtful whether, if you have not had considerable experience in coil-winding, and especially in coil insulating, you could better it much. Still, if you like to try, you may use two layers of No. 16 double silk-covered wire for the primary, and about 1¼lb. No. 38 best silk-covered for the secondary. If nicely wound, and especially if the secondary is carefully insulated from the primary, you should get 1in. spark easily. S. BOTTONE.

[97060.]—**Alpha Orionis.**—In the 1897 edition of Ball's "Story of the Heavens," it says: "The leading star in Orion is known either as α Orionis or as Betelgeuse." There is no mention of it being the brightest. In Smyth's "Cycle of Celestial Objects" we have the following relating to α Orionis:—"'H.' pointed out this fine star as being variable and periodic. On his star-list the maximum was stated as above β Orionis, the minimum below α Tauri. Fletcher, in 1852, confirmed Herschel; but Schmidt pronounces strongly against the idea of variability." In a selection of variable stars from Dr. Chandler's catalogue, α Orionis is given as ranging in variability from 0·7 to 1·5, and not periodic. W. B. D.

[97060.] — **Alpha Orionis.** — Proctor, in his "Half-hour," says:—"The star α (Betelgeuse) is . . . one of the most remarkable variables in the heavens. It was first observed to be variable by Sir John Herschel in 1836. At this period its variations were most marked and striking. This continued until 1840, when the changes became much less conspicuous. In January, 1849, they had recommenced, and, on Dec. 5, 1852, Mr. Fletcher observed α Orionis brighter than Capella, and actually the largest star in the northern hemisphere. It appears that there is decisive evidence of the presence in this luminary of many elements known to exist in our own sun. . . . Secchi considers that there is evidence of an actual change in the spectrum of the star, an opinion in which Mr. Huggins does not coincide." I have seen Orion myself two or three times lately, when weather permitted, and there is certainly not much difference, if any, between the brightness of the stars α and β. There is, of course, a great difference in the colour of the two stars, and this may account for your seeing Rigel the brighter of the two.
Earlsfield, S.W. SILVERPLUME.

[97060.]—**Alpha Orionis.**—Rigel (β) is certainly, as a general rule, the brightest star in Orion, the Harvard magnitudes of that star and Betelgeuse (α) being 0·32 and 0·91 respectively. Aldebaran (α Tauri) is of magnitude 1·00. Betelgeuse was found to be variable by Sir John Herschel in 1836-40, being at a minimum (below Aldebaran) from 1839, Nov. 26, to 1840, Jan. 7, and then varying little until 1849. Argelander believed it to have a period of 196 days, its light increasing for 91½ days, and falling for 104½ days, this diminution being imperceptible from the 20th to the 70th day after a maximum. "Occasionally its variation is scarcely noticeable," he added. Observations by Schönfeld and Schmidt did not confirm periodicity. On 1852, Dec. 5, Fletcher rated the star brighter than Capella, and nearly as brilliant on 1865, Dec. 25. A well-marked minimum was observed by Gore and others about the middle of December, 1887, when the brightness of Betelgeuse was exactly equal to that of Aldebaran. In the winters of 1890 and 1891 it was generally of magnitude 0·5, and on the whole brighter than in February and March, 1889 (Markwick). In 1893, December, and 1894, January, the magnitude was 0·6-0·8; but very fluctuating in 1894, January to March, 1895, January to March, and the following winter, being as low as 1·0 in the middle of March, 1895 (Pereira). My own observations give the following limits:—1897, Jan. 2-3, 0·3; Mar. 3, 0·7; Dec. 20, 0·3; 1898, Oct. 12, 0·8. Betelgeuse is No. 2098 in Chandler's "Third Catalogue of Variable Stars."
WALTER E. BESLEY.
Clapham Common, Nov. 18.

[97062.]—**Tommy Atkins.**—The name Thomas Atkins was at one time printed on a nomination paper in connection with the Army, being a name used simply to show how the form was to be filled up. It has caught on from this fact alone. HANDEL.

[97065.]—**Whitworth Standard.**—To find the size across the flats of a Whitworth nut, take 1½ the diameter of the bolt which it fits, and add ⅛in. For instance, for a ½in. bolt the nut will measure ¾in. + ¼in. + ⅛in. = ⅞in., and the spanner may be $\frac{29}{32}$in. W. EWART GIBSON.

[97066.]—**Observatory Lamp.**—I used to use an ordinary lantern, burning petroleum, and never had any trouble with it. At first I tried colza oil, but one of its objections was that it froze in winter nights. After I had used the lantern with petroleum for some years, I made two batteries of four cells each for bichromate of potash. One battery lighted a low-resistance lamp, and by having two batteries; I always had one sufficiently fresh, not to run one in a long night's work. I made the solution in large quantities now and then, so that I had not much trouble in refilling the cells. Chromic acid could be used now. The advantage of this light over the lantern was its greater convenience in reading the circles, and in drawing or writing, where perfect darkness was required every minute or two. I made a lamp-holder with a switch on it, and could have the holder in my hand or in a pocket. There was another switch at the battery. I wound up the plates whenever I was not using the light for any time. The batteries lasted well. M.

[97072.]—**Rotation of Shell.**—Certainly the shell is usually still rotating. The rotation is slowly stopped by the friction of the air on the shell-case, and the power of rotation is absorbed (or resolved) into heat. If the shell is still rotating when it explodes, each fragment will travel in a direction governed by its paths of projection and rotation caused by the gun, by its path of projection, and possibly rotation caused by the exploding agent, and by the force of the earth's attraction on it. If the exploding agent is lyddite, the action of this will practically swamp all others at any point near the explosion. GEO. W. COBHAM.

[97076.]—**Medical Batteries.**—Before "Lancastrian" entirely discards primary batteries for working the above, I should advise him to try the Gordon-Burnham copper oxide battery as supplied by the Edison-Swan Co., Braulik, and other electrical supply houses. Prof. Gordon's No. 1 (quart size) battery gives 100 ampère hour output, with one charge of elements, at 1 volt per cell, and no action goes on except on a closed working circuit. The internal resistance is very small, hence its usefulness for medical work. I have had two of these cells, coupled in series, working my medical coil for the past eighteen months, and it still works well. I can therefore confidently recommend it for this purpose. VALENTINE HOLMES.

[97076.]—**Medical Batteries.**—You are quite right; wherever batteries can be dispensed with, it is advisable to do so. For this reason I have devised and patented a special form of dynamo for medical use that supplies at will, two forms of current, (A), one continuous and unidirection, from the armature of dynamo direct, the strength of which can be regulated to a nicety by driving slowly or fast, or by tilting the brushes to different positions on the commutator; and (B) an alternate current set up by a coil which forms part and parcel of the winding of the yoke of the dynamo. The whole machine weighs about 15lb., and occupies a space of only 7in. by 7in. by 5in. It can be driven either by a hand wheel, or by power. The coil portion is capable of giving a spark ⅜in. long, equal to about 15,000 volts; the dynamo current being equal to about 15 to 20 volts. I shall be pleased to give fuller details, if you will write direct to—
Wallington, Surrey. S. BOTTONE.

[97078.]—**Acetylene.**—The haze referred to is caused by phosphoric acid, no doubt, owing to the acetylene being impure. There is an article on the "Purification of Acetylene" in last week's "E. M.," which will no doubt help you.
W. EWART GIBSON.

[97079.]—**Wimshurst.**—The data given are not sufficient for me to be able to diagnose the complaint or locate the fault. There is no doubt that there is a want of insulation somewhere, but where it is not easy to say. Go over your photos again with good clean methylated spirits applied with a clean diaper (previously rinsed in clean water to remove all soap, and then thoroughly dried). Then varnish the plates carefully with good thick shellac varnish, which you should make yourself by dissolving good shellac in clean methylated spirits. Dry this carefully near a fire—not so near as to crack the plates. Now, have you good well-insulating bottles as Leyden jars? Test these for insulating power by charging them, and noting how long they hold their charge. In a fairly dry room they should retain a charge for a quarter of an hour. If they do not, reject them, and rig up others. Of course, you are aware that to get good long sparks, all the woodwork must be well polished or heavily varnished, and all brasswork highly polished and all snags or roughnesses removed. Paints are fatal. The ball on the "brushing" side of collectors should be twice the size of that on the "star" side. S. BOTTONE.

[97080.]—**Soap.**—I think the following may be of some use to "Embosser":—The materials are (1) pure white tallow (not Russian), (2) caustic soda, (3) filtered rainwater. Quantities for 1cwt. of soap: Tallow 70lb., soda 10lb., water 32lb. Tallow is first melted, care being taken not to let it reach boiling point. Then, having first put the soda into the water and allowed it to remain a few minutes, mix the whole together in the boiler, and stir well for an hour. Lade out into a box lined with common canvas, cool, and cut into bars.
E. B.

[97080.]—**Soap.**—Have not come across exactly what you appear to want, but send you second-best. Transparent Soap: From perfectly dry almond tallow or soft soap reduced to shavings, dissolved in closed vessel in equal weight of rectified spirit, clear portion after a few hours' repose poured into moulds or frames, and after a few weeks' exposure to dry atmosphere pieces are trimmed, &c. May be scented at will; coloured by tincture of archil for red, and yellow by tincture of turmeric or annotta. Does not lather well. Probably powdered steatite or French chalk, mixed with water or other liquid, might suit. REGENT'S PARK.

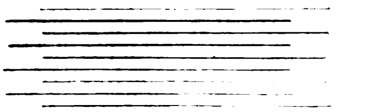
[97081.]—**Strongest Adhesive.**—To MR. BOTTONE OR OTHERS.—I regret that my knowledge does not extend to adhesives. S. BOTTONE.

[97082.]—**Dry Cell.**—To MR. BOTTONE.—(1) Yes. (2) Yes. (3) The Carsak is practically a Leclanché in which the porous cell is replaced by a sack made of canvas or similar coarse material. Procure a wide-mouthed glass jar. Fit it with a cylinder of zinc a trifle smaller. This need not be soldered up the side, nor does it require a bottom. Now make a sack to fit inside the zinc cylinder, of any rather open material, such as canvas, sacking, or even unbleached sheeting. Procure a suitable carbon rod or plate, to stand in the centre of the sack, and fill up with the usual mixture of coarsely-broken graphite and manganese dioxide. Place this inside the zinc cylinder, and fill up the cell with a solution of salammoniac 1 part, water 5 parts.
S. BOTTONE.

[97085.]—**Spark.**—1. With only two pint cells, such a coil would probably not give more than a 1in. spark; but with three quart cells in series, it should give a good 2in. spark. It would not be advisable to exceed this battery-power. 2. The weight of core would be about 2lb. 3. The uranium ammonio fluoride is well known. I have described it in my book on "Radiography." It stands next best to the barium platinocyanide. This salt can be purchased commercially under the name of "Metchebecke's Salts." 4. The seventh edition is now in the publisher's hands, and will probably appear early next year. 5. Because the Wimshurst is so far superior. One with a pair of 12in. plates will easily give 6in. sparks, and never fails to start even in damp weather. S. BOTTONE.

[97083.]—**Quarter-Inch Spark Coil.**—To MR. BOTTONE.—The faults in your coil are several. 1.

You cannot get a decent spark from a coil which has a *solid* core; it must be built up of a number of fine soft iron wires (No. 20 gauge is a good size) drawn out perfectly straight, and cut to the length. 2. The direction of winding of secondary, as regards the winding of primary, has no influence on the result; but if you have reversed the winding of any of the secondary layers, you spoil the coil. 3. The kinks and joins are probably at the bottom of the mischief. Kinks are inadmissible, and these, along with the solid core, account for the failure. If you wrap a condenser round a coil, unless you take extraordinary pains in insulating, you will most likely cause a short circuit to take place. 4. Arrange precisely similar sheets as below, taking care to have a sheet of paraffined paper between



each tinfoil; then roll together all the tinfoils extending beyond the papers at one extremity, and all the others together at the other. S. BOTTONE.

[97084.]—**Imitation Gold and Silver Paint.**—These "paints" are known as Bessemer's, because he was the first to introduce them. They are simply metals very finely ground, and mixed with "varnish"—a copal diluted very much with turpentine. I do not think the powders can be made on the small scale so cheaply as they can be bought (the price per ounce is roughly a shilling, but it varies from 5s. to about 36s. a pound, according to the fineness). There are various shades of gold and copper, but silver is of one tint, though there are some powders which have a greenish tinge. The querist can find full directions in the back volumes; but unless he wants them in cwts. he will find it economical to buy of those who make them by the ton. S. R.

[97086.]—**Dynamo.**—To MR. BOTTONE.—As the coils get hot, it is evident they are taking too much current. Your best plan will be to add on a layer or two of wire, testing after each addition, until you get the machine to run cool. But are you sure the machine was built for the output you state? Perhaps if you wrote to the makers, giving the number of the machine, or a description, they would tell you what it was designed to do. S. BOTTONE.

[97087.]—**Watch Jobbing.**—A watch may go slower in the pocket than when lying on the table from several causes. 1. If it is not well compensated, the heat of the pocket will cause it to go slower than in the cold. But if the watch in question has a compensation balance, a loss from this cause should not amount to many seconds per day. 2. When a watch is in a horizontal position, the balance rests and spins on the end of one pivot only, and there is very little friction. But when the watch is in a vertical position, as in the pocket, the weight of the balance rests upon the sides of two pivots, and the friction is greater, causing the watch to lose. High-class watches have their hair-springs so adjusted as to counteract this tendency to lose; but cheaper watches will often go one minute per day slower in the pocket than lying on a table. F. J. G.

[97088.]—**Motor.**—It would be far better if "Tourvan" used a petrol motor. They are more powerful, have less smell, and easily handled, and petrol can now be obtained at almost any village of importance. 6H.P. would not be sufficient to negotiate a stiff hill (say, 1 in 10) at three miles per hour, especially if the road is in a bad or soft condition. 8H.P., at least, should be used. Could be of assistance to "Tourvan" if he likes to advertise his address, and put himself in communication with— AUTO-CAR ENGINEER.

[97088.]—**Motor.**—I should advise you to purchase back numbers of "E. M.," which contain articles on Oil Motor, prize design Taylor's. Do not on any account put an undersized motor on your cart; you cannot expect a pony to do work of a horse. Have plenty of power. It has been the cry all the time "Not enough power! Sticks on hills, bad roads, and mud!" Put an engine 20B.H.P. on it, and it will be a source of pleasure and use to you. This approximately would come out two cylinders 6½in. dia. by 6in. stroke, run 800 revolutions per minute. See power on all late racing cars used. You will not then be lumbered up with a multiplicity of speed-reducing gears, though you may require one to crawl bad hills. There is little difficulty in getting petrol now in any main town in England, and, with proper forethought, sufficient for run would be carried. It is far better than paraffin for many reasons. MONTY.

[97089.]—**Pneumatic Cover.**—Dissolve solution with naphtha. REGENT'S PARK.

[97093.]—**Motor Cycles.**—You can use phosphor-bronze for cylinder if you like, but I should not recommend it. One or two makers are trying it, though it has long ago been found inferior to cast iron in gas-engine practice. The carbon deposit seems to set on it very hard and quickly—much more so than cast iron—and particles of this deposit will soon score large grooves in cylinder when hot, unless water-jacketed. Nickel or manganese bronze is much to be preferred—and these only when obtained from reliable makers. Gunmetal is not suitable in any form, as the high temperature will sweat the tin out, and leave it rough and porous in a short time. Ball bearings are not satisfactory for any part of the motor which is subjected to sudden shocks. This soon dents up ball-races, owing to bearing only on points; and it is also difficult to get exact adjustment of races. When cold they are too slack, and explosion has bad effect. If you adjust to fit when cold, when warm they are too tight, causing grinding, wear, and hard work. MONTY.

[97093.]—**Motor Cycles.**—If you like you can get the outside made of gunmetal or any of the bronzes; bore out and insert a steel tube. But cast iron is the best material, especially if made of good toughened range metal. This matter should be studied by those who make a speciality of these things. I have some drawings by me—i.e., rough sketches, to perfect, that will open some of your eyes as to building motors presently; but through a series of accidents have been unable to get on. JACK OF ALL TRADES.

[97093.]—**Motor Cycles.**—Phosphor-bronze would do; but, in my opinion, cast iron would be better. Do not try to make cylinders or valves thinner in proportion than dimensions given in recent articles; if you do, trouble will be given when the parts are heated. Ball bearings would do if made very large. I would recommend not less than ⅜in. balls, with large races for about 1in. shaft. The chief objections to them in use are their size and cost. R. J. U.

[97093.]—**Motor Cycles.**—Cast iron is preferable to phosphor-bronze for motor cylinder; it wears much better. The objection to ball-bearings for crankshaft is that, if properly adjusted when motor is cold, they are too tight when it warms up. W. EWART GIBSON.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96639. Motors and Castings, p. 121.
96644. Marine Engineers, 121.
96646. Hernia, 121.
96653. Sailing Boat. 121.
96657. Laundries, 121.
96664. Sunken Ships, 121.
96667. Wheel-cutting, 121.
96672. Mexican Furnace Chimney, 122.

96835. Motor for Phonograph, p 214.
96836. Microphone, 214.
96842. Motor Tricycle, 215.
96843. Motor-Car, 215.
96844. Arc Lamps not Burning, 215.
96845. Water Motor, 215.
96850. Leaven, 215.
96853. Heat-Absorbing Power of Alum, 215.
96854. Rolled Paper Pipes, 215.
96855. Aluminium for Electric-Lighting Cables, 215.

QUERIES.

[97094.]—**Dew-cap for Refracting Telescope.**—Will some reader kindly tell me the best material and dimensions for a dew-cap for a 6 n. refractor to be effective in a heavy dew, when the tube and stand literally run with water? F. J. G.

[97095.]—**Photographic Enlarging.**—I have worked for some time with a home-made enlarging apparatus, but only by daylight. I am anxious to continue my work at night, but do not quite know how to begin the construction of a lantern or other source of light, and should be obliged by directions as to burner, reflectors, &c. Also for keeping undue heat from negative. Gas and oil available, electricity out of the question.—H. H. S.

[97096.]—**Amyl Acetate.**—Can anyone inform me whether this substance is soluble in water, whether it is very volatile, whether it will dissolve copal and amber, and what are its principal uses?—PLANTAIN.

[97097.]—**To Sensitise Bromide Paper.**—Will anyone give working formulæ and directions for the sensitising of bromide paper?—H. H. S.

[97098.]—**Adjustment of Newtonian Reflector.**—Suppose the telescope is pointing to the zenith during the daytime; when the flat appears round the reflection of the large mirror is at the bottom of the flat; the image of the flat when adjusted in the centre of the reflection of the large mirror being almost on the lower edge of the flat. When the image of the large mirror is centrally adjusted, the vertical diameter of the flat is less than the horizontal diameter. Will some reader kindly say where the fault is?—W. M. WORSSELL.

[97099.]—**Metal Spinning.**—1. Could Mr. Richard Larsen, who wrote the article on metal spinning in February, 1896, be good enough to let me know if aluminium requires annealing during the process of spinning? And, if so, in what way is the operation performed? 2. How do they obtain that frosted appearance on aluminium? 3. Could Mr. Larsen give full-sized drawings in all sections of the spinning tools, *a*, *b*, and *c*, mentioned in his article? My copy was rather faint, and I cannot make them out. 4. What solder should be used for candlesticks and such articles not intended for cooking?—H. D. CHRISTIAN.

[97100.]—**Lyddite.**—Is there any ferro-cyanide of potassium or other cyanide in lyddite?—F. B. ALLISON, Peasmarsh.

[97101.]—**Acetylene Lamp.**—Is there any way of cleansing the burner of a small portable acetylene lamp without unscrewing the burner, which appears to be choked? The lamp has not been used very much.—C. G. L.

[97102.]—**Speed-Gear.**—To "MONTY."—Some time ago you promised a drawing and particulars of two-speed gear and friction clutch for motor-tricycle. Should be very pleased to see this in the "E. M." Mine is a Beeston motor-tube ignition. Would "Monty" advise the Sims magneto, or the ordinary electric ignition? Can the Editor say when we are going to have the promised articles on the motor-car?—J. H. H.

[97103.]—**Kitchen Boiler.**—Will any of your readers be kind enough to give me information upon the following points? (1) The kitchen-boiler often makes a gurgling noise, which is most annoying, and we have to let some of the hot-water escape. At the instant the tap is opened, instead of water rushing out, a great volume of steam comes forth, and after a time the whole place is nothing but steam. Is this dangerous? And would some kind reader explain the cause of it? (2) And again, when the hot-water tap in the bathroom is opened, upon closing it, the whole of the pipes vibrate most profusely, and make a knocking noise. The knocking can be felt quite distinctly if the hands are rested against any part of the bath; and if the tap be opened it stops. It also stops upon opening the cold-water tap. I am of opinion that it is something to do with the pressure, but know not what. Is this so? If it is anything to do with the pressure, what is the cause of it?—POOCHO.

[97104.]—**Eight-Plate Wimshurst.**—To COL. RICHARDSON AND OTHERS.—Will you kindly say what size sectors should be for this machine? Also what size tube it should work? The plates are glass, 20in. in diameter.—H. M. C., Leeds.

[97105.]—**Bran Tea.**—Can anyone tell me the best way to prepare this? How much bran, say, to a pint or quart of water, and should it be boiled or not? And how to keep the bran back?—BRAN.

[97106.]—**Induction Coil.**—To MR. BOTTONE.—I have made a Wimshurst from the instructions in your book "Radiography," and have obtained good results with it. I am now making the smaller of the two coils described, and should be much obliged if you would tell me what modifications (if any) are necessary to enable it to work a 4in. tube.—A. H.

[97107.]—**Steam.**—Will some reader give me a little information on the following subject? 1. A quantity of water in a boiler is converted into steam, passed through engine into condenser, and thus returned to boiler. When this goes on for some time the quantity of water diminishes. What becomes of it? 2. If a cast-iron vessel containing some water is sealed up air-tight and capable of standing a large inside pressure, and is heated to a great heat, then allowed to cool, will the bulk of water have decreased?—ALEX.

[97108.]—**Cold Glue.**—I should be glad to know of a recipe for a white glue to be used cold.—G. W. B.

[97109.]—**Dynamo.**—How can I find out the correct amount of iron for F.M. and A. in any desired form of dynamo?—E. G. WOODHOUSE.

[97110.]—**Dynamo.**—Will any electrical readers say what output I may expect from a dynamo of these dimensions?—F.M., 3½in. long by ¾in. in thickness, armature tunnel 1⅞in., armature made up of 16-cog drum armature punchings. Also kindly state gauges of wire on F.M. and armature, and what speed. And would a ½H.P. gas-engine be sufficient to drive this?—WOODHOUSE.

[97111.]—**"Norton" Door-Springs.**—I have three doors in my house which are much exposed to strong draughts, and to prevent the banging I have hitherto used "Norton" springs; but these I find, after several years' experience, are unfitted to stand the wear and tear of constant use, and either very quickly get out of order or, as has often happened, are broken in one part or another. I should be glad, therefore, if any reader of the "E.M." could recommend some other form of spring which answers the same purpose as the "Norton"—i.e., that of keeping the door closed, and at the same time preventing it from banging?—N. MACLACHLAN, Rontenbrom, Largs.

[97112.]—**Tin and Sheet Mills.**—Being employed in tin and sheet mills, would someone inform me in your pages if there is a book, not too expensive, that would tell me all about mill-managing, so that I should know how to order bars to be cut and rolled, steel or iron, for either of the mills, and what might the price be? Also if there is a weekly for the above trade, as there is for other trades, such as building, &c., and what is the name of it?—JOE EDWARD.

[97113.]—**Bermaline Bread.**—Would any reader kindly give recipe for making the above?—HOME.

[97114.]—**Telephone.**—I am desirous of constructing a telephone with underground wire from my house to the village, which is about a mile off, and I also wish to be able to communicate with the stables, which is about 100 yards from my house, on the line which the wire will take, and with three other houses, which are 300 yards, 400 yards, and about half a mile respectively from my house, and each about 50 yards on different sides of the line which the wire must take. There is no necessity for the other houses being able to communicate with the village or with each other. I shall be very much obliged for any information as to how this can be most simply and economically accomplished, and as to what the probable expense would be. I should, perhaps, say that there

are local reasons which prevent the use of overhead wires, or of the underground wire following any other line.—E. H. B.

[97115.]—**Dynamo Construction.**—Will any of your readers kindly tell me whether the following particulars for a dynamo are practicable, and whether I can expect to get 110 volts 22 ampères out of it? Manchester type. Shunt wound. Ring armature 9in. long by 7in. diameter, wound with 250 yards No. 11 B.W.G. Field-magnets each 9in. long by 6in. diameter, wound with 6.140 yards No. 16 B.W.G. (i.e., 6,140 yards for the two magnets). Top yoke 2ft. 10in. long by 11in. wide by 1in. thick.—FORWARD.

[97116.]—**Tortoise.**—I have a (Kimberley, S.A.) tortoise that is kept in the kitchen, and has not eaten for five weeks, but remains active, and refuses to settle in a box of dry earth prepared for it. What provision and protection for it should be made for its winter sleep and to keep it alive during winter?—J. A.

[97117.]—**Medical Electricity.**—To MR. BOTTONE.—I have a three-pair plate Wimshurst, 18in. plates, and four Leyden jars. Can I safely use this for medical shocking without endangering life? If I put the spark-gap balls nearly touching each other, and then take a damp string with a sponge at the end from each of the rods carrying the brass balls, could I then use this arrangement with absolute safety, or would you advise using a water regulator?—MEDICAL.

[97118.]—**Cylinder for Oil-Engine.**—Will "Monty" kindly tell me the smallest efficient diameter and stroke of cylinder for an oil-engine using ordinary petroleum to give three or four B.H.P., with pair of flywheels 3ft. diam., 4½in. rim? Also would 1½in. diam. crankshaft be sufficient?—HENRY A. S. UPTON.

[97119.]—**Water Gas.**—Can any reader give me any information as to the most improved method of manufacturing water gas, and what number of thermal units are yielded by combustion of one cubic foot of same?—F. MASON, Electrician.

[97120.]—**To Mr. S. Bottone.**—I want a light for no more than two hours at a time, a 5-candle incandescent lamp. I don't care about the voltage, as I can have any I choose; but I will be most obliged if Mr. Bottone shall kindly suggest what battery and number of cells should be more convenient for my purpose. Impossible for me to use accumulators, because I have no means of recharging them. If the suggested battery is, as probable, a liquid one, what must I do to avoid the spilling of the liquids while carrying about the battery?—HIMOS.

[97121.]—**Geometrical.**—A B is base, C apex, of any triangle A B C. Given P¹ a point in the side A C, find P², a point in the side B C, such that the perpendiculars from P¹ P² on the base A B shall be together equal to the line joining P¹ P².—X.

[97122.]—**Small Motor Winding.**—A small Simplex machine has bipolar armature 1¼in. by 2in., wound open circuit about 2½oz. No. 20 S.W.G. Fields ordinary cast iron, core 1¼in. by 1in., wound 7oz. No. 22 S.W.G. (450 turns). Shunt; massive pole-pieces; small air gap. This machine gives 4 to 5 volts, 3 ampères, as a dynamo, but runs very badly as a motor, taking about 4 volts, 4 ampères, on no load. Would someone kindly state better winding for armature, using same field winding, so as to make machine run well as dynamo or motor? Either shunt or series.—R. W.

[97123.]—**Wireless Telegraphy.**—To MR. BOTTONE.—Would you tell me whether the decoherer, as shown on p. 19 of the "E. M." for Feb. 17, 1899, strikes the glass only when the electrical waves cease, and, if so, why, as the decoherer seems to me to be arranged to act instantly? If this is so, how are dots and dashes distinguished?—RIFLE.

[97124.]—**Medical Coil.**—To MR. BOTTONE.—I have made a medical coil as per your instructions in your book "Electrical Instrument-Making." It is a sliding type. Primary ⅜lb. of No. 24 single-silk-covered. Secondary ⅜lb. of No. 36. Now can I, by making a condenser, get a spark from it of any size-length? If so, how many sheets of tinfoil, and the number of bichromate batteries will it stand? As the coil is now, with two batteries and the wires of the secondary coil about ¹/₃₂in. distance, I can get a spark. Also, can you tell me how to make a dial for the coil to mark the strength?—F. E. A.

[97125.]—**Colouring Metals.**—Would some brother reader kindly inform me how the cases of some watches are coloured black, and some other class of goods in gun-metal coloured something like bright steel?—THOS. J. O'CONNOR.

[97126.]—**Problem.**—Find x from the equation $x^{\frac{1}{3}} + (x-1)^{\frac{1}{3}} = (x+1)^{\frac{1}{3}}$. Professor Chrystal, in his Algebra, gives for the answer—

$$x = \pm \frac{2}{\sqrt{20\sqrt{6} - 45}} \text{ or } \pm \frac{2i}{\sqrt{20\sqrt{6} + 45}}.$$

I cannot succeed in getting this result.—F. OGRAM.

[97127.]—**To Electricians.**—Will some electrician kindly tell me whether the acid used in accumulators is the pure sulphuric acid, or is it the commercial (oil of vitriol)? And I should be very grateful if someone would answer my query—Pasting Accumulator Plates (96912), which appeared on p. 238.—P. A. S.

[97128.]—**Rate of Interest.**—Will someone kindly show, in a simple and easy manner, how the following calculations may be made? I buy a 4 per cent. security at the price of 108, carrying £1 10s. of accrued interest. It is redeemable at par in 10 years. What rate of interest does this investment yield?—not approximate, but strictly accurate, taking into account that the premium (£8) is deducted in one sum at the end of the term (10 years).—CHERCHEUR.

[97129.]—**Wheeled Carriages.**—I have been told that a three-wheeled carriage is more stable than a four-wheeled one. Is this so? And, if so, why? I am also informed that a four-wheeled carriage with a long narrow wheel-base is more stable than one with a short wide wheel-base. This is opposite to what obtains in boats. Why? Finally, is a car with small wheels more stable than one with large wheels, if the centre of gravity is the same height in each case?—MOTOR CAR.

[97130.]—**Drawing Wire.**—Will some reader advise me what sort of steel I am to get for making dies for drawing wire that will stand a great pressure, and will not chip or wear in a short time, and what is the best method of hardening steel for this purpose? I have tried best tool steel, and find it wears and chips in a very short time. Or can you tell me if steel is used for this purpose? If not, what is used, as it is to be drawn uniform size?—C. A. FAULKENER.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 22, and unacknowledged elsewhere:—

ERG.—Alex. Smith.—Hugh Alexander.—Lightning.—A Fellow of the Royal Astronomical Society.—Rex.—H. H. S., Paris.—F. H. Wenham.—Coherer.—Carton.—J. M. S. P.—J. E. Gore.—Try Again.—H. Lattey.—A Reader.—M. S. Don.—Algol.—Alex. Reith, M.D.—A. R.

J. B. CLIVE.—The query was published on p. 98. The title and number were given on p. 237, and again on p. 325. It is not unlikely that readers did not understand it, and so did not reply. An alloy of lead and antimony is readily covered with a film of copper, and then it is easy to cover that with a wash of silver. For "good work" it will be necessary, probably, to use a battery. See many replies in back volumes, or text-books of electro-metallurgy.

APPRENTICE.—Query seems to be wrong. As to a sanitary inspector, procure the publications of the Sanitary Institute, Margaret-street, W. A "clerk of the works" is a man with technical knowledge, who is competent to pass an examination in Building Construction. They are altogether different "lines."

R. W.—We have not heard of their publication in book form.

MAC.—Probably the village blacksmith or a travelling tinker can convert your copper coal-scuttle into an ornamental flower-pot. As to the "expense," that will depend on the condition of the scuttle, and on the amount of work to be expended on it.

W. R. PIDGEON.—To what does your letter of Nov. 14 refer?

P. H.—There are vacancies for engine-room artificers, but we do not know what the "test job" is. That would be kept secret until the candidate was asked to perform it. If you can pass as a "fitter" or a "turner," you would no doubt be accepted—especially at the present time.

JAMES PARIS.—We cannot find space for discussion between customers and advertisers as to quality of goods supplied. Nor can we accept any responsibility in such cases. Where fraud is evident, as in the case of money being received and no goods sent, we do our best to see readers righted; but disputes as to quality or value must be settled in the ordinary way. Your remedy is to sue the advertiser for the return of your money if the lathe, in your opinion, does not warrant its description. By the way, there is *no* such advt. as you refer to on p. vi. No. 1,801, in the position you indicate, or we might possibly have been able to form some opinion as to the character and standing of the advertiser.

O. TOM OBILE.—The correspondent you mentioned subsequently qualified his offer by a suggestion inviting private correspondence, which we did not insert, having reason to apprehend that he sought his own personal advantage rather than that of correspondents he offered to help.

F. W. E.—It produces the sounds that are mechanically imprinted on the cylinder: but as to how long the materials will last there is no information. The articles on the Grammaphone commenced in No. 1779, April 28, 1899. See the numerous replies on the subject: some instruments appear to be better than others. Obviously the sounds of a solo are reproduced more accurately than those of a band or an orchestra.

HOPEFUL.—All in good time; they will begin shortly. For one thing the author has been on his honeymoon trip, and, besides, we have the series now appearing to finish first.

H. T.—We do not think the immediate future of the brickmaking trade is likely to be a prosperous one, and should recommend you *not* to take shares in the company you name.

OXFORD.—Sorry, but we cannot make out your sketch, and correspondents must please observe our rules above, if they expect their communications to appear.

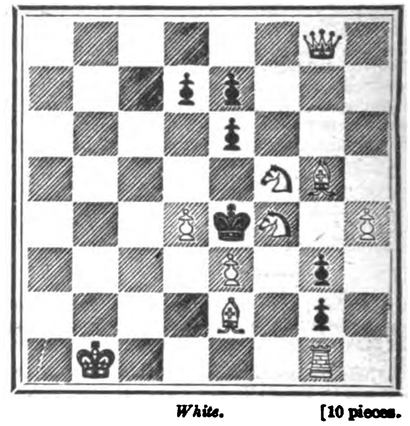
IN TYPE.—Alex. Smith, T. G. P.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1702.—By L. HAWKINS.

Black. [6 pieces.



White. [10 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Dec. 4.*)

Solution of PROBLEM No. 1700.—By H. V. GOTTSCHALL.

Key-move, B-K 5.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1700.—Correct solution received from J. E. Gore, J. Mason, Richard Inwards, N. M. Munro, A. Tupman, Whin-Hurst, Rev. Dr. Quilter, Quizco, F. B. (Oldham), T. Clark, Wm. Peters, H. B. F., S. Woollen.

H. FELLOWES.—Captn. G. H. Mackenzie was born 24th March, 1837, and died in New York, April 14, 1891. Paul Morphy was born in New Orleans in 1837, and died in 1884.

J. CHIPPERFIELD.—Solutions of No. 1699 and 1700 not correct.

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 1, 1899.

INLAYING.—VIII.

THE next stage of inlaying is termed the "chopping in inlays," so termed because if we desire to enrich the flat surface of any

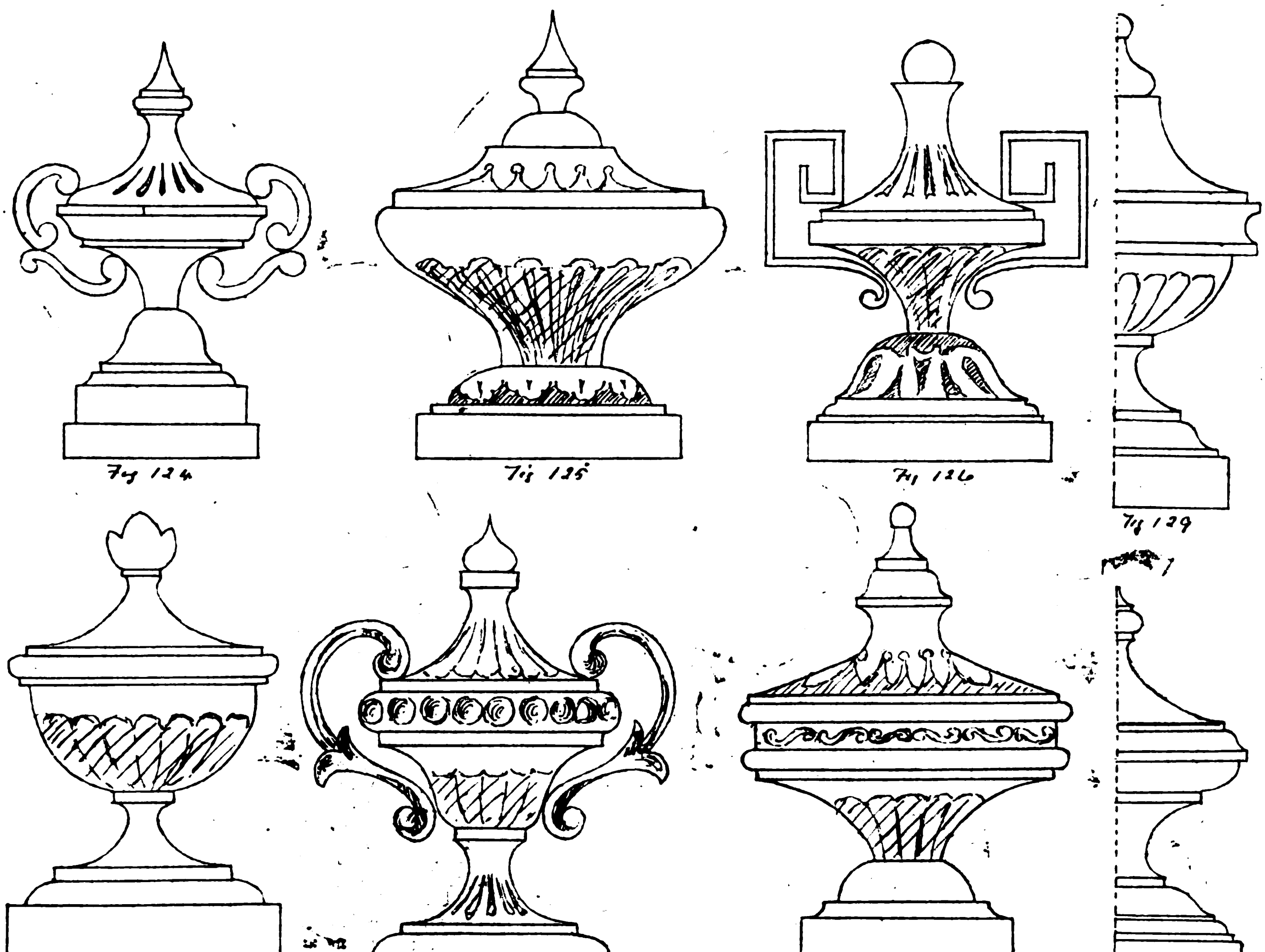
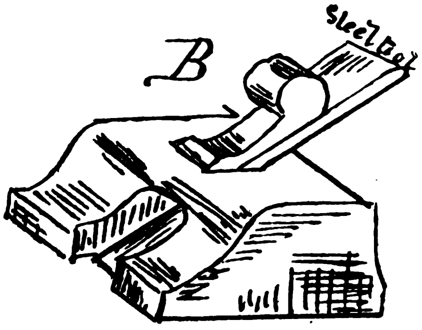


Fig 124 Fig 125 Fig 126 Fig 129 Fig 127 Fig 129 Fig 128 Fig 130

article devoid of any inlay or other ornamentation, then we must "chop" out (or in) a space to take the ornament desired. Figs. 124 to 130 are for the above, and the ornamentation is suggestive.

The ornament, generally of some simple form or outline, is assembled and glued to a fairly stiff paper. When so done the cutting is laid down on the work and marked distinctly with a marking-awl. It now remains to cut away a shallow space, so that when the cutting is laid in all should be flush or level. To assist us in gaining the requisite depth, we employ a tool called an old woman's tooth (see sketch B). The desired end is best gained by working out a partial depth at first, then by tapping the chisel or tooth the depth required can be cleanly and accurately got. The work of cutting the outline is, and must always be, the first step. If of varied and intricate form, a ready access to gouges will materially help. Where the surface is larger than the "tooth block," a narrow strip must be left for the block to rest upon, the removal of which is an after-process. Having successfully cut out the receptacle for the inlay, it remains to glue the latter paper side outwards. All flat work is safer if pressure can be brought to bear upon the caul or warmed piece of flat wood. If hand-screws, cramps, or other tools are not at hand, a spring bar is at once sound and practical. Having the work on a bench or table, and a beam overhead, it is but the work of a few moments to cut a lath, preferably of hickory, or an old string-bow, if strong enough. By springing the same between beam and work, there need not be any fear of unsound work.

The part that will tax the student mostly is in sweep or shaped work. A ready means can be obtained by making a bag and filling the same with either sand or fine sawdust. A piece of zinc will answer the purpose of a caul. It is a question which is best: to warm the sand-bag or the zinc. We in



Old Woman's Tooth

practice bed the bag to fit, and warm the zinc, applying heavy weight where permissible to gain the desired pressure.

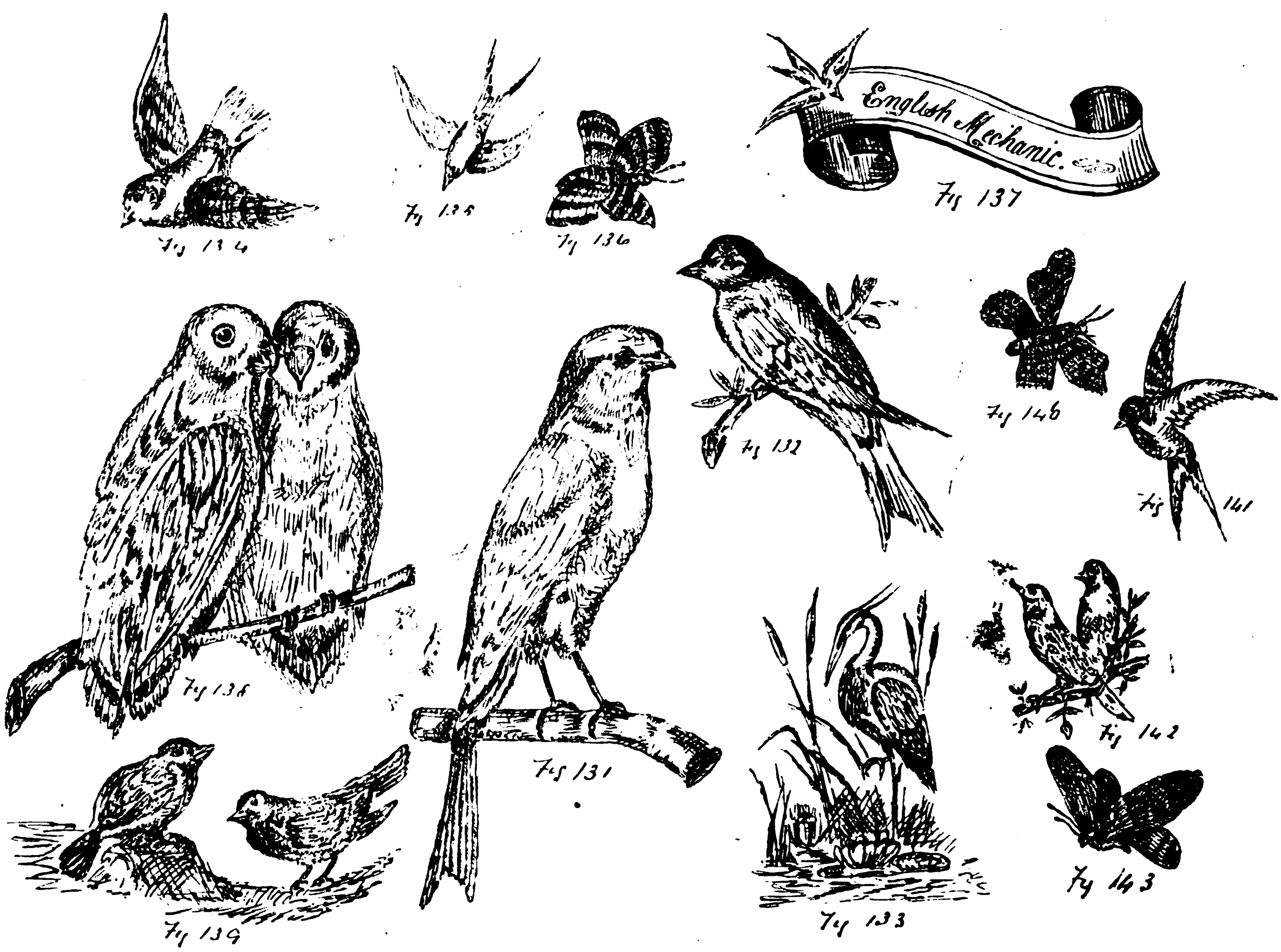
With respect to the bar-work, it must be plain to the merest tiro that the bar, ever endeavouring to regain its straight condition, will tend to force the veneer in that direction, which in this instance is outwards. Therefore it behoves one to set the two ends as near coincidentally as possible (one exactly over the other). In that way, the pressure will be downwards and upwards, or nearly. If that little point is looked to, much trouble will be saved.

Another point is the releasing of the pressure. It should not be too quickly released ere the glue is set, *with the just possibility of the work (cutting) sticking to the veneering caul*, or rising in bulges or blisters; nor should it be left too long, because the glue always oozes through, and may pass the outer paper and adhere to the caul, so that when lifted it may bring away some of the cutting with it; it is for that reason we rub moderately wet soap on the caul before pressing together.

Flat work can well remain under pressure from 10 to 24 hours, with the above precaution of soaping; the work should not be touched under 24 hours, or even more, if convenient; it can then be safely prepared for polishing.

Where wood cauls are used, soaping the surface with a piece of dry soap will prevent it adhering to the work. If zinc is used, a smear of mutton fat will help to the same end, and where the work cannot well be retained in position, a few veneer pins will help to keep all right.

To gain time and lessen the after-work, the surface of the cutting is invariably damped just sufficient to moisten the glue that holds the paper. In nowise must the soaking be prolonged or too hot; therefore, taking it for granted that the cleansing



process has got all surplus glue and paper off, it must be examined carefully to see if all is sound and in perfect contact. If not, then the part must be warmed gently with an iron, afterwards using a caul, as before stated.

We can now follow on with wider stringing or banding. If the groundwork holding the cutting is of a dark nature, such as walnut, rosewood, Coromandel, or any other darker wood, then the relieving band should, for euphony's sake, be gradual; too great a contrast should be avoided. If the ground is walnut, then a band of satinwood, boxwood, or yew, cut across the grain, having a black line each side of the band, and a white ditto outside that, which can be from $^3/_{16}$in. to $^3/_8$in. in width. If the band is rosewood, tulipwood, or kingwood, then a satinwood line, with an outer one of silver-grey as outside bindings. If the banding is of silver-grey, then a black line, with an outer ditto of redwood, will not look amiss. If the ground should be rosewood, either silver-grey, satin, or boxwood can be used in conjunction. Cut either across the grain or lengthwise, with the outer fine line in harmony. There are many more; but it would be superfluous to describe them all. The above should guide as to the making-up. Figs. 146 to 149, which will appear anon, give a narrow band; but they can be made all widths by following instructions.

Birds, &c.

We now approach a task which will demand a fair share of patience. We need not repeat what we have previously stated; but to help as much as possible, we will describe the method of working to obtain the best result. The first example (Figs. 131 or 143) will suffice for the major portion of designs; where even the zigzag exists, it can safely be brought into use. What we mean is, take the upper portion of wing. If cut carefully, the effect will not be lost; but it entails much work. By cutting the upper part of wing, and printing its serrations on to the body portion, a fairly fine joint should be got, and that applies to the collar-ring, and likewise the feathers; but the tail can be cut solid, and engraved up to gain the desired effect. Yet it does not follow that the entire markings cannot be cut; but it would be a work of great patience. The moths and butterflies will not call for much comment; only endeavour to copy the natural object for colour, &c.

We should advise the cutting of the birds to be done in three or four shades of rich brown; the browns can be enriched with the addition of a little cochineal to the brown dye; but do not overdo it. In that way the filling can be of, say, lampblack and glue, and the groundwork either satinwood, silver-grey, or bird's-eye maple. The colours for the moths cannot be too rich, and yet they should not give too great a contrast; otherwise the roundness in natural appearance will be lost. Fig. 133 should be cut in browns, using the darkest tints for the surroundings, so as to throw the bird up in relief as much as possible.

NOTICES OF BOOKS.

A Textbook of Physics. By W. WATSON, A.R.C.S., B.Sc.Lond. London, New York, and Bombay: Longmans, Green, and Co.

THIS work is intended for the use of students already familiar with the elements of the subjects, and is by the assistant professor of physics at the Royal College of Science, London. The principal point the author had in view was the arrangement: the best sequence or the most convenient for teaching. Anything "taken for granted" in any section has been previously explained in a preceding section, instead of postponing the explanation. The author writes from practical experience of the art of teaching, and, as he says, no textbook can take the place of experimentally illustrated lectures and of actual work in the laboratory. Therefore the illustrations are diagrammatic, and the work is really to be read by the student who is attending courses of lectures and classes in a laboratory. Nevertheless, it is an excellent textbook for those who cannot spare the time to attend classes, and we should not be surprised if it becomes a formidable rival to Ganot's "Physics." Some of the illustrations are taken from that famous work, but the majority have been specially prepared. There are 564 figures altogether, and there are nearly 700 pages of text.

Mechanical Movements, Powers, Devices, and Appliances. By GARDNER D. HISCOX, M.E. London: Sampson Low, Marston, and Co., Ltd.

ABOUT thirty years ago a useful work entitled "Five Hundred and Seven Mechanical Movements" was brought out in America, and portions of it were reproduced in our columns in Vol. XI. and subsequent volumes. Such a work is of great assistance to the inventor and to the engineering and mechanical student, and the author of the present work has endeavoured to help the engineer in ideal and practical mechanics in the "true line of research." He has therefore presented the reader with no fewer than 1,649 engravings specially drawn for the work, which illustrate the "movements" themselves, but also show their application in machines actually constructed or patented. Hence his textbook is well adapted to the wants of inventors, mechanics, engineers, draughtsmen, &c., and should find a place in all public libraries and in mechanics' institutes, and in places where science classes are held in all subjects connected with the mechanical arts.

On the Theory and Practice of Art-Enamelling upon Metals. By HENRY CUNYNGHAME, M.A. Westminster: Archibald Constable and Co.

THE author of this work, who is well known as a craftsman of no ordinary skill, says that the development of "modern machinery and of the factory system has produced, among other changes, the practice of making jewellery out of

stamped metal—a practice which has deprived modern work of most of its artistic value." When Mr. Cunynghame first commenced the work of enamelling he found great difficulty in obtaining information, but he pursued his hobby—if we may so call it—and searched far and wide for hints and notes and "secrets," not merely in English publications, but in those of Germany, France, and Italy. Every process he describes has been repeatedly verified practically, and he has tried and suggested some new ones. The earlier pages of the work are devoted to an introduction which is historical, but the remainder are occupied with chapters on the choice of a style in enamelling; the mode of executing "Limoges enamel"; cloisonné enamels, jewellery, and imitation glass gems; and the manufacture of enamel. The practical descriptions of the methods of enamelling are complete, and are amply sufficient to enable any intelligent man to perform the necessary processes, and it is to those workers who are something more than "hands" that this book is addressed. The frontispiece is one of a series of eighteen enamels representing scenes from the life of Christ by J. Pénicaud II., date about 1530, in the South Kensington Museum. It is reproduced in colours; another plate in colours is from the Salting collection. There are many illustrations, and those showing methods of manipulation, &c., will be especially useful to the beginner.

We have also received *Electric Wiring, Fittings, Switches, and Lamps*, by W. Perren Maycock, M.I.E.E. (London: Whittaker and Co.), a practical book for electric-light engineers, and also for students.——*Arc Lamps and How to Maintain Them*, by H. Smithson and E. Sharpe (London: Whittaker and Co.) is a practical handbook for the use of those who have charge of arc lamps.——*Electric Bells and Alarms*, by F. E. Powell (London: Dawbarn and Ward, Ltd.), is a little work which may be useful to those who wish to fit up electric bells and alarms.——*The Story of Eclipses*, by George F. Chambers, F.R.A.S., (London: Geo. Newnes, Ltd.) is a popular account of eclipses, written by one who has all the information to his hand.——*Problems in Machine Design*, by Charles H. Innes, M.A. (Manchester: Technical Publishing Company, Ltd.), is the second edition of a useful work for students preparing for the Honours stage.——*Natural and Artificial Methods of Ventilation* (London: Robert Boyle and Son, Ltd.) is a "compilation," as it professes to be, of the views of experts who have turned their attention to the subject. It is a useful work for the householder who studies the healthy condition of his rooms, and will afford some valuable hints to those interested in the important, but troublesome, matter of ventilation. ——*Key to Engines and Engine-Running*, by Joshua Rose, M.E. (London: Sampson Low, Marston, and Co., Ltd.), is a work that may be found useful by students, for the author has taken much pains to make everything as clear as possible.——*Heat for Advanced Students*, by Edwin Edser (London: Macmillan and Co., Ltd.), is intended for students who are already grounded in the principles of physics. ——*Practical Mathematics*, by John Graham, B.A., B.E. (London: Edward Arnold), is an elementary treatise in which the attempt has been made (successfully) to make the subject a little more practical and interesting.——*Practical Plane and Solid Geometry for Advanced Students*, by Joseph Harrison and G. A. Baxandall (London: Macmillan and Co., Ltd.) is written for the use of science students who are required to give accurate draughtsmanship throughout their work.——*Practical Geometry for Science and Art Students*, by John Carroll (London: Burns and Oates), is the 39th edition of a well-known work.——*Experimental Science*, by R. A. Gregory and A. T. Simmons, B.Sc. Lond. (London: Macmillan and Co., Ltd.), is a useful work for students, as the authors recognise that its merits, whatever they may be, are due to the plan of construction.——*Building Construction for Beginners*, by J. W. Riley (London: Macmillan and Co., Ltd.), is an elementary work well adapted for its purpose, as there are plenty of illustrations.——*Dissected Model of a Direct-Current Dynamo*, by Arnold Philip (London: George Philip and Son), is a method of instructing the reader in the construction of a dynamo by means of coloured plates which overlap, and have the parts numbered the same, descriptive matter being furnished. It is a useful method of teaching.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—VIII.

It is a question among meteorologists as to whether the spectroscope is or is not of any assistance in forecasting the weather. As applied to meteorology this instrument is chiefly used for investigating the so-called rainband, and since it is considered to offer a means of arriving at a solution of the problems of the weather by pointing out, as it were, a short cut, it has always enjoyed a certain amount of popularity. But the short cuts pointed out to meteorologists are many, and some have an astronomical basis and suggest that the changes in the sun and the moon or one of the planets synchronise with alterations in the weather; while at other times the secrets of sunshine and storm are said to be revealed by studying the vagaries of terrestrial and atmospheric electricity. None of these suggestions, although it may have the truth of the matter in it, stands the test of being actually employed in the work of preparing a daily weather forecast. It is but fair, however, to observe that many of these ideas have not had a proper opportunity of demonstrating their worth, for it is only by daily experiments and tests over a lengthened period that the value of any meteorological novelty can be discovered. The rainband spectroscope is one such idea which may be said never to have had a fair trial, for, owing to certain difficulties of manipulation, those observers who have procured these instruments, either at their own expense or who may have had them supplied to them from a Government office, have been discouraged by their lack of success in using them, and have pronounced them of no utility. Seeing, however, that other observers have claimed a large percentage of success in estimating the degree of moisture in the air by means of the spectroscope, there is encouragement to persevere a little longer along this line of meteorological research. So far as can be judged at present, it would appear to be impossible to foretell the weather by observing only a single phenomenon, and it is only when numerous observations are combined that a weather prophet can hope for even a moderate success in his predictions. If, therefore, the rainband spectroscope is not asked to read right off, so to speak, the sphinx riddle of the weather, but is merely required to supplement records obtained by other means, it ought to prove a useful adjunct to the meteorological armoury.

The rainband is principally found in the red, orange, and yellow portion of the atmospheric spectrum, and the intensity of the lines composing the band is said to vary according to the amount of vapour in the air. As a rule, rainband spectroscopists confine their attention to the group of lines which are to be found on the red side of the D line, and although there are other portions of the spectrum which are considered to change their appearance with the alterations in the atmospheric humidity, it is the former lines which receive the most notice. Now, it need hardly be said that these lines have received special attention in some of the principal meteorological observatories, the spectroscopes employed for this purpose being fitted with elaborate appliances for measuring the rainband; and it is also well known that there are smaller and more compact spectroscopes, such as can be used by the ordinary observer. These latter instruments are about 2in. long and ½in. or so in diameter, and there is at one end a milled head which regulates the breath of a small slit formed of two pieces of brass placed parallel to one another. Inside the tube which carries the slit is another tube closed by a lens, the other end being protected by a thin disc of glass. The inner tube it is which holds the series of prisms, which are, of course, the most important part of the instrument. The apparatus therefore for studying the rainband may easily be carried in the pocket, and is always at hand when it is desired to make an observation.

By using a direct-vision spectroscope the rainband is split up into many hundreds of lines, and one investigator, by employing a fine spider thread or platinum wire fixed in a movable frame, has succeeded in obtaining some very refined measurements. To measure the more important portions of the rainband the wire is moved slightly out of focus, so that its image becomes less distinct as the distance increases, and in making an observation a micrometer screw is manipulated until the image of the wire is as intense as that of the principal line in the rainband. A number on the divided head of the screw then indicates the degree of visibility or intensity. By means of this arrangement the observer to whom the credit of this method of measuring the rainband is due, has been able to differentiate some thirty or forty different shades in the lines, and some interesting observations have been made at different seasons of the year and at different altitudes above the horizon. No such detail as the foregoing is, however, possible with a pocket spectroscope, and, indeed, with these instruments the observer has to detect changes in shading which occur in a band of colour which is but an inch long and only half an inch broad. At best also the rain-band in these instruments appears but as a burr or shadow, and, unlike the larger spectroscopes mentioned above, there is no definite standard to which their indications may be referred, so that the measurements or estimates are made with a mental scale which depends for its consistency upon the ability of the observer, and which, moreover, changes with his mental moods from day to day.

Some observers adopt a scale in which 1 represents a faint rainband and 10 a strong. Seeing, however, that the intensity of the band changes with passing clouds, it has been found somewhat difficult to determine the approximate value of any given intensity, and many observers have accordingly employed a scale which only ranges from 1 to 5, and these five values are probably as many as can usefully be recorded. But before the attempt is made to use either one or the other of these scales the rainband has to be focussed in the spectroscope, and this is an operation in which all observers are not equally successful. Some never succeed in seeing it at all, and they are therefore ready to agree with the facetious remark once made to the effect that the rainband was an optical delusion strengthened by long practice. A wise man, however, once observed that the eye sees what it brings with it the power of seeing; and as regards the use of a rainband spectroscope, a little training and the exercise of a few simple precautions are necessary to secure the best results. In the first place, it is important to keep the spectroscope clean, and the prisms, lens, and slit need constant attention to keep them free from dust, for dust will produce appearances in the spectrum which, by the unwary, are often taken for the rainband. A camel's-hair brush will be found effective in keeping the slit free from intruding and vitiating dusty particles.

In making an observation, it is not necessary to point the spectroscope towards the sun, and all that is required is that it be directed towards some portion of the sky that is free from cloud, preference being given, as a general rule, to some quarter in the north or north-west. Supposing the observer has plenty of time at his disposal, it is recommended that he examine the sky from the zenith down to the horizon. Many observers are content with making only one observation; but experience indicates that two at least should be made. If no more than two are possible, they should be made at the horizon and at 45° above it. At all times there is a danger in taking observations simply at the horizon lest a rainband produced by columns of vapour rising from the surface of the earth should be taken for the effect produced by rain-clouds, and while the amount of vapour at all levels plays an important part in the condensation of rain it is well to investigate the atmosphere at distances above these low-lying bands of vapour. In addition, therefore, to directing the spectroscope towards the horizon many observers examine the atmosphere at 45° above this point, and at each observation they further use a scale which ranges from 1 to 5. The sum, therefore, of the two readings gives the value of the observation as compared with a scale in which the maximum intensity of the rainband is represented by 10. By thus taking the observations in two portions the difficulties of estimating the values of the band are considerably lessened.

As regards determining what is to repesent the maximum value of the scale, this can only be discovered by experiment, and it may be fixed by directing the spectroscope to the western sky at sunset when the rays of light are passing through a great depth of vapour, or it may be determined by looking at the sky on some occasion when a heavy downpour of rain is imminent. In focussing the spectroscope, the shadow or burr to the red side of the D line is, of course, the main feature for examination; but this portion of the spectrum is often made more distinct if such lines, for

instance, as those known as E and *b* in the green area are clearly focussed. Many people who have invested in these pocket spectroscopes appear to think that the chief aim is to get the colours of the spectrum as brilliant as possible; but in actual practice the colours should be rather subdued and the lines among them made as black as possible. Moreover, before making the daily observation it is advisable to focus the spectroscope at a point about 20° above the horizon, and then, having primed the instrument, as it were, at this elevation, its indications will not be far wrong either for the subsequent observation at the horizon or at 45° altitude. Assistance in examining the variations in the spectrum will be rendered by shading the eyes with the hand, and if the observer does not object to having a charge for eccentricity brought against him by his neighbours, he will add to the accuracy of his records if he imitates the action of the photographer and surveys the heavens with his head shaded by a black cloth. Seeing, however, that the early morning hours, say, 7 a.m. or 8 a.m., are the most suitable for making these rainband investigations, the observer may probably defy personal criticism.

The hope of those meteorologists who use these spectroscopes is that their utility as hygrometers may be demonstrated. A hygrometer such as that, for instance, formed by combining the familiar dry-bulb and wet-bulb thermometers is commonly erected in a screen some 4ft. or so above the ground, and the indications of such a hygrometer, therefore, merely refer to a very small portion of the atmosphere, and tell next to nothing of the hygrometric condition of the strata of air overhead. Supposing, however, the hygrospectroscope, as these instruments are sometimes called, could be developed into an instrument of precision, the atmosphere could be explored at all heights, and the rate of increase in the amount of moisture from the horizon to the zenith be discovered. When the spectroscope indicates that the intensity of the rainband decreases but little from the horizon up to an altitude of 45°, it is said that there is reason for supposing much vapour to be present, and when there is no decrease right up to the zenith a heavy downpour of rain may be prophesied with confidence. In passing, it may perhaps be noted that observations made with the hygrospectroscope in balloons indicate that the rainband grows fainter as the height above the earth increases; and at 20,000ft. it disappears altogether, these observations being corroborated by the investigations made with the aid of this instrument at the top of Ben Nevis. It is, therefore, from its supposed ability to sum up the aqueous condition of the atmosphere as a whole that the spectroscope gains its superiority over the hygrometers, and although during many years it was considered to be nothing more than a scientific toy, it must always be of interest, as being an attempt to record the meteorological conditions existing in the upper regions of the air. But, as already indicated when writing in previous articles concerning the different processes at work in forming the clouds, there are many other things besides aqueous vapour which help to produce rain. The spectroscope tells nothing, for instance, about the alterations in temperature, pressure, and electrical potential, and movements of the vapour-laden air, and at best it gives information concerning only one factor in the problem. It is because of the incomplete information provided by the hygrospectroscope that it sometimes fails as a weather prognostic, so that even when it indicates much aqueous vapour a wise prophet will not forecast rain unless his other instruments tell him that the conditions are favourable for its condensation. The rainband spectroscope should not, therefore, be expected to clear the difficulties from the path of the meteorologist without other support, for at present it is but a comparatively undisciplined auxiliary, and has yet to demonstrate its worth.

ORNAMENTAL TURNING.—XXXI.

By J. H. Evans.

I LEFT off in my last at a very interesting point in the construction of the spherical slide-rest, viz., the making of the tangent screw and frame which actuates the rotary motion. After the full details therein explained, I hope I may conclude that this particular part is so far finished and ready to put in its place.

It is important that the screw, and consequently the frame, stand perfectly square or tangential to the wheel. I have on more than one occasion rejected work of this kind, although very little out; but still it was not correct. The argument put forth in favour of its passing being that it would work just as well—as far as causing a rotary motion, yes; but, for our present purpose, certainly not. It must be remembered that an extended winch-handle has to be employed when this motion is in use, also a gun-metal arm supporting the end of a long spindle

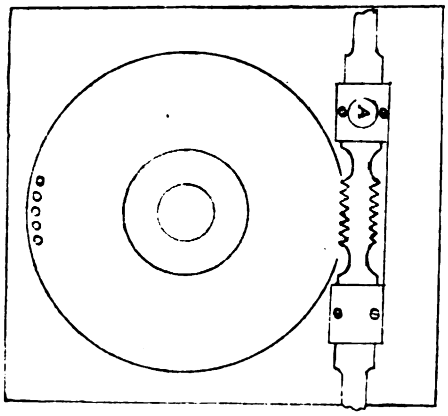
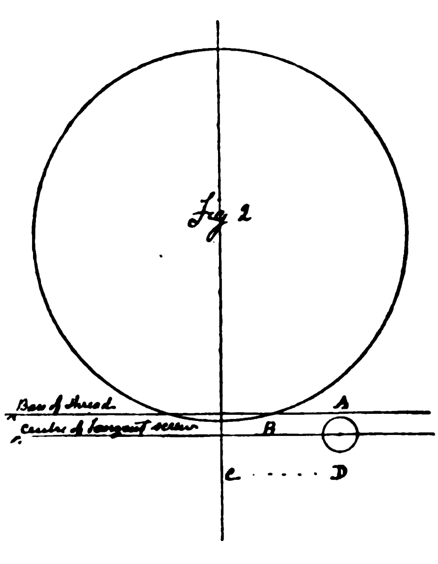


Fig. 1.

carrying a mitre-wheel, when fitted to work in connection with the spiral apparatus; therefore it will be obvious that a small error in the pitching of the frame would become so multiplied that we should find ourselves in difficulties, which might cause much trouble to overcome.

Having made this as impressive as I can, I will endeavour to point out as clearly as possible the best way to set out the work to overcome the difficulties.

In the first place, it is essential that the exact point at which to drill the hole in the plate that is to receive the stem of the tangent frame should be determined, I have set out, in Fig. 1, as clearly as possible, the best and safest way to set about this particular part. The illustration shows the frame and screw in its place; if we regard this as what we may call a surface or top view, A represents the stem of the frame, which is, of course, at the base; but the circle shown together with the



other points clearly define the manner of obtaining the correct position in which to drive the plate.

Now, if we strike a line tangential to the wheel at the precise depth of the bottom of the thread (A, Fig. 2), and another line in the same plane to correspond with the centre of the tangent screw B, it will be seen that the position of the hole to receive the stem of the frame is certified in this direction, providing, of course, that the stem is immediately under the centre of the bearing through which the screw passes. This must be fully ascertained, and if any error exists in this respect, allowance must be carefully made for it when setting out the work. So far we have the means provided of pitching the line in the one direction, and to obtain the distance from the centre of the wheel it is simply to take half the length of the frame C D, so that the centre of the screw will work in the wheel when in its place. I have thought it better to give a second illustration of this, as it may materially assist in the ultimate result.

And now I am going to explain what may be regarded as another little piece of dodging, but this is not exactly so; but I wish to point out and make it clear that in order to facilitate matters with respect to any very slight errors in pitching the centre for the stem, if there should be—and it is not at all impossible, although after the above details it should be most improbable—let us err on the right side. By this I would suggest that the operator should be quite certain to keep the centre of the line (B, Fig. 2) absolutely perfect if possible, and it is, of course, to be done; but here I will show that if the hole should draw, as it is termed, outwards, the screw, when in its place, would fall to an angle inclining inwards, for which there is absolutely no remedy. But if there should be a very slight deviation tending in the reverse direction, the angle of the frame would assume the opposite, and in this case, the error being very slight, we may get out of it. The wear of a series of revolutions of the screw in the wheel may be sufficient to allow the screw to become tangential. If so, that is all we want. If this should not be quite sufficient, a few rounds of the router in the wheel may assist without the least detriment to the latter.

All this, I need scarcely say, must be prevented by the exercise of care as to the points explained; but as there is no infallibility attached to any individual mechanic, amateur or otherwise, I like to give all the little hints that may be useful, should occasion arise, when they may be of assistance.

I think we may now pass on to the third slide, which is made as shown in Fig. 3, the dimensions also given. This slide, it will be seen, is made of considerable less width than those preceding it; for this there is every reason, which will soon become clear.

When this slide is planed, and the surfaces got up, it may be fixed to its place before the metal slide which works upon and carries the fourth, or tool-box slide, is fitted. As will be seen by the illustration, Fig. 3, the slide is made about 7¼in. long by 2¼in. wide, leaving an interval at the centre of ⅞in. for the passage of the nut. With regard to the length, I give it as 7¼in. about, for the simple reason that a ¼in. one way or the other is of no moment, and as I shall show a new method of attaching the nut in two different places, it is well not to increase the length of this slide.

We will now set about the fixing of the slide to the top surface of the worm-wheel. In order that this may be perfectly clear, I have shown in Fig. 4 the manner in which the four screws that hold the slide to the wheel are placed. It will be noticed that the two screws, 1 and 2, come within the circular bearing. This is a matter of no importance, and is no detriment. On the other hand, it is an improvement to get the screws as far apart as possible. The two screws at the opposite end, it will be seen, come partly on the bearing only.

The holes in the wheel must be thus carefully set out, drilled and countersunk with a sharp keen cutting-tool. The cutting out of the holes without raising a burr is of great importance, as the removal of anything of the kind is likely to cause damage to the finished surface of the wheel. It will, of course, have to be gone over; but the less required to be done the better. Having the four holes finished, the slide must be arranged on the surface to which it is to be fixed, as shown by the dotted lines. It will be, of course, clearly recognised that, as seen, the wheel is placed on the slide as it is to be fixed, the object being, as before stated, to show both the position of the slide and the screws that hold it. The slide must be set very accurately across the centre of the wheel. Here I must impress upon my readers is another point requiring special care and attention, as any want of truth in this setting will probably cause trouble ultimately. This slide is at times used to pass the cut forward, and it will be quite clear that should the slide be out of the direct line, the penetration would be at a slight angle, and thus render many works substantially inaccurate.

The best way to insure this point is to set out the slide as indicated in Fig. 4, then mark off from the hole in the wheel a distinct circle on the

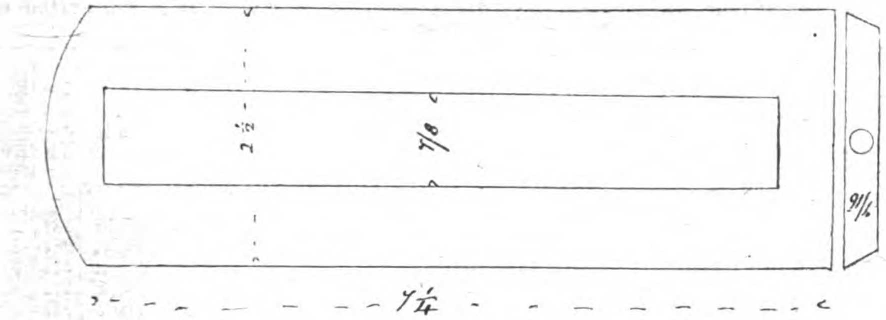


FIG. 3.

slide, and drill very carefully the latter to receive the tap which is to make the thread. As to the size, ¼in. is a very good size; but should any other tap be ready to hand a shade different either way, it will answer just as well. With one screw in its place we have the means of holding the slide securely to the wheel while the three succeeding holes are marked off.

The screw with extended head which holds the wheel to the plate of the second slide must be made to move freely under the slide when fixed. This is simply a matter of slightly reducing the thickness until it is below the surface of the wheel, and when finally putting together, this screw must, of course, be in its place before the slide is fixed to the wheel. It may seem superfluous to mention this; but as I have heard such a deal of indifferent language emanate from this simple point being forgotten, I think reference to it will not be out of place.

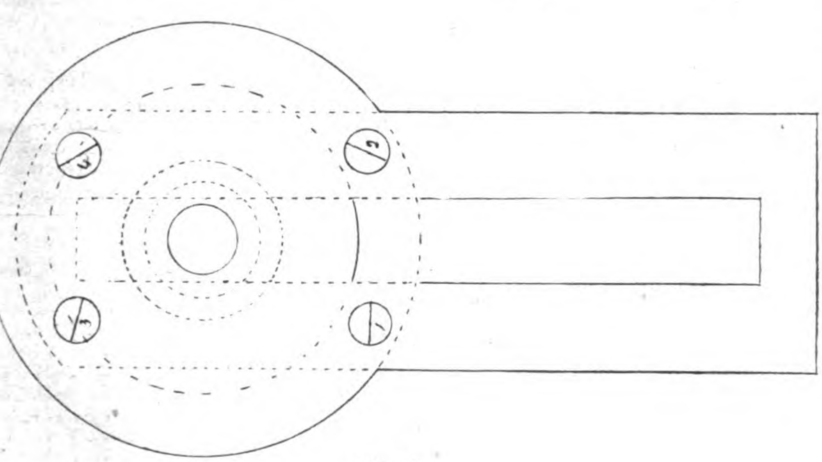


FIG. 4.

Reference to Figs. 3 and 4 will show that one end of the slide is reduced to a curve, and this to correspond with the diameter of the wheel. The object of this is also, its being placed away from the extreme edge of the wheel; Fig. 4, dotted line, is to allow sufficient space for a circle of holes to operate in conjunction with a stop, or stops, which will be fully explained. If for any reason it is preferred to square the end, there is no objection, provided it is fixed in a similar position, in order that there be sufficient room for the stops to be placed in the holes thus provided.

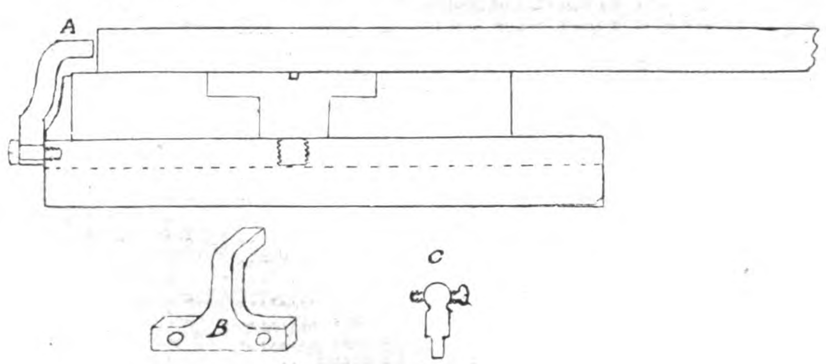


FIG. 5.

In Fig. 5 I have provided a section that will both clearly show the meaning of my previous remarks, and fully illustrate the wheel in its place with the top slide fixed; also the stop, which is in reality a segment stop. If we take observation of A, Fig. 5, it will distinctly show the manner in which the stop is made, also that in which it is fixed to the plate of the second slide, which carries the wheel. It is made from a small steel forging, and filed up to the shape shown in B, Fig. 5, which clearly defines it in all ways. There it will be seen that the two holes through which the screws pass are drilled through exactly in the centre of the base, and this must be rather less than the thickness of the plate to which it is screwed, so that it does not interfere with the traverse of the slide.

As the pins which fit into the holes in the wheel are necessarily at the top, the stop must be carried up, as seen, to about the centre of the third slide, and it must be left as rigid as possible, because when the wheel is moved round under the influence of the screw it may happen that undue force may be applied, which would tend to either force it out of its place, or create a pressure upon the pin that might distort the hole. It will not be found that there is any excess of space, and all these small but important parts must be very carefully worked up and fixed as detailed.

This stop should also be fitted to either side of the plate, in order that it may be removed from one to the other, which is a matter of no difficulty, and, as it is only to repeat the process, no more need to be said on this point, except that it is a most necessary adjustment, and must not be forgotten. It often happens that the distance or space required cannot for various reasons be attained from the one position, but may be easily effected by the simple movement of the stop, as I have explained.

We now come to the pins, which have a distinct character, and this is illustrated by C, Fig. 5. It will here be seen that it is provided with a short and slightly taper pin at the base, which fits into the hole in wheel. Here again is a matter for much care. It will be at once obvious that if this pin does not accurately fit the hole, the pressure cannot be equally maintained throughout a long series of cuts; the body is carried up, and on the top it is turned to a ball, which has passing through it an adjusting screw. This is for the purpose of regulating more closely the relative distances that may at times be required between the spaces set out. For instance, it may be that a short distance representing but a small portion of what would be acquired by moving the pin one hole forward. In this case the adjusting screw is moved, and so the exact segment required is readily obtained.

When the holes in the wheel are drilled, it is better in the first place to use a sharp double-angle drill, and as I have pointed out what is likely to occur by over-pressure, a carefully made taper bit should be ready to take the place of the drill, and passed into each hole exactly the same distance, certified by a stop to the slide which carries the drill frame.

The position and approximate size of holes will be seen in Fig. 1. There should be 60: that number is found to be sufficient for all practical purpose. If there is any particular fancy to have more, it does not matter, provided it does not bring the holes dangerously close. However, the space roughly shown between each in Fig. 1 will be a guide to anyone who has determined to overcome the task. I have taken the opportunity of giving illustrations of all the different parts, as I consider them of much greater service than the matter, considering that each one is also fully explained, and I think that when carefully studied, little difficulty will be found in fully understanding the many points referred to. There is ample room for a good display of workmanship to get to the above stage, and in my next we shall proceed to the fourth and final slide, composing the spherical slide-rest.

ASTRONOMICAL NOTES FOR DECEMBER, 1899.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	11 49 9·73 A.M.	16 29 40	21 49 43	16 40 30·20
6	11 51 10·75 ,,	16 51 24	22 30 54	17 0 13 01
11	11 53 24·40 ,,	17 13 20	23 1 5	17 19 55·78
16	11 55 47·01 ,,	17 35 26	23 19 53	17 39 38·58
21	11 58 14·00 ,,	17 57 36	23 27 2	17 59 21·38
26	0 0 44·57 P.M.	18 19 49	23 22 25	18 19 4·15
31	0 3 11·54 ,,	18 41 58	23 6 3	18 38 46·95

The method of finding the Sidereal Time at Local Mean Noon at any other station is described on p. 454 of our LXVIIIth volume.

As the Sun is passing through a period of Minimum of Spots, his blank disc ordinarily presents nothing to interest the observer in any shape or way, though on rare occasions small spots may be discerned on his face.

At 1h. a.m. on December 22 the Sun is said, technically, to enter Capricornus, and winter is supposed to commence. By this is meant the "sign," and not the constellation Capricornus, as at the instant specified he will be a little to the east of the 4·6th magnitude star 4 Sagittarii. This is the theoretical date of the shortest day; but in London no difference in this respect will be perceptible from the 17th to the 25th inclusive, during which period the Sun will only be 7 hours and 46 minutes above the horizon, and, of course, 16h. 14m. below it. Should the sky be clear, from the 19th to the 24th will be an excellent time for determining the meridian by the ancient method of equal altitudes, as the Sun

scarcely sensibly changes his declination during the few hours that he is visible, and, being low down, must obviously cast long shadows. On the 21st and 22nd this method may be applied so as to obtain a very fairly accurate result indeed.

There will be

An Annular Eclipse of the Sun

on December 2; but as it will be only fairly visible in the immediate neighbourhood of the South Pole, no further reference is needed to it here.

The Moon.

New Moon....	Dec. 3	......	12h. 47·7m. a.m.
First Quarter..	,, 9	......	9h. 2·6m. p.m.
Full Moon....	,, 17	......	1h. 31·1m. a.m.
Last Quarter..	,, 25	......	3h. 57·4m. ,,
Perigee	,, 7	......	6h. 12·0m. ,,
Apogee	,, 22	......	11h. 0·0m. p.m.

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	
	Days.	h. m.	°	Sun.
1	28·06	10 23·2 a.m.	75·3 E.	S.
6	3·47	3 10·3 p.m.	41·5 W.	R.
11	8·47	7 25·5 ,,	21·5 E.	R.
16	13·47	11 52·6 ,,	84·5 E.	R.
21	18·47	3 7·4 a.m.	45·2 W.	S.
26	23·47	6 35·8 ,,	17·4 E.	S.
31	28·47	10 58·3 ,,	80·4 E.	S.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

When our Notes begin, the Moon is in Libra. She enters:—

——	Day of Month.	Hour.
		h. m.
Scorpio	2	5 0 a.m.
Ophiuchus	2	5 0 p.m.
Sagittarius	4	3 0 a.m.
Capricornus	6	Noon.
Aquarius	7	4 0 a.m.
Pisces	9	4 0 p.m.
Aries	12	8 0 p.m.
Taurus	14	2 0 p.m.
Gemini	17	9 0 a.m.
Cancer	19	2 0 p.m.
Leo	21	8 0 a.m.
Sextans	22	9 0 a.m.
Leo	23	8 0 a.m.
Virgo	24	Noon.
Libra	27	9 0 p.m.
Scorpio	29	3 0 p.m.
Ophiuchus	30	3 0 a.m.
Sagittarius	31	2 0 p.m.

The Moon will be in Conjunction with

——	Day of Month.	Hour.	Planet.
			° ′
Jupiter	1	10 p.m.	3 7 N.
Mercury	3	1 ,,	0 48 ,,
Ceres	3	4 ,,	0 9 S.
Mars	3	9 ,,	0 56 ,,
Saturn	4	1 a.m.	0 39 N.
Venus	4	2 p.m.	2 11 S.
Jupiter	29	6 ,,	2 35 N.
Mercury	30	11 ,,	1 30 ,,
Saturn	31	4 ,,	0 20 ,,

On the night of December 16, and on the early morning of the 17, there will be a

Partial Eclipse of the Moon

visible at Greenwich, of which the details are subjoined:—

		h. m.	
First contact with the Penumbra..	Dec. 16	10 33·7 p.m.	Mean Time at Greenwich.
First contact with the Shadow	,, 16	11 44·6 ,,	
Middle of the Eclipse........	,, 17	1 25·9 a.m.	
Last contact with the Shadow....	,, 17	3 7·2 ,,	
Last contact with the Penumbra..	,, 17	4 18·1 ,,	

Magnitude of the Eclipse (moon's diameter = 1) 0·995, a very close approach to totality indeed.

Occultations of (and near approaches to) Fixed Stars by the Moon, and an Occultation of Neptune, visible at Greenwich.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
14	DM + 20°602	6·2	7 43 p.m.	Dark	148	181	8 3 p.m.	Bright	181	211
15	κ^2 Tauri	5·5	2 48 ,,	Dark	57	90	3 34 ,,	Bright	284	331
15	κ^1 Tauri	4·6	2 55 ,,	Dark	31	64	3 27 ,,	Bright	311	347
17	NEPTUNE		3 36 a.m.	Bright	158	118	4 11 a.m.	Dark	222	180
19	*f* Geminorum	5·2	6 31 ,,	Bright	161	120	7 9 ,,	Dark	239	198
19	DM + 16°1679	6·5	11 0 p.m.	Bright	92	129	12 13 ,,	Dark	302	331
20	29 Cancri	5·9	†6 53 a.m.	S.S.W.	204	164				
24	*e* Leonis	5·1	†7 36 ,,	N.E. by N	29	5				
25	DM − 6°3518	6·4	†4 56 ,,	S.W. by S.	211	221				
26	DM − 10°3570	6·0	2 39 ,,	Bright	128	160	3 47 a.m.	Dark	288	314
27	83 Virginis	5·8	4 22 ,,	Bright	172	199	5 3 ,,	Dark	241	262

† Near approaches. A description of the above table will be found on p. 455 of Vol. LXVIII.

The First Contact with the shadow occurs at 66° from the north point of the moon's limb reckoned towards the east. The Last Contact 59° towards the west—in each case as seen with the naked eye.

Mercury

comes into Inferior Conjunction with the Sun at 5h. a.m. on the 6th, and is, of course, there after a Morning Star. He is, however, very indifferently placed for the observer, for although he rises more than an hour and a half before the Sun towards the end of the month, yet he has very considerable South Declination, and is still immersed in the mists of the winter horizon by the time it is daylight. His angular diameter increases from 9·4″ on the 1st of December to 9·8″ about the time of his conjunction, but diminishes to 5·8″ by the end of the year. He attains his Greatest Elongation west of the Sun (22° 5′) at 1h. p.m. on the 25th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 15·1	23 10·7	0 34·5 p.m.
6	16 49·4	20 55·9	11 49·2 a.m.
11	16 25·5	19 0·3	11 5·8 ,,
16	16 17·9	18 27·9	10 38·5 ,,
21	16 26·2	19 9·2	10 27·1 a.m.
26	16 44·8	20 24·5	10 26 0 ,,
31	17 9·5	21 44·0	10 31·0 ,,

The curiously-looped path indicated in the above ephemeris lies mainly in Ophiuchus, though in describing a small portion of it, Mercury just enters into the confines of Scorpio. The region in which it is described is a blank one.

Venus

is an Evening Star from the beginning to the end of December; but, as in the case of Mercury, her very great South Declination is terribly against observing her. The gibbosity of her little disc is now quite perceptible in the telescope; but she is far from being an interesting object. Her angular diameter increases quite insensibly from 10·6″ on the 1st to 11·4″ by the 31st.

Day of Month.	Right Ascension	Declination South.	Souths.
	h. m.	° ′	h. m.
1	17 53·0	24 25·7	1 12·3 p.m.
6	18 20·5	24 31·5	1 20·0 ,,
11	18 47·9	24 18·4	1 27·8 ,,
16	19 15·2	23 46·7	1 35·3 ,,
21	19 42·1	22 56·9	1 42·5 ,,
26	20 8·6	21 49·9	1 49·3 ,,
31	20 34·7	20 26·8	1 55·6 ,,

The path indicated above crosses practically the entire width of Sagittarius and a considerable portion of Capricornus. On the evening of the 6th She will be less than 1° north of 3·1 mag. star λ Sagittarii; but this is the only star of any size that she will approach.

As far as the planets are concerned, the night sky is still a blank,

Jupiter

only rising some three hours before the Sun, even on the last day of the year, and

Mars, Saturn, and Uranus

being too close to him to be visible; but

Neptune

comes into Opposition to the Sun at 5 p.m. on the 17th, and, with his considerable North Declination, is now visible during nearly the whole of the ordinary observer's working night.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 43·1	22 5·5	1 4·4 a.m.
6	5 42·5	22 5·2	12 44·1 ,,
11	5 41·9	22 5·0	12 23·8 ,,
16	5 41·3	22 4·7	12 3·6 ,,
21	5 40·6	22 4·4	11 39·3 ,,
26	5 40·0	22 4·2	11 19·0 ,,
31	5 39·4	22 4·0	12 58·8 ,,

This tiny retrograde arc is described in the most easterly portion of Taurus to the North of Orion, in a part of the sky destitute of stars visible to the naked eye.

Greenwich Mean Time of Southing of Twenty-seven of the Principal Fixed Stars on the Night of December 1st, 1899.

Star.	Magnitude.	Souths.
		h. m. s.
α Aquarii	3·2	5 19 16·65 p.m.
η Pegasi	3·1	5 56 50·72 ,,
Fomalhaut	1·3	6 10 37·16 ,,
Markab	2·6	6 18 15·19 ,,
γ Piscium	3·8	6 30 25·37 ,,
α Andromedæ ..	2·1	7 21 31·58 ,,
γ Pegasi	3·0	7 26 22·81 ,,
α Cassiopeiæ ..	2·2 to 2·8	7 53 3·89 ,,
β Andromedæ ..	2·2	8 22 16·92 ,,
Polaris	2·2	8 41 29·03 ,,
β Arietis	2·8	9 7 8·56 ,,
γ^1 Andromedæ ..	2·2	9 15 46·23 ,,
α Arietis	2·0	9 19 31·86 ,,
γ^2 Ceti	3·0	9 56 0·80 ,,
α Ceti	2·7	10 15 53·59 ,,
Algol	2·2 to 3·7	10 19 30·13 ,,
α Persei	1·9	10 34 59·27 ,,
η Tauri	3·0	10 59 16·06 ,,
ϵ Persei	3·0	11 8 50·99 ,,
Aldebaran	1·0	11 47 46·60 ,,
ι Aurigæ	2·7	*12 8 1·54 a.m.
Capella	0·2	*12 26 48·10 ,,
Rigel	0·3	*12 27 12·95 ,,
β Tauri	1·9	*12 37 25·96 ,,
δ Orionis	2·2 to 2·7	*12 44 20·05 ,,
α Leporis	2·7	*12 45 45·16 ,,
ζ Tauri	3·0	*12 49 5·76 ,,

* Early morning of the 2nd.

The method of finding the Greenwich Mean Time of Southing of either of the stars in the

above list on any other night in December; as also that of determining the Local Instant of its Transit at any other station, is described on p. 456 of our LXVIIIth volume.

It must be noted, however, that the rules there given are not rigidly accurate as applied to Polaris, or, in fact, to any close circumpolar star, although they will doubtless be found sufficiently so in practice for the regulation of any ordinary clock or watch whatever.

Minima of the Variable Star Algol.

Day of Month.	—
	h. m.
4	6 37 a.m.
7	3 26 ,,
10	12 14 ,,
12	9 3 p.m.
15	5 52 ,,
27	5 8 a.m.
30	1 57 ,,

And on other occasions when daylight will render the phenomenon invisible.

Shooting Stars

are not particularly numerous or plentiful in December. The principal shower may be looked for on the night of the 10th. It is that of the so-called Geminids, from the situation of its radiant point somewhat to the west of Castor; but, unfortunately, the moon will not set until midnight on the night in question. Smaller displays are predicted for the 4th, 6th, 8th, 12th, 22nd, and 25th.

MILLWRIGHT'S WORK.—XVIII.

METHODS of calculations based on trigonometry are given in textbooks for obtaining the lengths of belting. In the shops the length is always taken with a cord laid round

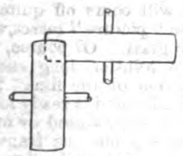


FIG. 112.

over the pulleys—a safe and simple way. After the length is obtained thus, a slight allowance is made for tightening. That is done, because, if the belt were laced up to the exact length given by the cord, it would fit too easily on the pulleys, and would have to be relaxed almost immediately.

The allowance given varies with the character of the belt. The allowance should be greater in a new than in an old one, in which most of the stretch has been taken out. Generally, before new leather belts are used they are stretched a little by hanging them from a beam and loading them with half-hundred weights, or by using a belt-stretcher.

The allowance given when lacing depends on the length of drive. From ½in. to 1in. in 10ft. less than the measured length is a fair allowance, depending on the conditions just named. In any case the tension will soon fall by reason of some stretch taking place.

To measure the length of belting when in the roll:—To the outer diameter of the coil in inches, add the inner diameter, also in inches; multiply this sum by the number of coils in the roll, and by 0·1309. The product will give the length of the belt in feet.

To settle a minimum distance between pulleys is not always easy, because circumstances often do that. Reddaway and Co. fix it at one and a-quarter times the sum of the diameters of the driving and the driven pulleys. If pulleys are nearly equal in diameter, they can be brought closer; if much disparity in size exists they should be set rather farther apart; but an excessively long drive causes the belts to sag, and flap, by their great weight.

When possible, pulleys are best proportioned to give belt speeds not exceeding the maximum limits of from 3,000ft. to 4,000ft. a minute. Reddaway's rule is:—For 3,500ft. per minute, the number 13,400ft. divided by the number of revolutions per minute gives the diameter of the pulley in inches. The same number divided by the diameter of the pulley in inches gives the number of revolutions per minute, at 3,500ft. belt speed.

Horse-power of belting as given in tables is

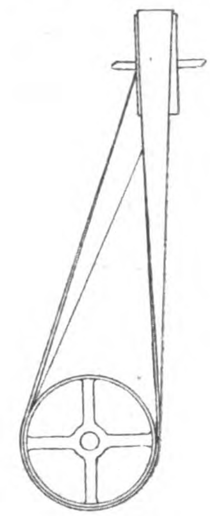


FIG. 113.

very uncertain, because so much depends upon conditions. Tensile strength, speed, grip on the pulleys, which is dependent on width and arc of contact; freedom from slip or otherwise, all affect results, so that to assume that a given belt will

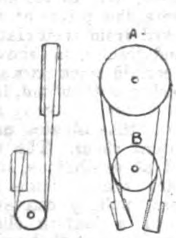


FIG. 114.

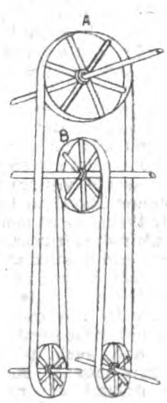


FIG. 115.

transmit an exact quantity of horse-power under all conditions, is to expect too much. Allowances have to be made, and judgment exercised.

A useful and safe rule is to allow 50lb. working strain for every inch of breadth in a single belt, and 80lb. in a double one.

The driving of pulleys at various angles with

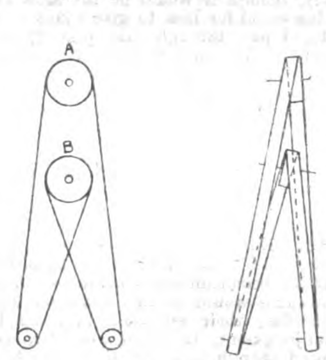


FIG. 116.

twisted belts is one of the curious feats of engineering. One would think such belts must run off. So they do in most instances, if the direction of revolution is reversed. But if the simple rule is remembered, that the edges of the driving and the driven pulley are kept in the same plane, Fig. 112, then the others can come as they will. A few examples of such drives are given in succeeding figures, for some of which I am indebted to Messrs. Tullis and Son.

Fig. 113 is the most common drive met with, being constantly used for transmitting motion between pulleys at right angles. Fig. 114 shows a belt transmission between pulleys, A, B, which are not in the same plane, the belt being brought round guide pulleys. Fig. 115 is a case of two pulleys, A and B, at right angles, and very close together, being driven through guide pulleys. In Fig. 116, two pulleys A and B are situated too closely for a good direct drive to be obtained. Hence the belt is brought round the guide pulleys

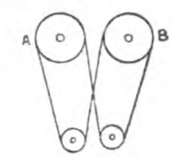


FIG. 117.

seen below. The shafts of A and B may or may not be parallel. Fig. 117 is an instance of pulleys A and B in such proximity that a crossed belt could not be used with effect. The belt is, therefore, brought round indirectly through the guide pulleys beneath.

Fig. 118 shows how shafts at right angles can be driven by belting carried round guide pulleys, through which the strains on the belt can be equalised. Fig. 119 shows another similar case with different arrangement. Fig. 120 illustrates a quarter-twist drive, in which the twist of the belt is removed by a guide pulley before it is delivered to the driven pulley. In Fig. 121 a belt is seen transmitting power between two shafts which are parallel, but not in the same plane, guide pulleys intervening. In Fig. 122 a quarter-twist drive is seen between shafts which are not parallel, a case in which no guide pulley is required if a thick-sided link belt is used.

Instances of this character can be multiplied abundantly. If a given drive is necessary, pulley arrangements can be designed to suit. The awkwardness and the undesirability of such drives is quite another matter. They are generally absorbent of power, and injurious to the life of belting. When they are unavoidable then the thick-sided link belting, described in the last article, has advantages. And so have ropes.

Of the numerous kinds of belting made of canvas, cotton, hair, and cementing materials their principal advantages lie in drives in the open air, in hot rooms, and places where they are exposed to steam and water. The frequent objection to

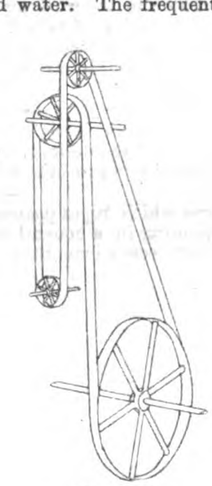


FIG. 118.

them is that the edges fray out. But this is got over in some instances by the use of protective edgings. The Reddaway, the Gandy, the Dick's, and other beltings are well and favourably known, and are used extensively. Another point in favour of these, besides their ability to stand heat and moisture without alteration in length, and without being spoiled, is, that they stretch less than leather, that they are stronger, and that they slip and creep less.

Reddaway and Co., of Manchester, have put down a large number of heavy drives in mills with their camel-hair belting. The compound system of driving, illustrated in the last article, is carried out also by this firm. In an ironworks at Warrington, a compound drive of three belts,

each 16in. wide, is used to operate three sets of ingot rolls from one driving-wheel. Large numbers of the Lancashire cotton-mills use these belts. Thinner camel belts will perform the same work as those of leather—a $\frac{3}{16}$in. belt driving as well as a $\frac{1}{2}$in. one of leather, with the numerous advantages in regard to diminution of stress and ease of movement that follow. But here we must

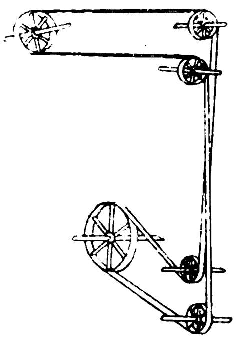


Fig. 119.

leave the belting for a section of modern millwright's work, equally interesting—namely, ropes.

(2) *Ropes*.—Mention was made in Article XV., p. 266, that the users of leather belts might take lessons from the designers of rope drives, in respect of working stresses. The latter is by no means so novel as many might think. It was introduced over forty years ago in the shops of Combe, Barbour, and Co., of Belfast, shops which the writer was privileged to visit a few years ago, and in which the machines are mostly driven by ropes instead of belts.

Rope driving owes nothing to theory, either in

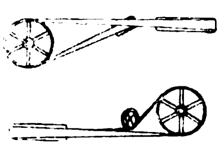


Fig. 120.

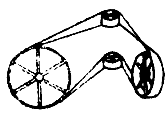


Fig. 121.

inception or development. A mere incident, the use of a rope on an expandieg pulley, led to its invention. The breaking strength of a rope bears but a slight relation to the working strain permissible. The velocities of travel have been made the subject of experiments, and the maximum and the best speeds are thus settled. Curiously, Mr. Combe settled the best angle of sheave, 45°, at the beginning by experiment, and that is still adhered to closely to-day. Experiment, too, has settled the desirability of certain changes in angle of sheaves to suit different conditions of driving.

The advantages which ropes possess over belting are not, speaking in a general way, great; but under certain conditions they are better.

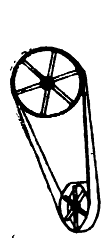


Fig. 122.

They are much better for twisted drives. We have seen how awkwardly half-crossed belting drives, and how the bevelled belting has been designed to obviate this difficulty. Ropes fulfil this function more efficiently. Again, in very wide main-driving belts, the trouble is great, due to insufficient contact with the pulleys. Using ropes, the contact of every rope can be insured. Another point is, that the tightening up of a wide belt involves much loss of time, while a single rope can be removed, and respliced, while those remaining will continue to drive.

Having thus cleared the way, the principal practical points relating to rope driving may be considered immediately. J. H.

Fig I

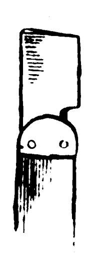


Fig II

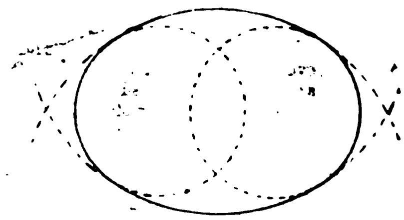


Fig IV

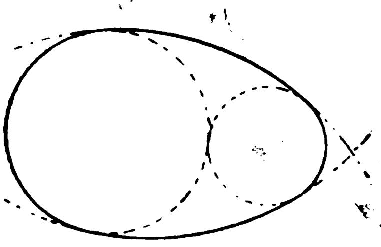


Fig III

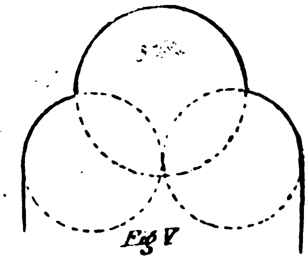


Fig V

A SUGGESTION TO LANTERN-SLIDE MAKERS.

In these days of ceaseless improvement and progress it is not a little surprising to find that the appearance of a lantern slide, as shown on the screen, has made no advance whatever. The screen itself has been improved to a degree which probably touches the possible limit. Lanterns, lenses, and illuminants we have in endless variety and with endless virtues; the attainment of the ideal in this direction appears to be subject only to the means of the buyer. The views produced by capable workers, within their limits, leave nothing to be desired. But how are they set forth? With the same ugly plainness that would evoke a storm of condemnation were it applied, say, to pictures. What would visitors say were the prints at the Salon and Royal to be removed from their elaborately thought-out mounts and frames, and shoved into plain deal frames, all of certain stock sizes and shapes, and retailed at so much per thousand, like bundles of firewood? And yet this is exactly the method, varied only in detail, that obtains universally in the case of lantern slides. The rebuke not infrequently heard at exhibitions, that such and such pictures are simply "made" by their mounts and frames, nobody can ever have dreamt of applying to a lantern slide. Yet a little thought must convince one that many slides are seriously hampered by their lack of a suitable setting. A picture without a frame is like a beautiful woman dirty, unkempt, ill-clothed; or like a hot grog without whisky—choose your metaphor to match your ethics.

The reason that will at once be urged in justification of the present state of affairs, is that slides are turned out in far larger numbers than mounted and framed prints. No man would dream of exhibiting at one show from 60 to 120 pictures (the gods preserve us!), though it would be the most natural thing in the world for him to give a lantern entertainment and pass through that quantity of slides in a single night; and if the same amount of thought and labour had to be bestowed on the making of each of these slides as in the case of pictures prepared for exhibition, then lantern shows and lantern slides would be much rarer than they are.

Inshallah! Would it were so! But there is no question of putting an ornamental border on all one's slides. By far the larger number do not require it, and, indeed, would only look ridiculous if so treated. Nobody in his senses ever puts an elaborate frame round a chart or an oleograph. The point has been sufficiently laboured. Admitted that some slides would be the better for an ornamental border, their selection may be left to individual judgment. In our own case two methods are followed, though, no doubt, there may be others as good which have not occurred to us.

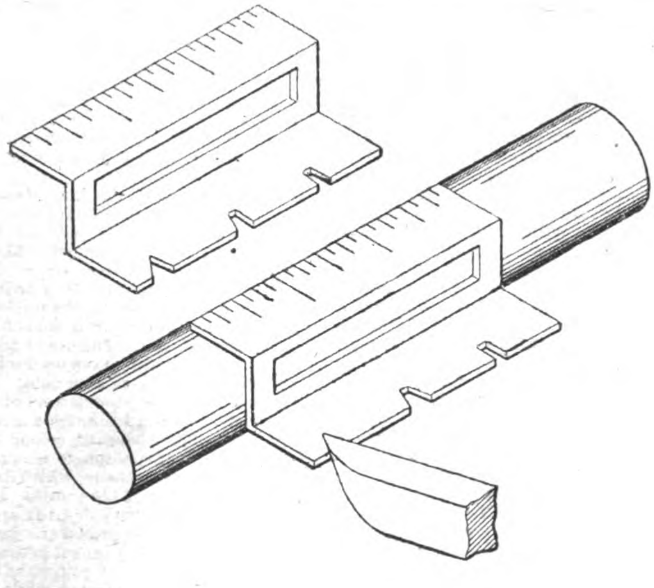
One way is to make little mats of translucent paper, such as the so-called "butter-paper" used by grocers, and sandwich these between the positive and the cover-glass. A second way is to frost or varnish the cover-glass itself, taking the necessary precautions for keeping clear the central portion. Before entering into the details of these methods a word must be said regarding the preparation of the positives themselves.

It seems to be the universal custom when making slides (especially by contact) to let the image cover the whole surface of the plate, and then, by a process analogous to the trimming of prints, to cover up the marginal parts of the view not required with an opaque mask. Such a proceeding must be avoided in making slides that are to have an ornamental border. The opaque mask should be placed in position before the plate is exposed, and precautions should be taken in developing, &c., to keep the margin quite free from fog and stain. Slight veiling can subsequently be removed with a suitable reducer, applied with a brush. If, however, it is desired to put an ornamental border on a positive which has already been covered to the edges, we have found it practicable to carefully cut the film all round the portion which is to be retained, immerse the slide in one of the baths usually recommended for stripping a film, and then roll back and peel off the marginal "trimming" of the latter. It will come off quite neatly at the cut, and leave the "picture" intact, surrounded by a margin of clear glass. Of course, the slide must not be left in the solution long enough to induce spontaneous flotation of the film. The positive is now washed and dried and is ready for use, as if the clear margin had been produced by masking.

Now, as to cutting out the translucent masks. The cutting instrument must be sharp and pointed. The common ink-eraser (Fig. 1) is very useful, though our favourite cutter is an old broken penknife blade (Fig. 2). The easiest mats to make are those of rectangular shape. The straight lines are cut by means of a straight-edge, and the rounded corners are produced by placing in the angles some circular object to act as a guide. When it becomes a question, however, of cutting a circular, oval, or elliptical aperture, some more elaborate device must be used. A raid on the kitchen and neighbourhood will yield ample booty in the shape of circular lids of all dimensions from the tins in which various domestic preparations are stored. With a good assortment of these to act as cutting guides it is fairly easy to cut almost any kind of curved outline by using guides of varying diameters in combination. Reference to Figs. 3, 4, and 5 will explain matters far better than it could be done in words. Having secured the mat, it may at once be bound up with the positive, and will in this state give a very effective grey border, like the pleasant margins we see in half-tone reproductions of photographs. Or it may be further worked upon in a dozen different ways. It may be tinted; a granular pattern may be imparted with a stump, to imitate wood; with a brush and some water-colour, lines and stripes may be marked; and, finally, one skilled in the use of his pencil may produce some elementary form of decorative design. This, however, requires considerable expertness, as, owing to the magnification, the slightest blemish will be much exaggerated. The simplest effects are nearly alway the best.

Our second method is to paste in the centre of the cover-glass a piece of paper a shade smaller each way than the picture, and then at once to pour on matt varnish. This will have set enough in a few seconds to allow the protective paper to be stripped off; it will come away quite easily, leaving the central part of the glass clear. Any irregularity at the edges of the varnish may be scraped smooth. The varnished margin may be worked upon as before.

Yet a third way, and one capable of producing very beautiful results, consists in covering the glass with some crystalline substance in solution. This, when it has evaporated, leaves the glass covered with crystals. It is now exposed to the fumes of hydrofluoric acid, the centre being again pro-



tected with any substance through which the acid cannot act. The result, if a success, is charming, but the process is difficult and uncertain, at least so it has proved in our hands during a by no means exhaustive trial. The experiment is, however, worth making.—Creel, in *Photographic News.*

NEW METHOD OF ARTIFICIAL LIGHTING FOR PORTRAITURE.

At a recent meeting of the Croydon Camera Club, Mr. W. H. Smith gave a demonstration of "A New Method of Artificial Lighting for Portraiture," and in the course of his remarks alluded to a few of the methods of artificial lighting in use for photographic work. There were great disadvantages in the systems already adopted. The arc lamp had its drawbacks in its expense of current and skilled labour required to use it and also in its varying candle power. A certain system of incandescent lights seemed to have an insufficient reflecting surface, and was deficient in actinic rays. Incandescent gas was probably the worst of the lot, as it was found not very durable, the heat was unbearable, and the light far from satisfactory. Flash lamps were rather dangerous, and a nuisance also arose from the fumes and products of combustion. One of the great difficulties experienced with artificial light was the want of diffusion, and he had come to the conclusion that they might obtain what they wanted—viz., a pure reflected light—with magnesium burned in oxygen. With this end in view, he had fitted up a room lined with white paper to diffuse the light satisfactorily and evenly. Mr. Smith then proceeded to explain in detail the various experiments which had led to the present invention. This was a piece of magnesium ribbon, fired by a current of electricity in a glass combustion vessel containing oxygen, with the help of mechanism specially contrived for the purpose. The cost of this system of lighting was very small, the total outlay being about one farthing per exposure. He had arranged his apparatus so that just as much oxygen would be taken up as was needed for the exposure. About 5in. of magnesium wire was used at one time, and the combustion vessel contained a little water to keep it clean.

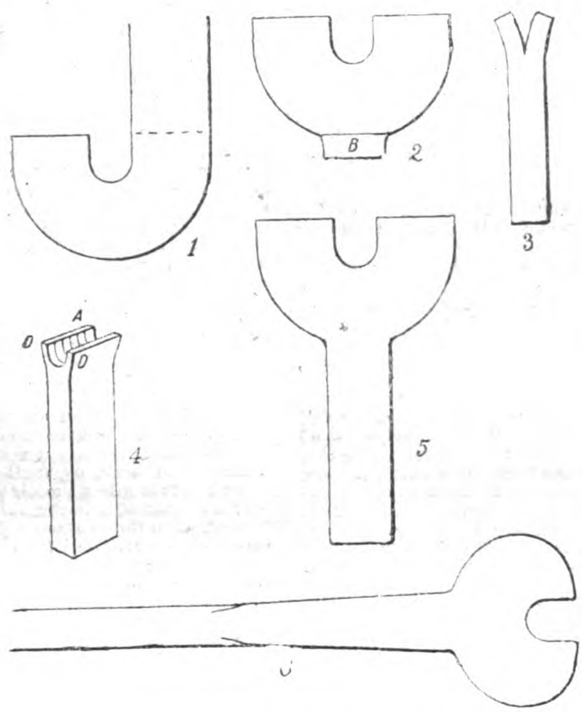
With the assistance of Mr. A. Beales at the camera a number of negatives were taken by the new light of those present, and these, on being developed, showed most clearly the success and importance of the apparatus invented by Mr. Smith.

A KEY-SEAT AND THREAD-TOOL GAUGE.

The cut shows a little tool, recently patented, which should interest the machinist of the shop, and should be found useful for many purposes. It consists, as will be seen, of a double-angle iron, the central web of which common to both angles, is slotted, one of the outer webs being graduated in convenient divisions while the other edge is notched as a gauge for V and other tools. More notches may be inserted than here shown. The slot or slit in the central web, it will be noticed, is nearer one web than the other. The edges of this slit are used for scribing parallel lines upon shafts or other cylindrical figures. When the shaft is small, as shown in the right-hand figure, the inner edge of the slit is used to scribe by, and by using both angles and both edges of the slot, four different distances from the apex of the angle are available. The tool is supposed to be correctly made, and, the ends being perfectly square, when the tool is stood upon end it may be used as a square in places where the common try-square cannot be applied. Other uses of the tool will readily suggest themselves. The inventor is John Beach, Springfield, Ohio.—*American Machinist.*

MAKING A WRENCH.

The following description of a method of making a wrench for nuts on bolts is given by Mr. Arthur Shay, of Orvisburg, Miss., in the *Blacksmith and Wheelwright.* As to how to make a



wrench for a 1¾in. hexagon nut, to be 1½in. in thickness, I submit the accompanying sketches and description:—Bend a piece of 1½in. by 3¼in. iron, and cut off at dotted line, as shown in Fig. 1. Swage down for 2½in., as at B, Fig. 2. Take a piece of iron 1½in. by 2½in. 8in. or 10in. long, and split open for about 1½in. (Fig. 3.) Fuller for the weld and scarf off the points D D. Jump weld A on to B (Fig. 2), and you have an unfinished wrench, as in Fig. 5, with a 1½in. by 2½in. handle 8in. or 10in. long. I would suggest cutting off to, say, 3in. Draw out and weld on handle either of round or flat iron, as may be desired—see Fig. 6, which will give the necessary particulars to the blacksmith, and the directions will do for any size of wrench or spanner.

Rich auriferous deposits are reported to have been discovered in Siberia, on the north-western shore of the sea of Okhotsk.

HEAT LOSSES FROM IMPERFECT BOILER AND CYLINDER COVERING.

The Imprisonment of the Thermal Unit was the name of a lecture delivered by Capt. Wallace W. Johnson before the Railway Engineering Class, Sibley College, Cornell University. The lecturer took the stand that while engineering science has laboured industriously and successfully to convert a potential power of fuel into heat with the least possible degree of loss, little effort has been made to imprison the heat generated till the time when it could be transformed into work. If anything is acting to restrain the free conversion of fuel into heat, the fact soon becomes known through even the crude evidence that the boiler is not making steam freely enough, and a remedy will be sought for. But when steam once generated is permitted to escape as through a sieve, very little attempt is made to hold it back, unless the escape is of a visible character. If the owners or men in charge of a steam plant could see 10 per cent. of the boiler steam and 40 per cent. of the cylinder steam passing through the inclosing walls without doing any useful work, there would be tumult and shouting, and effort directed to find an immediate remedy. These manifestations of zeal to restrain waste of heat are not much in evidence in ordinary boiler and engine rooms, for the reason that the heat is stealing away like a thief in the night, and those responsible for its imprisonment fail to understand that anything is escaping. What is true of engine and boiler rooms in regard to the escape of heat is particularly conspicuous where locomotives and their boilers are concerned. In their case the losses are particularly great, because the conditions of operating expose the locomotive boiler and steam-transmitting parts to more exacting atmospheric conditions than those found in other engines.

It will be an interesting and profitable mental exercise to follow the heat losses partly preventable that happen with a locomotive from the time the coal is passed into the fire-box until the exhaust steam passes into the atmosphere. We have said so much lately about good and bad methods of firing, that we need pay no attention to the man whose hand reaches from the scoop to the treasury of the railroad company. He is working on stronger lines of progression than any other person who has influence in saving or wasting heat. There is very little complaint made against the officials, who are responsible for the escape of heat units after the fireman has done his best to make the most out of every pound of fuel put into the fire-box. This is not because this loss is not often greater than that due to the worst kind of firing, but because the waste does not readily appeal to the senses.

If you stand upon a station platform any day, summer or winter, and a locomotive passes at a lower speed than twelve miles an hour you will feel the warmth thrown off from the boiler and cylinders. Reflection will tell you that the engine moves along giving forth at all times a volume of heat into the surrounding atmosphere. Some engines are more liberal in heating the air than others; but nearly all of them send forth heat rays that can be distinctly felt 6ft. away. The principal source of this radiation of heat is the boiler, and the resulting

loss is due to defective insulation. It is perfectly practicable to make and apply a boiler covering which will prevent the escape of any heat except through the proper channels, and that this has not been done is due to the fact that people in charge are not properly impressed with the magnitude of the losses now going on. To feel the hot air raised perceptibly in temperature by a passing locomotive ought to indicate that the losses from this source are serious; but no data are provided to tell what the aggregate amounts to. This ought to be supplied by accurate tests. Very little has been done to measure these losses, and all we have to guide us are rough guesses. Few locomotives steam so freely in winter as they do in summer, and the cause doubtless is that in cold weather a large proportion of the steam generated is wasted by radiation before it has the opportunity to do work in the cylinders. Mr. J. C. Hoadley, a well-known mechanical engineer, made some tests with ordinary boilers years ago to ascertain the heat losses due to uncovered and defectively-covered boilers, and he found the loss as high as 12 per cent. It must be much greater with a locomotive rushing through the air at a high speed and forcing currents of air under the defective lagging. Considerable progress has been made in the last five years in the introduction of good sectional lagging that prevents the heat units from escaping through the parts where it is applied; but too much of the boiler still remains uncovered.

A surprising thing to us is that some enterprising railroad company does not make systematic tests to ascertain an approximation of the heat losses due to defective boiler covering. This could be easily done by taking, say, three engines and stationing them in an exposed position on a very cold, windy day. One might be covered with the best known kind of boiler lagging, the next with pineboard lagging that had been some months in service, the other might have the boiler bare. The difference in the amount of fuel required to keep the steam pressure close to the blowing-off point would give a good approximation of the value of efficient boiler covering.

If there is one part of a locomotive boiler that deserves more attention than other parts in the way of proper insulation it is the fire-box. Yet the fire-box has been more thoroughly neglected than any other part. This has come about merely because the fire-box presented greater difficulties than the barrel to those planning or applying covering. The flat surface in front of the fire-box gives good resistance for the wind to act upon. The chilling effect of the wind is so great during cold weather that the front of the firebox becomes a veritable condenser of the steam generated inside. Several railroad companies have succeeded in applying effective covering to the whole of the fire-box, and there is no reason why others refrain from doing the same thing, except that the extent of the heat losses is not appreciated.

In this connection it would be well to caution railroad companies against using plaster boiler covering. The plastic part consists invariably of plaster of Paris, which is sulphate of lime. Under certain circumstances that sulphate becomes sulphuric acid, which attacks the boiler-plates, and causes dangerous weakening unless promptly detected.

There is doubtless serious loss of heat going on all the time from the cooling effect of badly-covered boilers; but there is good reason for believing that even greater loss results from cylinder condensation. The best steam engineering authorities say that the result of careful tests proves that from 25 to 50 per cent. of the steam generated in the boiler is condensed before it can be utilised to do work inside of the cylinders. A considerable part of this loss is unavoidable where steam jackets are not in use, and is due to the cooling of the cylinders during the period of exhaust, and the need for heating the metal again to the temperature of the incoming steam. To go more into detail: The steam on entering the cylinders goes into what is a partial condenser, and as saturated steam is ready to return to water as soon as the least portion of heat is abstracted, part of the steam becomes vapour, and has lost its capacity for doing work. As expansion proceeds and the pressure decreases, the condensed steam inclines to vaporise, and it draws heat from the walls to aid this process. By the time the exhaust opens, that end of the cylinder has descended into temperature near to that due to the temperature of the boiling-point at atmospheric pressure.

When the cylinders and steam-chests are badly protected, and most of them are, this condensing process is much more active than it is where good insulation is provided. The saving of heat due to well-covered cylinders and their connections is so great, and the expense of imprisoning the thermal unit so trifling, that it is amazing to find the greater part of our locomotives with no lagging on the cylinder heads, bare metal where the steam passages are, and no intelligent or careful attempt to cover cylinders and steam-chests.

In the course of a conversation the writer had lately with Mr. Aspinall, general manager of the Lancashire and Yorkshire Railway, but better known as locomotive superintendent of that railway, we learned several interesting facts about the difference between well-protected and badly-protected cylinders. Mr. Aspinall built a group of outside cylinder engines for switching purposes, all others on the line having the cylinders inside the smoke-box. The inside cylinder engines cause no annoyance by dripping water from the cylinder cocks, but the new ones, with the cylinders outside, were such a nuisance in that respect that the designer thinks seriously of changing them. That is probably one reason why British locomotives, with their well protected inside cylinders, do their work on less fuel than those in other countries where outside cylinders are the rule.—*Locomotive Engineering*, N.Y.

SILVER PHOSPHATE PRINTING PROCESS.

The patentee of a silver phosphate printing process, Dr. Johannes Meyer, of New York, says it is based upon the discovery of the valuable properties of the silver phosphates when combined with organic acids, such as acetic, tartaric, citric, and succinic acids. The silver phosphates have so far not been employed for photographic or other purposes, and the only mention of any application made of them is to be found in Hardwich's "Manual of Photographic Chemistry." He writes: "Other insoluble salts, such as the phosphate and citrate, render the paper more sensitive than when it has been treated with a soluble salt of silver only." The great value of the silver phosphates consists in their property of forming emulsions with suitable organic acids, which behave in all repects like the well-known emulsions of the silver haloid salts with albumen, gelatine, or collodion. Dr. Meyer proceeds: "I have discovered that the silver phosphates, aside from being soluble in ammonia, phosphoric acid, and nitric acid solutions, as was well known, form solutions with a number of organic acids, as, for instance, acetic, tartaric, citric, and succinic acid; but under certain conditions, silver phosphates will form, in conjunction with an organic acid, a true emulsion.

I have studied the behaviour of silver phosphate towards tartaric acid in this direction most carefully, and, as the tartaric acid—silver phosphate emulsion—is chiefly employed, I will now proceed to give directions how to prepare and how to use it.

To an aqueous solution of 1 drachm of silver nitrate a well-diluted solution of sodium phosphate is added. The resulting silver phosphate is well washed, by decantation, and brought to the volume of 1fl.oz. To this silver phosphate held in suspension we add 5 drachms of tartaric acid dissolved in 5 drachms of water, at the same time imparting to the containing vessel a quick rotary motion. In this way is obtained a white, jelly-like mass of a volume of 2oz., containing a quantity of silver phosphate equivalent to the drachm of nitrate we started from. It is essential that all the chemicals, including the water, be chemically pure.

To render this emulsion more fluid, it is either slightly heated, or agitated with a glass rod, or by shaking the bottle. In this state it is used for coating the paper or other surfaces on which it is desired to print.

The proportions given above are the best for practical use. The preparation of the emulsion is, however, easier, for one not experienced in this special line of work, by mixing a fluid ounce of silver phosphate with a smaller quantity of tartaric acid; for instance, 2 drachms of acid in 2 drachms of water, when the emulsion will set more readily. When the emulsion is left in its jelly-like state, crystallisation will set in, after some time, while a portion of the silver is retained in the solution.

Citric acid seems to have the greatest affinity for silver phosphate. Twelve drachms of citric acid mixed with 1fl.oz. of silver phosphate will produce a clear, transparent solution which has remarkable sensitiveness and qualities.

The emulsion, or solution of silver phosphate in organic acid thus obtained is then applied in any suitable manner to the surface to be sensitised. It may be applied by means of a soft, flat camel's-hair brush to paper, after which it is permitted to dry. When this sensitised photographic paper is exposed under a negative to direct or shaded sunlight, a positive picture of great accuracy and agreeable tone is obtained. When the paper is first coated with albumen or gelatine, or any similar substance, a photographic print can be produced in less time than by the silver haloids heretofore employed, and not only sunlight, but also artificial light, can be used for producing a direct print. The photographic print thus obtained can be toned by any of the well-known toning solutions, and finally fixed by means of sodium hyposulphite. The print is then washed until no trace of the hyposulphite is left in the same. In place of paper, any other material, such as wood, celluloid, lithographic stone, silk, cotton, or other textile fabric, and other materials, can be coated with the photographic film, and pictures of great delicacy and beauty, not inferior to prints on paper, be produced thereon.

The advantages of my improved process of producing photographic films are that silver phosphates can be employed without the aid of a viscous substance like albumen or gelatine; that the silver phosphate emulsion, or solution, can be spread over almost any surface, like a paint or dye; and that only a very weak solution of sodium hyposulphite, and a short immersion of the prints, is required to remove the unchanged silver and render the prints permanent.

When the prints are left in the fixing-bath for a longer time than a minute, the sulphuration of the prints will commence, which is induced by the organic acid, and which will be completed to blackness of the picture in a few minutes more. Though sulphur toning is believed to have many objectionable features, the prints made by the process described do not suffer in appearance if the sulphuration is not too long continued. The use of albumen will prevent the prints which have been toned by sulphur from becoming yellow and faded by atmospheric oxidation. These results were obtained by a number of tests, continued through a considerable period of time. The dominant colour of the prints made by the silver phosphate emulsion or solution is a brown or auburn shade, which darkens considerably with the drying of the prints. Toning may therefore be dispensed with in many applications in the arts. When the prints are made on textile fabrics they are generally brown in tone, but this can be changed, in the case of cotton, to black, by passing a hot flat-iron over the same, while prints on silk will not undergo this change. Though the predominating colour of the silver phosphate prints is brown, many of them show various other tones, and it must be assumed that certain negatives act as a media for the transferring of colour qualities and influence the production of the tone to a certain degree under conditions not yet known. When a silver bromide emulsion is added to a silver phosphate emulsion, the sensitiveness of the solution is so increased that even the light of a common petroleum lamp is sufficient to produce a direct print. The sensitiveness of the emulsion is also increased by the addition of a small quantity of citric acid. The solution of silver phosphate in citric acid, when applied to a plain piece of paper and exposed under the negative to direct sunlight, produces a print of very agreeable bluish tone, which will compare favourably with other prints in accuracy, in the high lights and in the depths of the shadows.

Paper coated with albumen and sensitised with a silver phosphate emulsion or solution has great durability, and will not deteriorate under climatic influences. It can be used, therefore, at any time for printing, without impairing the quality of the print. . . . The print is removed from the printing-frame directly to the fixing-bath, to which sodium bicarbonate is added when the original colour of the print is to be preserved. The print remains in the fixing-bath for a short time, and is then freed from any adhering traces of sodium hyposulphite by washing it in hot or cold water for about five minutes.

CARTER'S FEED-WATER APPARATUS FOR BOILERS.

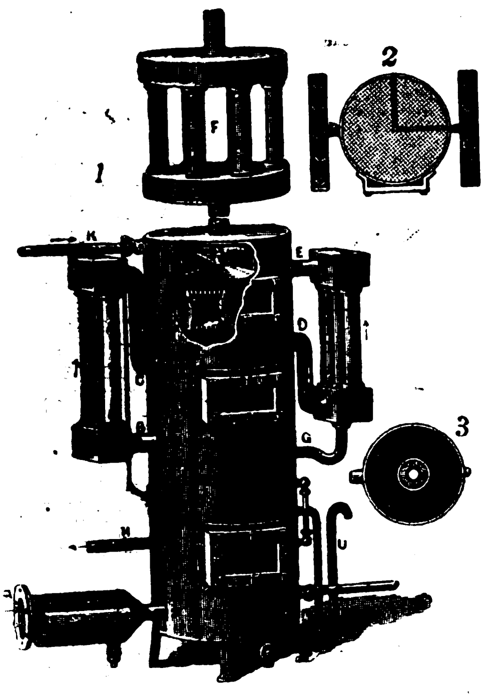
An invention patented by John S. Carter, of 483, Fargo-avenue, Buffalo, N.Y., provides an ingenious feed-water apparatus in which the exhaust steam from the engine is made to heat the feed-water, and is at the same time condensed and returned to the boiler. Means for purifying the feed-water and for separating the oil from the exhaust steam are also provided.

Fig. 1 is a perspective view of the apparatus, with parts broken away to show the interior construction. Figs. 2 and 3 are cross-sections through different parts of the device.

The apparatus is inclosed in a cylindrical casing, in the bottom of which is a chamber provided with a blow-out pipe. The exhaust steam enters this chamber through a drum A fitted with a stationary screw serving to impart a spiral movement to the steam, whereby the oil is centrifugally separated. Leading up from the bottom chamber is a pipe (shown in Fig. 3), perforated near its upper end, and provided with a baffle-plate, causing the steam to pass horizontally into a feed-water heating-chamber. From this chamber the steam passes through a pipe, B, into a condenser comprising two boxes and a number of vertical glass condensing-tubes. From the condenser the steam passes down through the pipe C to a second feed-water heating-chamber, from which it emerges by way of the pipe D. After passing through a second set of condensers the steam enters a third feed-water heating-chamber in the upper end of the casing, by way of the pipe E. The water of condensation from the second condenser is returned to the first feed-water heating-chamber by a trapped or return-pipe G. From the third feed-water heating-chamber the steam passes through a third condenser, F, provided with a vertical outlet-pipe. The steam in passing through the various compartments is condensed, and the water of condensation

runs back into the casing to be employed as feed-water.

The feed-water is led into the apparatus by means of a pipe, K, discharging upon a baffle-plate, from which it passes in a spray to the third feed-water heating-chamber, and is heated by the steam entering the chamber. The several feed-water heating-chambers are separated from one another by means of filtering partitions formed of upper and lower screens, between which filtering material is packed. The water delivered from the baffle-plate passes down through the several screens and filtering



partitions in a spray, is heated by the steam passing through the chambers, and finally reaches a reservoir, from which it is supplied to the boiler, heated and filtered, by the pipe H. The supply of feed-water in the reservoir is automatically regulated by a float-lever, connected by a link with a valve in the pipe K. A water-gauge and a trapped overflow pipe, U, are also provided for the reservoir. The upper filtering-plates or screens, as shown in Fig. 2, are made in two or more sections, to facilitate ready removal when cleaning.—*Scientific American.*

In the United States the smokeless powder stored in magazines, for the use of sea-coast guns, is said to have deteriorated to such an extent as to be dangerous to use. A 10in. gun was lately burst by this powder that had been stored two years, and the resulting examination showed that practically all the stored powder was affected. The cause of deterioration is being investigated.

The Marconi system of wireless telegraphy is to be tested for naval purposes in America, and the cruiser *New York* and battleship *Massachusetts* are being fitted up by Mr. Marconi for the test, with his headquarters on the former. If the experiments are satisfactory a land station will be established, and tests made to determine the value of the apparatus in lighthouses, to warn approaching vessels of danger.

Cheap Opalines.—Old negative-glasses may, with a little care, be used for making pretty opalines. First remove the film by soaking in a 10 per cent. solution of hydrochloric acid, and well wash the glass in warm water, dry, and polish. Make a solution of thin gelatine, and apply while warm over one side of the glass. Then dip the print in water and well squeegee in contact with the glass, and place to dry. When thoroughly dry, bind round the edges with some coloured binding-strips, blue or red, which will greatly improve the picture. It is now complete, unless a strut is required. One can easily be affixed. First paste a sheet of clean backing-paper over the back of the opaline. Then cut a piece of stout cardboard a little smaller than the opaline. Across this a cut should be made so that the card may be bent in the form of a strut. Over the cut a piece of thin linen must be pasted, so as to prevent it breaking in two. Now glue the top part of the card on to the back of the opaline, and allow to set; and then a piece of tape should be pasted on the inside of the loose part of card, and stretched across to the opaline, and pasted there; it will then stand up. Very pretty effects can be obtained at a very small cost by following the above directions.—O. T., in *Photographic News.*

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

At the meeting on Nov. 15, Mr. E. M. Nelson, President, in the chair, Dr. Hebb called attention to the Volume of the *Transactions* of the Jenner Institute of Preventive Medicine, which he thought would be of great interest to those engaged in bacteriological work. Mr. C. L. Curties exhibited a new form of portable microscope by Leitz. It had a folding foot and a removable stage, to enable the instrument to be packed in a small compass. The body was not made to incline, but was furnished with a coarse and fine adjustment, and the stage was fitted with a modified form of Abbe condenser with Iris diaphragm. The President thought the instrument would be useful to those requiring a very portable one; its great compactness was effected in an ingenious manner, while the working parts were well made and finished. The President read a short note descriptive of a set of three simple hand-microscopes, on the Coddington principle, sent for exhibition by Mr. Edward Swan. They were apparently made for a medical man, and could not be very old. Dr. Hebb said Prof. Groves had made some modification in a form of hand-microtome, and had sent it for exhibition. The President called attention to six photomicrographs of the larvæ of gnats, taken from life, by Mr. J. T. Holder. The President exhibited an old Gillett condenser, dated July 20, 1849, which had a collar adjustment. Dr. H. C. Sorby's paper, "On the Preparation of Marine Worms as Microscopical Objects," was read by the President, in the unavoidable absence of the author. The subject was illustrated by beautifully-mounted slides exhibited under microscopes. The attention of the meeting was then directed to a fine exhibition of Foraminifera, by Mr. Earland, shown under a large number of microscopes, with written descriptions explaining the points of interest in each slide.

USEFUL AND SCIENTIFIC NOTES.

Drainage.—In planning drainage schemes provision should be made for removing rainfall per hour as follows:—From roofs—measured horizontally—5in. in depth; from flagged surfaces, 2in. in depth; from paved surfaces, 10in. in depth; from gravelled, ·05in. in depth; from meadows or grass plots, ·02in. in depth.

Lightning conductors are usually made of solid copper tapes in continuous lengths, about ¾in. to 1¼in. wide, and ⅛in to ¼in. thick; or occasionally copper wire rope, ⅜in. to ¾in. diameter. For dwelling-houses and other ordinary buildings a copper rod ½in. diameter, and weighing 189lb. per foot, is frequently used. If an iron rod is used it is generally ¾in. diameter.

We Vary in Weight Hourly.—Mr. W. W. Wagstaffe, B.A., F.R.C.S., advances some curious facts in *Knowledge* for November regarding the—as he calls them—"Ups and Downs in our Daily Weight." He says:—"It is strange to see what absurd fallacies occupy the popular mind. . . . It has been seriously asserted by many people that you are naturally lighter after a meal, and they have even gone the length of explaining this by the amount of gas that is developed from the food. These people must be very uncomfortable after meals! It reminds one rather of the famous fallacy said to have been submitted to the Royal Society, asking why a fish could be put into a basin brimful of water without making it run over. When it was tried at someone's suggestion the water, of course, did run over. Supposing we want to find whether we do really vary in weight or not, there are two ways to set about the inquiry. We can either sit in a weighing-machine and live there—which does not commend itself to most of us—or we can weigh ourselves at regular times during the day, which is more feasible. Here are some figures which represent some actual observations. Average:—

	lb.	oz.		lb.	oz.
9 a.m.—Before breakfast	155	8	(losing	3	6)*
10 a.m.—After ,,	157	4	(gaining	1	12)
12 noon.—Before lunch ..	156	6	(losing	0	14)
1 p.m.—After ,, ..	157	6	(gaining	1	0)
5 p.m.—Before dinner ..	156	12	(losing	0	10)
6½ p.m.—After ,, ..	158	14	(gaining	2	2)

* During night.

By these it will be seen that we lose 3lb. 6oz. between night and morning; that we gain 1lb. 12oz. by breakfast. That we again lose about 14oz. before lunch; that lunch puts on an average of 1lb.; that we again lose during the afternoon an average of 10oz.; but that an ordinary dinner to healthy persons adds 2lb. 2oz. to their weight. What would be the result of a big dinner? It is easier to imagine than describe. And yet on more than one day there was a difference of 2lb. 8oz.; but this is not very excessive, considering that a pint of fluid weighs about 1lb.

SCIENTIFIC NEWS.

The annual eclipse of the sun on Dec. 2 will not be visible from any known land, but it is not improbable that some useful observations may be made from ships sailing over the seas, especially as many captains are now in possession of photographic and spectroscopic apparatus.

A nearly total eclipse of the moon is due on Dec. 16, and will be theoretically visible at Greenwich.

It appears that some observers in this country did see the meteors or shooting stars between midnight of Nov. 14 and the morning of the 16th, but the number of the Leonids seen was insignificant compared to what was expected.

The Russian Astronomical Society has, it is stated, resolved to erect a mountain observatory, but the site has not been finally agreed upon. It appears probable that it will be either in the Crimea or the Caucasus.

The *Bulletin Mensuel* du Magnétisme Terrestre de L'Observatoire Royal de Belgique, by M. L. Niesten, should be useful to those who keep a record of sunspots and of such phenomena of magnetism as the Aurora borealis. It is published by Hayez, at Brussels.

The *Journal* of the British Astronomical Association (Nov. 25) contains the business and official notices, and the usual notes of papers or reports which have appeared in the periodicals which deal with astronomical matters. A brief note announces the death of Mr. Nathaniel E. Green, a past president of the Association, and a Fellow of the Royal Astronomical Society since 1875. Mr. Green was president of the Association in 1896-98, and it is probable that a portrait, with a full obituary notice, will appear in the next number of the *Journal.*

The Parliament of Queensland has voted the sum of £1,000 towards the expenses of the proposed Antarctic Expedition; but it appears that, although so far the proposal has been liberally supported, a much larger fund than is at present available will be required to equip an expedition in a suitable manner.

Mr. Thomas Henry Ismay died last week. He was born at Maryport, Cumberland, in 1837, and came of a race of shipbuilders and shipowners. Apprenticed to Messrs. Imrie and Tomlinson, of Liverpool, he studied shipbuilding from every point of view, and visited many parts of the world. He acquired the White Star line of Australian clippers, and soon afterwards, in conjunction with Mr. William Imrie, formed the Oceanic Steamship Company, and subsequently commenced the Transatlantic service, which has become known to fame as the White Star line, the names of the vessels ending in "ic," as those of the Cunarders end in "ia." The *Oceanic* (the second of that name) is the longest vessel afloat, and made her maiden voyage this year.

The death is announced of Prof. Francis Guthrie, formerly professor of mathematics in the South African College. He was born in 1831, and went out to Cape Colony in 1861. The deceased was an enthusiastic botanist, and, in conjunction with Mr. Harry Bolus, did much valuable work in connection with the "Flora Capensis" in preparation at Kew.

Mr. William Lewis Morgan, M.A., formerly of Oxford, died at sea (on the voyage home from Cape Town) of malarial fever, at the age of 48. He was Lecturer at Exeter College in Biology and at Wadham in Natural Science.

Mr. Dixon Kemp, the well-known author of some standard works on yacht-building, died last week. He was an Associate of the Institute of Naval Architects, and had designed many more or less famous racing yachts, but of late years had interested himself with steam yachts.

To the Paris Academy of Sciences, Mme. S. Curie has presented a memoir on the atomic weight of the metal in radio-active chloride of barium, in which the results of the investigations carried out confirm the original view as to the existence of a new element, which has been named radium.

The Sale of Food and Drugs Act comes into operation on Jan. 1 next, and the Board of Agriculture has issued a number of circulars which concern sellers of cheese, butter, margarine, &c. The board points out, among other matters, that

the provisions of the Margarine Act, 1887, are extended to "margarine-cheese," which expression is defined as meaning "any substance, whether compound or otherwise, which is prepared in imitation of cheese, and which contains fat not derived from milk," and no such substance can be lawfully dealt in, exposed for sale, or sold except under the name of "margarine-cheese," and under the conditions set forth in section 6 of the Margarine Act, 1887. Every occupier of a manufactory of margarine or margarine-cheese, and every wholesale dealer in such substances, is required to keep a register showing the quantity and destination of each consignment of such substances sent out from his manufactory or place of business, and this register is to be open to the inspection of any officer of the board. The Act also enables the Board to appoint officers to execute and enforce the provisions of the Act when local authorities neglect their duty. Another circular addressed to the clerks of local authorities calls attention to the fact that every public milk seller must have his name and address conspicuously inscribed on his vehicle or receptacle for the milk, under a penalty not exceeding £2. Receptacles containing condensed separated or skimmed milk must bear a label clearly visible to the purchaser on which the words, "Machine-skimmed Milk," or "Skimmed Milk," as the case may require, are printed in large and legible type, under a penalty not exceeding £10. A person purchasing any article with the intention of submitting the same to analysis must divide the article into three parts, and must, if required, deliver one of the parts to the seller or his agent. The division of the sample is therefore obligatory, whether the seller requires it or not, and, on the other hand, the delivery of a part to the seller is not obligatory, unless he requires it. It may be doubted whether the penalties are high enough, for the profits when selling margarine for butter are so great that the large dealers can afford to laugh at the "fines."

It is announced that M. Henri Moissan has been appointed to the professorship of inorganic chemistry in the Paris School of Pharmacy, which had become vacant by the retirement of Prof. Riche.

A large number of candidates for the optical diplomas offered by the Spectacle Makers' Company presented themselves for examination at the Northampton Institute, Clerkenwell. Alderman Sir Reginald Hanson, M.P., the Master of the Spectacle Makers' Company, in a short address to the students, declared that owing to the technical instruction imparted under the ægis of the guild, the style and conduct of the optical trade of the country would be improved, while the interests of the public would be further protected, and the British optical trade would be increased and fostered. It was essential that the practical optician should be proficient in the mechanical requirements of his calling and thoroughly competent to distinguish between those cases in which glasses could be supplied by him and those which required the skill of an oculist. Sir Reginald Hanson having strongly deprecated the idea that opticians should take the place of the ophthalmic surgeon, pointed out that the function of the former was to deal with the eye as an optical instrument, and further, that the moment they found the eye was incapable of receiving perfect vision with the aid of the appliances of the trade it was the bounden duty of the optician to seek advice.

It is rather singular to read, after all the warnings that have been given in the scientific papers, the ideas of the uses to which aluminium can be put. In alloys it is a useful metal, but pure it is treacherous. It is not, however, so bad as the following paragraph asserts:—"Aluminium as an industrial metal has been very disappointing. Its undeniable merits, strength and lightness, are discounted to a serious extent by defects which it does not appear possible to overcome, so far as present experience enables us to judge. However brilliantly polished in the first instance, it oxidises very rapidly, and assumes a shabby appearance in ordinary use. It must be remembered that the United States Government made most exhaustive experiments with aluminium and alloyed aluminium for coinage a few years ago, but did not find these experiments at all so encouraging as to entitle them to even a tentative practice." The properties of aluminium have been known for a good many years, notably that it oxidises very rapidly in the presence of sea air, which is always more or less impregnated with salt. Some of the alloys of aluminium appear to be very useful, but pure aluminium has not yet been accepted for anything but special purposes.

It is reported that a fine specimen of the honey buzzard (*Falco apivorus*) has been shot near Boston. As these birds were supposed to be extinct in England, the capture has excited much interest amongst ornithologists. The bird was busily engaged in ransacking a wasps' nest in search of the larvæ, of which it is very fond. There may be some excuse for capturing rare birds, so that the "larger number" may have an opportunity of inspecting them in a museum; but many of them, left alone, would become more numerous in this country, and the honey buzzard is said to be a useful bird.

Another natural history note reads:—"While fishing in Hollesley Bay two fishermen brought up a crab, having fixed to its back a perfect four-year-old oyster. The curiosity is to be sent to Ipswich Museum."

A bottle-nosed whale, 66ft. long, weighing about eight tons, was stranded the other day off the cannon cartridge buildings, Woolwich Arsenal. It came up the river with the tide, and when it found itself stranded on the reed bed "blew" furiously, and turned "somersaults," injuring itself on the stones, and colouring the river with its blood. About two o'clock, the crew of a steam tug fastened a rope to it, dragged it off the beach, and took it in tow, with the intention of consulting the Thames Conservancy as to what was to be done with it.

In the description of a patent taken out (or more properly speaking granted) in the United States to Mary L. Whitfield, of Memphis, Tenn., for electro-medical apparatus, it is stated that it has been impossible to obtain good results, because the current raised was generated by outside means and passed into the body, so that it was conducted by the blood and not by the diseased portions, except those over which it had to pass on entering or leaving the body. By means of the patented apparatus, it is stated that "the entire body or any desired part can be treated by causing induction to take place in the diseased part, so that every particle of the body, when placed within the influence of a changing magnetic field, interrupts lines of force to generate electricity and to form a conductor."

It is announced that the torpedo-boat destroyer *Viper*, which is fitted with steam-turbines on the Parsons' system, attained in her trials on the measured mile a speed of 37 knots. Those most interested are, it appears, not responsible for the statement.

The lead-covered electric wires used at the official residences in Calcutta of the Lieutenant-Governor of Bengal have deteriorated considerably, and a large part will have to be renewed soon, although it is only about three years since they were put in. They were buried in the plaster, it is said.

At the Society of Arts, on Wednesday, Dec. 6, Mr. Joseph Cash is to read a paper on "Artificial Silk."

A THERMOSTAT has been designed in America to give warning of spontaneous combustion in coal pockets. A compound solder-release thermostat, encased and protected by iron pipe, is placed in the centre of every 10ft. cube of coal, both horizontally and vertically. The thermostat has two operating points, one at 155°, the other at 286°, and as these two points are reached bells are rung and warning given of an approaching fire.

What is Fog?—Prof. Barr, of Glasgow University, says it used to be commonly supposed that the particles forming a fog or a cloud consisted of small vesicles or bubbles of water, filled with some very light gas. This extraordinary conception arose from the supposed necessity of finding some explanation of the suspension of these particles in the air. The process of formation of such vesicles, and the presence in them of gas which was lighter than air, though subject to a very considerable pressure on account of the capillary contraction of the envelope, were mysteries never explained. But the principle just given will suffice to indicate that very small particles of water will fall slowly in still air, while a very slight upward current will suffice to keep them from descending at all in the case of very small particles. Aitken has shown that the globules forming a fog or cloud consist each of a film of water condensed upon a particle of dust. The core is therefore solid, not gaseous.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE LATE MR. N. E. GREEN, F.R.A.S.—THE TIDES—THE LEONIDS (THE LIGHT THAT FAILED)—A SPURIOUS "ASTRONOMER ROYAL."—ALPHA AND BETA ORIONIS—ROTATION OF A SHELL—PRONUNCIATION—THE LIMITS OF HUMAN KNOWLEDGE—"USSHERING" IN THE LEONIDS—STONEHENGE—THE LIGHTNING FLASH—SUNSPOT MINIMUM—DEWCAP FOR REFRACTOR.

[43073.]—BY the death of Mr. N. E. Green, F.R.A.S., the descriptive and observational provinces of astronomy have sustained a severe loss, and are distinctly the poorer. As an astronomical draughtsman he had but few equals indeed, either in this country or any other; his drawings of planetary detail being at once remarkable for their artistic excellence and for their rigid accuracy of detail. His observations and really superb sketches of Mars made in Madeira in 1887 are even yet unsurpassed for beauty and truthfulness, and are now classical. They may be studied with advantage by the young observer, whose ideas of the physical configuration of the surface of our neighbour in space have been derived from some of the recent fancy sketches of Areographical detail which have been published. Mr. Green drew what he saw, and really saw (and did not merely imagine, like some folk) what he drew. The student could have no safer guide than he was in the delineation of celestial objects.

Some few months ago the Rev. J. H. S. Moxly, the Chaplain to Chelsea Hospital, wrote a book, which was published by Rivingtons entitled "The Tides Simply Explained, with Practical Hints to Mariners"; the gist of his theory being expressed in the following sentence: "Well then, if the attractive force raises a tide under the moon, the force opposite the attractive force will produce a similar effect on the opposite side of the world." This "opposite force" being, as we are told a few lines previously, that "which keeps the earth and moon asunder." But Mr. Moxly is not even original in his paradox, for on October 5, 1898, more than a year ago, a paper was read before the North-Western (Manchester) Branch of the British Astronomical Association by Mr. E. McGauran, advocating the identical hypothesis. I cannot but feel that Messrs. McGauran and Moxly might both read Prof. Darwin's admirable book on "The Tides" (and notably Chapter V. of that work) with very great advantage indeed.

I sincerely hope that some, at least, of my brother-readers have been more fortunate than I was in the observation of the late shower of Leonid meteors—always supposing that there was anything worthy to be dignified by the name of a shower at all. Watching from midnight on November 14th, to 2h. a.m. on the 15th, I caught a very few, perhaps not half a dozen, little flashes in the moonlit sky: the next night, and early morning, 15th—16th, were densely cloudy at the place whence I write; while I could not detect a single meteorite near midnight on the day last named. Nor, judging from the newspaper reports, do observers seem to have been much more successful anywhere, either in this country or abroad. The message from Berlin speaks of their having been "seen in large numbers," and then goes on to say that about thirty-one were observed during a six or seven hours watch! Astronomers in Philadelphia, the University of Pennsylvania, Chicago, Greenwich, Oxford, and Cambridge seem to have seen but little more. One hundred and two (only sixty-nine of them Leonids) in three or four hours being the maximum recorded. It would be simply idle to describe this as anything of a display, because in 1866 thousands and thousands of meteorites rushed across the sky, which actually seemed to be snowing fire. One is tempted to wonder what has happened. Has the nucleus of the ring become disintegrated, and are we never again to have such an awe-inspiring exhibition as that of 1866? Is there any mistake about the period of these bodies—or what?

And, apropos of the expected shower, I am sure that a large number of those who will read these lines will be in accord with me in sympathising with my friends Mr. and Miss Bacon in the exciting and most perilous experience they had in their attempt to observe it from a balloon. That they should have been, as they undoubtedly were, so near their deaths in their venturesome journey, and that the young lady should have broken her arm in their terrible descent, must excite at once pity and admiration for those who bravely faced the danger of a balloon ascent in the middle of the night, solely in the interest of astronomical science. Scientific men in general, and members of the British Astronomical Association in particular, will couple such pity and admiration with the heartiest congratulations to both father and daughter that they are safe and sound on terra firma again.

I scarcely wonder at a more or less ignorant sub-editor perpetrating the heading to which "B.Am A." calls attention (in letter 43021) on p. 315, inasmuch as the gentleman who appears in such unwarrantably borrowed plumes there has really so advertised and puffed himself, both anonymously and *proprio nomine*, that I really believe that 85 per cent. of the non-scientific public are in doubt whether he or Sir Robert Ball is the Astronomer Royal! That that most important and dignified post is occupied by Mr. W. H. M. Christie, C.B., seems to come as a kind of revelation to an overwhelming proportion of the people in society to whom one sits next at dinner. The head of that scandalously costly South Kensington job, the (so-called) "Solar Physics Observatory," has as much, or as little, claim to be the Astronomer Royal as I have—neither more nor less, and most assuredly I shall occupy that position quite as soon as he will.

[Moreover, as an addendum to what I have here said, I may, perhaps, mention that the Report of the Madras Observatory for 1898-99, which has only reached this country since the above was written, contains one paragraph of so remarkable a nature as to deserve a wider publicity than it is likely to obtain in its present form; illustrating as it does the kind of "advice" that a non-scientific Government apparently seeks, even if, as in the case to be referred to, it disregards it when given. It is the 6th section of the Report, and in it the Government astronomer, Mr. Michie Smith, says, under the heading "Kodaikanal Observatory":—"As mentioned in last Report, the Government of India requested the Astronomer Royal and Sir Norman Lockyer to report on the various Indian Observatories. The former, after visiting Kodaikanal, approved generally of the plans for the observatory there, and made some suggestions for minor alterations, which were at once adopted. Sir Norman Lockyer, on the other hand, without visiting the place, objected entirely to the plans, and on his return to England represented to the Secretary of State for India that the buildings were 'too costly and too permanent,' and generally were badly designed and unsuited for their purpose. He went on to point out that "the South Kensington Solar Physics Observatory thus equipped with temporary structures is the most powerful in the world. It does more and better work than the similar institution at Potsdam, where the buildings cost £250,000,' and urged that the new buildings at Kodaikanal should be like those at South Kensington, 'shanties' built of wood and canvas. As a consequence, the Secretary of State telegraphed out that the work on the observatory was to be stopped till the reports of the Astronomer Royal and Sir Norman Lockyer had been duly considered. To anyone acquainted with the climatic conditions existing at Kodaikanal the proposal to house valuable instruments in such 'shanties' as Sir Norman Lockyer recommended seems as strange as his estimate of the relative values of the work done at South Kensington and Potsdam, and the Government Astronomer protested strongly against his proposals. Whether or not this protest was forwarded to the Indian Observatories Committee is not known; but the result of the deliberation of the committee was that no reference whatever was made to the buildings, and after a delay extending from the beginning of June to the end of October, the buildings were allowed to go on according to the designs which had been so strongly condemned." It seems almost needless to comment on these words of the Indian Government Astronomer; but if, or when, his Report reaches Potsdam it is easy to picture the amused contempt of Drs. Vogel, Spörer, Lohse, and their *confrères* at an impudent attempt at self-advertising at their expense which might well turn Beecham, Pears, and Holloway green with envy.]

Premising that I have never seen Peck's "Observer's Atlas of the Heavens" in my life, and know nothing at all about it, I may tell "G. J." (query 97060, p. 325) that while Rigel is permanently of the 0·3 magnitude, that of α Orionis varies from 1 to 1·4 at irregular intervals. I have never myself seen Betelgeuse brighter than Rigel, and my experience is a fairly extensive one.

If "Hinel" (query 97072, p. 325) will reflect that the ultimate direction of the particles of a shell must be compounded of its rotary motion, which, of course, it never loses, and those of the fragments dispersed by the bursting charge, he will see that as these latter are incalculable, the paths of the segments must *ex necessitate* take all imaginable directions when it explodes.

In reply to query 97077, p. 325, the best educated people do *faintly* aspirate the *h* in such words as which, when, and why; albeit your average middle-class Cockney invariably renders them as witch, wen, and wye, as though he were speaking of a sorceress, goitre, and a familiar Welsh river. Sure is pronounced shure (to rhyme with pure). I am grieved to be obliged to add, though, that there is at present in society an affectation of clipping and distorting words; and that you hear but too many Johnnies and grand ladies talk of goin' out, eatin' cowcumber, and the like.

The *Philosophical Magazine* for November contains a very remarkable paper by Dr. G. Johnstone Stoney, F.R.S., entitled a "Survey of that Part of the Range of Nature's Operations which Man is Competent to Study," which is well worth careful attention as indicating more or less the limits of human knowledge. It will amply repay the serious study which it alike deserves and requires to be appreciable and intelligible to the student.

We have yet another illustration of Mr. Garbett's unfortunate habit of arguing merely for victory (in letter 43051) on p. 340, where, speaking of the (mythical) destruction of Sodom and Gomorrah, he says: "The date of the event is correctly given in Ussher's notes to Genesis as 1896 B.C." Now I would ask any one of my brother readers to turn back to Mr. Garbett's recent letters on cognate subjects in these columns, and to note how systematically he condemns and repudiates Ussher's chronology when it conflicts with his wild assertions concerning patriarchal history. When, however, he can twist ascertained facts into anything even apparently corroborative of his own nonsensical interpretation of history (?), then the despised Ussher is promptly erected into a valuable authority. I prefer not to comment on the impertinence of the allegation: "So Leverrier's origin for the Leonids in A.D. 126 is utterly disposed of." Garbett v. Leverrier!!!

In reply to Mr. Allison (letter 43057, p. 340), I know of no other cause than that of a change in the obliquity of the Ecliptic (which absolutely certainly exists) for the change of azimuth in the point of sunrise at the summer solstice. According to Stockwell, the limits of the obliquity are 21° 58′ 36″ and 24° 35′ 58″—i.e., its range = 2° 37′ 22″. Of course, all such calculations as those of Prof. Petrie and Mr. Whitmell must be made on the assumption that the "pointer-stone" was originally orientated with mathematical accuracy from the "altar-stone," and that the present apparent change of azimuth in the point of sunrise on Midsummer Day is really and truly an actual one. It is well known that the whole neighbourhood of this wonderful monument is crowded with tumuli, there being some 300 of them within a radius of three miles, *while the rest of the county is comparatively free from them*. Now, if Mr. Allison will turn to pp. 115 and 116 of the second edition of Sir John Lubbock's "Pre-historic Times," he will find that eminent authority pronouncing his opinion, founded on the nature of the contents of such of these grave-mounds as have been opened, that Stonehenge must date from the Bronze Age, which would put the date of its erection many hundreds, not to say possibly even thousands, of years before A.D. 400 or 425 either. Unfortunately, the merely astronomical data are both vague and questionable, owing, as I have previously hinted, to the vagueness of our knowledge of the original mode of determination of the orientation of what I may call the fiducial points of measurement. Were we entirely certain that the azimuthal direction, from some fixed point, of sunrise on Midsummer day, was determined with absolute precision by the builders of Stonehenge, the calculations of Prof. Petrie and of Mr. Whitmell would be conclusive, as coming from men of their scientific standing. But ——? Bear in mind this is a question of seconds of arc.

Will Mr. McDowall (letter 43070, p. 342) tell us *why* it is "premature to assume that we have reached the turning-point of the sunspot curve?"

"F. J. G." (97094, p. 345) will not improve upon a tin tube for a dewcap. But it must be kept bright outside, and must be long enough.

A Fellow of the Royal Astronomical Society.

OBSERVATIONS OF THE LEONIDS, 1899.

[43074.]—The following table shows the watches kept:—

1899.	From.	To.	Meteors Seen.	Meteors Rec'rd'd	Leonids Seen.	Leonids Rec'rd'd	Seeing.	Notes.	Hours of obs.
	h. m.	h. m.							
Nov. 8	16 0	17 45	13	13	0	0	1	—	$1\frac{3}{4}$
" 9	—	—	—	—	—	—	-	Sky cloudy	—
" 10	16 30	18 0	3	3	0	0	4	Sky exceedingly poor	$0\frac{3}{8}$*
" 11	—	—	—	—	—	—	-	Sky unobservable	—
" 12	—	—	—	—	—	—	-	Sky unobservable	—
" 13	17 0	18 10	2	2	0	0	4	Sky very poor; observation only possible at intervals ..	$0\frac{1}{4}$*
" 14	—	—	—	—	—	—	-	Unobservable	—
" 15	13 15	17 15	16	11	10	7	3	Moon up during whole watch	4

* Time of actual observation.

In the above table, under the heading "Seeing," the following numbers are used: 1, seeing very good; 2, good; 3, fair; and 4, poor.

During the whole period of observation (eight hours) there were $6\frac{1}{4}$ hours of clear sky. Thirty-four shooting-stars were seen, and 29 registered; of these, ten were Leonids, and seven of these latter meteors were mapped.

Nov. 13.—Master R. Lamming, of Leicester, watched the sky after 12h. throughout the night, but reports that clouds prevented observation of meteors.

Nov. 14.—A large number of people here stayed up all night in hope of witnessing an abundant shower. According to accounts, the sky cleared for a short time soon after midnight, and six meteors were seen, one of which, nearly as bright as the moon, "fell down slowly from Leo." However, from what I can gather, the shower was not of the expected strength.

Nov. 15.—The evening promised very badly at first. Mr. G. W. Cook, of Rearsby, and myself were observing at this place, a village seven miles N.E. of Leicester. Soon after midnight the clouds became very broken, and at 13h. 15m. we were able to commence observations. We took up a position on a hill in order to get above a low mist. Here we had an uninterrupted view all round, and the sky remained clear throughout the rest of the night, except on one occasion when a mist drifted over for a few minutes. Meteors came slowly. In the first hour only six were seen (four Leonids). The maximum was placed in the fifteen minutes between 14h. 0m. and 14h. 15m., when three meteors (two Leonids) were observed. In the half-hour 14.45 to 15.15 only one shooting-star—a Leonid, by the way—was seen. From 15h. 15m. to 17h. 15m. only five meteors were counted. Of these three were Leonids. At 17h. 15m. we abandoned the watch, although the sky was still very clear. The horary rate of the Leonids works out to 2·5. It is very probable that many fainter meteors escaped recognition, owing to the bright moonlight.

On projecting the Leonid paths, I find a radiant diffuse to the extent of 4°, with its centre at α $151\frac{1}{2}°$ δ + 22° (seven meteors). They were all very swift, but only one was recorded as having left a streak.

Minor Showers.—Other minor radiants were observed as follows:—

Radiant Point.	No. of Meteors.	Appearance.	Nights of Observation.	Name.
α δ			1899.	
$132° + 45\frac{1}{2}°$	4	Swift	Nov. 8, 15	*i-k* Ursids
160 + 11	4	Swift; streaks	Nov. 8, 10, 13	α Leonids

Leicester, Nov. 24. **A. King.**

[43075.]—I notice in Mr. W. H. Daw's letter (43046) on p. 338 that on the morning of Nov. 15, between 4.30 and 6, he saw a meteor near the radiant point, which he describes as bursting out into a blaze of light of fully a quarter of a degree in diameter, and after going out leaving a haze somewhat resembling a comet. As I had a somewhat similar experience that morning, it would be interesting, as possibly throwing fresh light on our knowledge of the extent of the atmosphere, to know whether this meteor, which he saw in London, was the same as the one which I noticed up here in

North Ayrshire. For the purpose of identification I quote from my notes made at the time: "Leonid (?) 2nd magnitude, yellow, 4.50 a.m., no motion, blazed out like a star between μ and ε Leon. Maj., lasted about one second or slightly longer, left no trace." If the time and position were the same, it is possible that they were the same meteor, as the discrepancies in the other particulars might be accounted for by our personal equations. On the other hand, it seems impossible with the *estimated depth of the atmosphere* that the same meteor should appear to be coming straight towards the eye of two persons at a distance of something like 400 miles apart. With regard to the time (4.50) I should mention that in verifying my watch next day by the station clock, I found that I was rather more than half a minute fast; but as I have since had reason to doubt the accuracy of the station clock more than that of my watch, I prefer to give the time as I recorded it, though the former was said to have been set to G.M.T. at 10 o'clock that morning.

I kept an intermittent look-out for meteors from 11.30 p.m. Nov. 14, going out for about five minutes every half-hour or so, but saw nothing till 4.2 a.m. (Nov. 15) when I saw a Leonid. As there was a strong and very cold N.E. wind blowing I went back and prepared myself for a longer vigil, returning to my post about 4.15; and between that time and 5.25 I saw eleven other Leonids, including the one described above, which I marked (?) owing its distance from the true radiant, and four other meteors belonging to other radiants. The Leonids were all swift, but only four left any trail; they varied in magnitude from 2nd to 4th; their colours were white (or more strictly bluish-white), yellowish-white, yellow, and (one) orange. The other meteors were all comparatively slow; two were of 2nd mag. and two of 4th mag., and in colour two were orange, one yellow, and one white. There was very little cloud after midnight, and none after 4 a.m. On the next few nights the sky was completely overcast with dense hazy clouds.

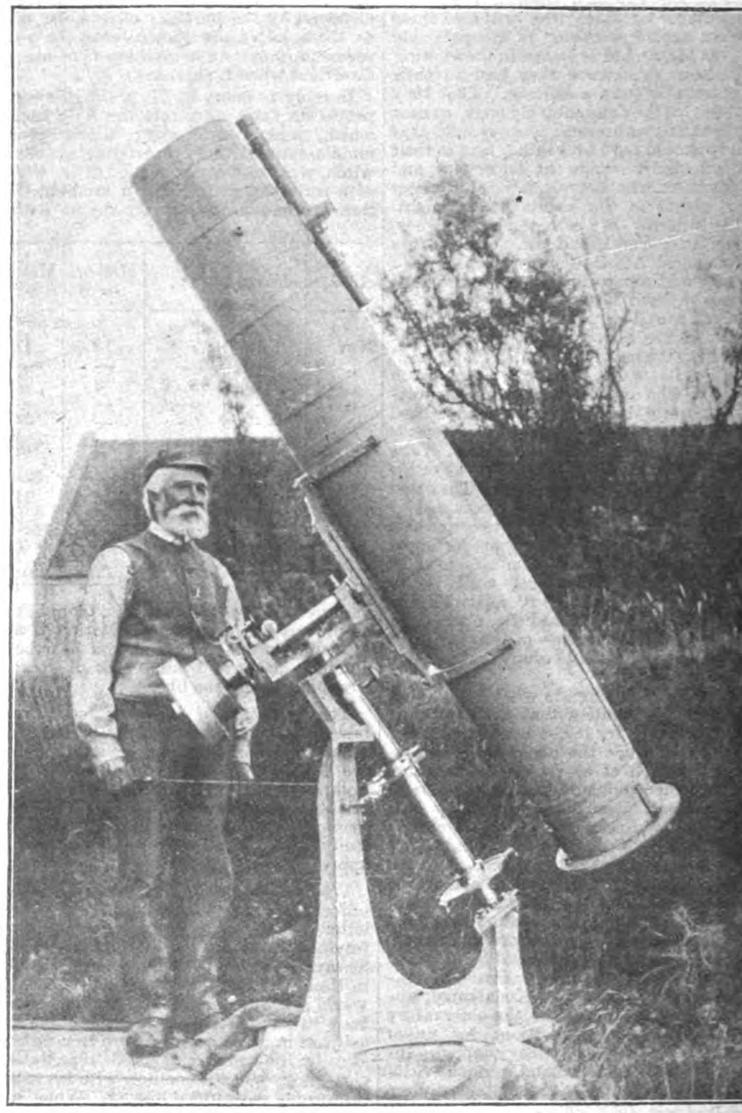
N. Maclachlan.

Routenburn, Largs, Ayrshire, Nov. 25.

THOSE DANGEROUS LEONIDS.

[43076.]—Might I suggest to Mr. Garbett that the stones which slew the Canaanites on the day of the battle near Gibeon were Leonids, and that it was the blaze of the shower (which was equal to the light of the sun) that led to the belief that the sun was standing still? Perhaps he will find something to this effect in the pages of Comte, though if the latter only knew of four asteroids in the year 1850, I should not rate his astronomical knowledge very highly.

W. H. S. Monck.



A FINITE UNIVERSE (?)—THE DESTRUCTION OF SODOM—COMETARY ASTRONOMY.

[43077.]—When all has been said on the subject of a finite universe, it must still remain a matter of opinion as to whether the universe is finite or not. It cannot be proved one way or another. Whatever limit may be set, we always want to know what is beyond that limit. Myself, I see no reason why infinity should not be. There is always the possibility, nay, the probability, of the existence of stars so remote in the space that their light, though it started perhaps before the earth was formed, has not reached us yet. When a new temporary star blazes out, people are apt to forget that the cause of its sudden appearance is not in operation at the moment of appearance, but hundreds or thousands of years before. Were the stars infinite in number, they would not necessarily cause the sky to appear a blaze of light. The enormous distance of the more remote of them, the enormous time their light would take to traverse the distance, and the presence of dark bodies in space shutting out the light of a certain proportion of them, would account for their not all being visible.

One hesitates on the momentous question of the destruction of Sodom. Possibly London is in danger of destruction by the Leonids on each Nov. 15. If so, it is a blessing that the great autumn shower failed to put in an appearance. The ludicrous spectacle of Lot's wife standing (43051, p. 340) under a falling meteor composed of salt can only be provocative of derision. To make these assertions, however ingenious they may be, "E. L. G.," is one thing; to prove them is another. I fail to see that Leverrier's origin for the Leonids is "so utterly disposed of."

I thank "E. L. G." (letter 43062, p. 341) for his instructive quotations; but it does not go to say that we are to study "sun, moon, and comets" only. Suppose a comet to be in such a position as to make its collision with the earth inevitable. What could we do? We could not prevent the catastrophe. And suppose that the earth did encounter a comet, would not the comet come off worst? Mr. Hind, one of the foremost authorities on comets, said that on June 30, 1861, the earth actually passed through the tail of the great comet of that year, and on that day several observers noticed a peculiar phosphorescent glow in the sky. Did anything happen? No. There was no geological catastrophe. The whole mass of a comet is comparatively small—so much so that, even supposing one did collide with the earth, no harm much, if any, would result, except to the comet.

Earlsfield, S.W. Silverplume.

IS THE UNIVERSE FINITE?

[43078.]—When so competent a judge as Mr. Monck pronounces the arguments in letter 43023 invalid, it requires some temerity on my part to advance anything further to support them. But it seems to me of prime importance, in connection with the intensity of light received by the earth, that the solar surface may be regarded wholly of the same distance from us when compared with the great diversity of stellar distances in any portion of the heavens of like area.

Given a star of a certain magnitude, four others of the same kind at double the distance, or nine at treble the distance, might double the light we receive from that portion of the heavens, whilst doubling the effulgent area. Hence, if the intensity of the hypothetical light reaching us from an invisible star required doubling before any sensible effect was produced on the retina, it is obviously possible that the eye might become aware of the luminosity of a disc-area doubled thus. But the probability of a disc-area being doubled by four, or nine, or other small number of stars is remote, on account of the diversity of distances between the stars. There is, I think, reason to believe that few stars are separated from others by a less distance than that between the nearest of them and the sun. Let us, therefore, imagine a series of about equal size occupying much the same apparent position in the heavens. The intensity of the light from the direction of star A must be doubled to insure visibility. Star B on its farther side reinforces A by a fourth; star C on the farther side of B helps A with a ninth more; star D adds a sixteenth, and so on. Admitting the reinforcing stars to be arranged spirally round A in a space not exceeding A's area, how many such stars would be required before the requisite duplication of the intensity be attained? And if it were needful to treble or quadruple the intensity, how many?

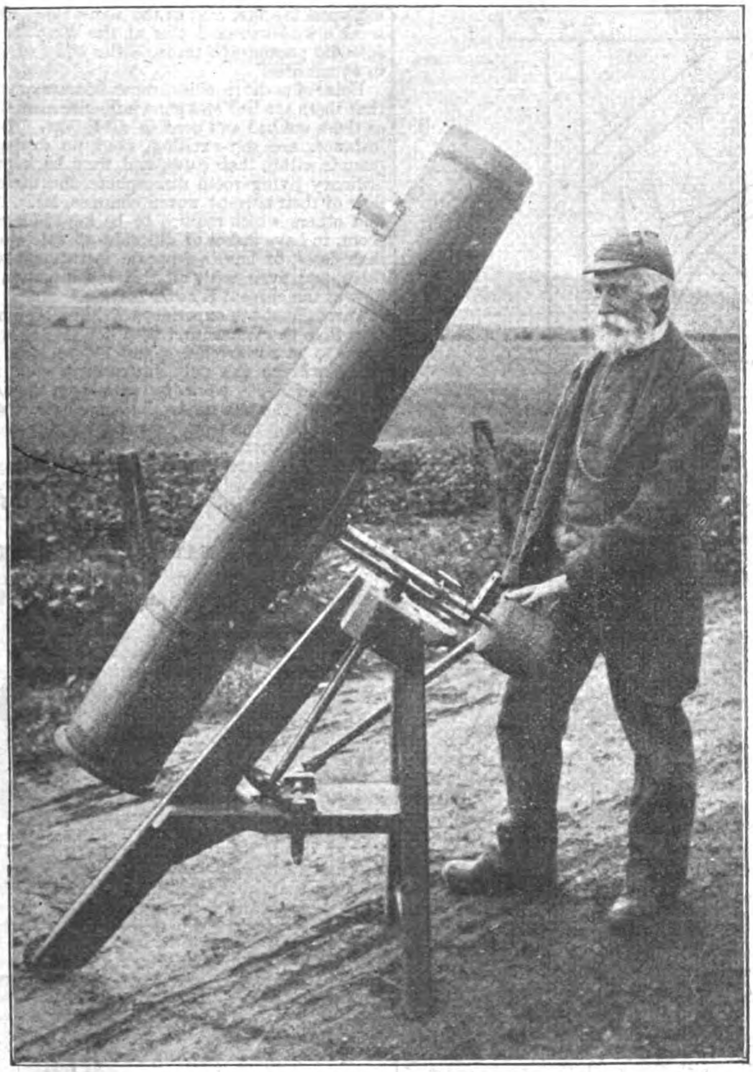
Again, a certain number of stars are visible on a photographic plate which are indiscernible to the eye even with the aid of the best telescope. The light from one of them takes perhaps hours to affect the sensitive emulsion; yet can we be certain that the work then done is the operation of a single star? Is it quite out of the question that that tiny speck may be due to the action of light from a multiple-disc area whose components are irresolvable? Indeed, I do not realise any absurdity in supposing that some dark spaces in the heavens are possibly due to the hypothetical light reaching us too feebly to affect retina or plate, which, I take it, means to us that any stars which may exist in such obscure regions are at an infinite distance from the earth. By "infinite" I understand that which our faculties do not allow of our measuring, counting, or even estimating. I use the word somewhat agnostically, so to speak, as an expression connoting compusory human ignorance, not as an absolute negation of limit. Frankly, I find it easier to picture generations of men striving to reduce the universe to a row of figures than to realise some outer star as the first milestone from void space.

J. Dormer.

A WORKING-MAN ASTRONOMER AND HIS TELESCOPES.

[43079.]—As matters pertaining to the telescope appeal to a very large number of your readers, I have much pleasure in sending you a brief account of some very creditable work which has been done by one of your oldest subscribers, with no other assistance than that derived from the pages of your Journal, and under surroundings by no means congenial to the pursuit of such hobbies; indeed, when the whole circumstances are taken into account, the results accomplished by this working man stand out as examples of pluck and perseverance seldom to be met with.

Mr. John Glass, who follows the occupation of a meal miller in a somewhat isolated glen a few miles from the village of Tarland, in Aberdeenshire, has been a somewhat constant reader of your valuable publication almost from its commencement. The



"E. M." has been one of his best friends, and few have perused its pages with greater interest or profit.

About twenty years ago, Mr. Glass set about the construction of a small pipe-organ from the articles which appeared from 1870 to 1874, and contributed chiefly by "J. D." and "An Adept." This instrument, which is 7ft. wide, 8ft. high, and 30in. deep, has 198 pipes and three stops—viz. Stopped Diapason, Open Diapason, and Wald Flute—while an octave-coupler upwards with twelve added pipes practically gives Stopped Flute, Principal, and Piccolo. I have very little knowledge of organ matters; but those better able to judge have expressed admiration of the tone and capabilities of the instrument.

Mr. Glass next directed his attention to the astronomical telescope. He had taken an interest in astronomy for many years, and longed to have an opportunity of examining the more prominent celestial bodies through such an instrument. There was, however, nothing of the kind available, and he resolved to make one—a task which was rendered all the more difficult from the circumstance that he had never seen a telescope of any kind. Having first carefully studied the valuable letters by the late Mr. H. A. Wassel on "Grinding and Polishing Glass Specula," which appeared in your pages between 1881 and 1886 (Vols. XXXIII. to XLII.), and the article on "Testing Specula" by Messrs. M. T. Tydeman and H. Parker, which appeared in 1871, he next made a polishing and grinding machine according to the directions given by the first-named contributor. The size of mirror fixed upon was 6in., which was worked to a focus of 5ft. It was mounted as a Newtonian on an equatorial stand of simple construction, and, with the addition of a flat and a few eyepieces which were supplied by Mr. Linscott, Mr. Glass found himself in possession of an instrument of which he was justly proud. At a subsequent date (June, 1893) the speculum was resilvered by the optician referred to, and was pronounced by him to be "very good indeed."

Mr. Glass has been so pleased with the success which attended his first effort, that two years ago he decided to make a telescope of larger aperture. He procured an 8in. disc, which was worked to a focus of 80in. This mirror, the actual focus of which is 79½in., is beautifully figured, and gives very fine results. It has been mounted on an equatorial stand, which would do credit to a skilled optician. This stand is fitted with 8in. gunmetal R.A. and Declination circles, the former being divided to 4m. and the latter to 1°, and reading to 12s. and 3m. respectively. The design for the stand was taken from a drawing, which appeared in your issue of August 16, 1872, by your old and valued contributor "F.R.A.S.," who at that time communicated two articles on the equatorial and its adjustments, and who will no doubt be pleased to learn that his drawing has been utilised to such advantage. As the articles referred to will show, the design was intended for a refractor; but, with a few alterations, it makes a capital stand for a reflector as well. When bolted to the base it is exceedingly rigid, as I can testify from personal examination, and by hand-driving I found, even with a high power, that the image was quite steady.

Mr. Glass has almost completed the erection of a small observatory for the 8in. instrument, and we may hope he will spend many a pleasant evening under its roof.

I inclose photographs of both telescopes, and next week hope to send you a photograph of the grinding and polishing machine. The principle on which its utility depends and the various movements are practically the same as recommended by Mr. Wassell, but in minor details Mr. Glass has been able to effect a number of improvements.

Dalbeattie, Nov. 10. Alex. Smith.

THE ABSORPTION OF STARLIGHT.

[43080.]—MR. BURNS's reasoning on the absorption of starlight seems to be inconclusive. The question whether the ether may not absorb light and heat is not touched on, and the assumption that radiant heat is proportional to radiant light rather begs the question at issue. If there is an obstructing medium which intercepts the light of distant stars, it probably absorbs this light, and gives out the same amount of energy in the shape of dark heat. This seems to be, in fact, what our atmosphere does.

From the small amount of the total starlight compared with the sunlight, Mr. Burns infers that space is too cold for gases to exist in it. But, in the first place, the total starlight is different at every point of space, and, in the neighbourhood of rich clusters, for example, it is probably very different from what it is just outside of the limits of the Solar System. But, in the next place, large patches of the sky are covered with gaseous nebulæ, and with better instruments, or more careful research, we are constantly discovering more. These are in a state of incandescence. May we not reasonably suppose that there are many others whose temperature is not so high as to render them visible?

Nor do I think Mr. Burns is much more successful in dealing with the question of cosmical dust. The assumption of a universe eternal as regards past time, but finite as regards space, is likely to land us in some startling conclusions, and I think his reasoning might be equally employed to prove the impossibility not only of meteor-showers, but even of asteroids—and I may add that bodies as large as the asteroids would be properly classed as cosmical dust for the present purpose, provided that they were far enough away from us. Indeed, the earth itself would answer for the same purpose. But Mr. Burns's theory of the gradual destruction of cosmical dust at all events only holds good in case there is no way of replacing it. Yet we only require a volcanic eruption somewhat more violent than usual in order to generate cosmical dust ourselves, and if there is a volcano on one of the asteroids, we may regard the generation of cosmical dust as certain.

The two theories of cosmical dust (i.e., dark bodies in space) and gases should not be regarded as opposed. Very likely the distant stars in some directions lose much of their light owing to the interposition of invisible nebulæ, while in others they lose it owing to the interposition of solid dark bodies. That considerable diminution of starlight is sometimes caused by both of them, seems to me pretty certain. But whether this takes place over the whole (or the greater part) of the sky, is a different question. W. H. S. Monck.

THE MOON AND THE WEATHER.

[43081.]—THERE is a terrestrial pulsation, the intervals of which are, as nearly as I can make out, $7\frac{1}{15}$ days. At the end of each interval the weather may change; but as the change also depends on various meteorological conditions, this is not always noticed. The effect, however, on animal life and vegetation is very marked. The moon being, physically speaking, a limb of the earth, is governed by it, and is full at the end of an interval. It is perhaps natural that the moon is often saddled with the responsibility of any change in the weather which takes place at the time.

J. H. Schucht.

SEEING BY WIRE—DIRECT POSITIVES—THE PLANETOIDS — EXPERIMENTUM DOCET.

[43082.]—A FEW weeks ago there was mentioned in these columns a popular magazine account of a Polish inventor's method of "seeing by wire." As there seems to have been a little embroidery in this description of Messrs. Szczepanik and Kleinberg's telectroscope for electrically transmitting photographs, &c., it may be worth mention that this apparatus was described at length in the *British Journal Photographic Almanac* for 1899, and elsewhere.

A method of obtaining a positive direct on ordinary plates (which was the subject of a query here a short while ago) has been suggested by Dr. Scott Lauder. The negative image is first developed, then removed by persulphate of ammonia, and the remaining bromide, after a brief exposure to light, is developed. The results, however, are, so far, not very satisfactory.

Without, I hope, indulging in carping criticism, I suggest that there is a slip in Mr. Garbett's letter, 43062. Before 1850 ten minor planets had been discovered, which number was trebled by the year 1854, when the "Politique Positive" was completed.

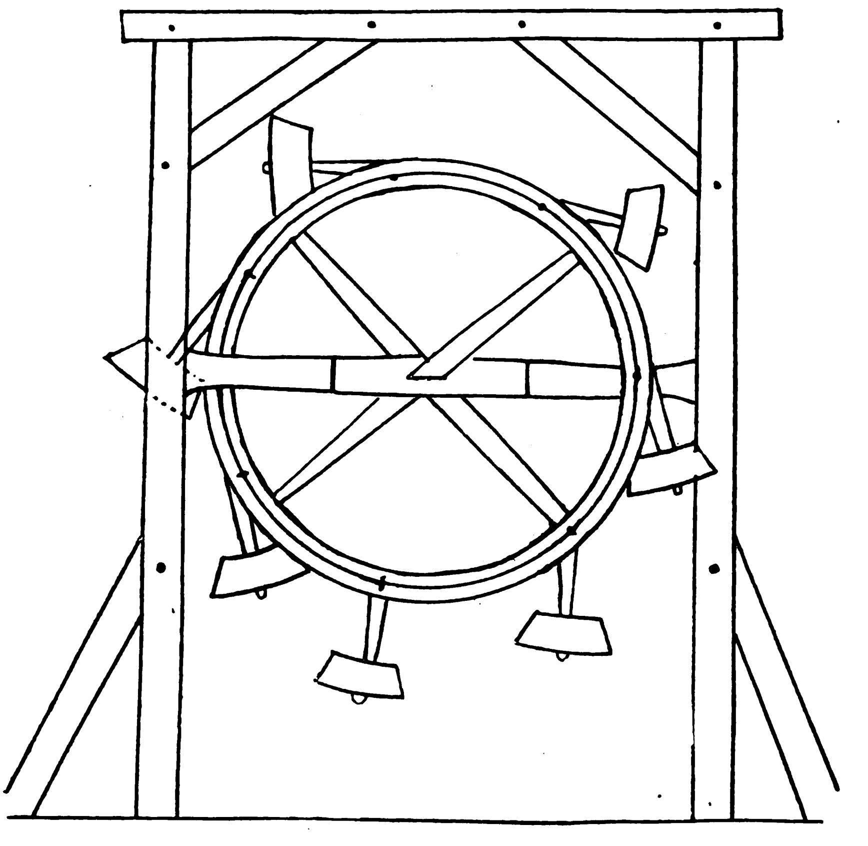
The writer of letter 43067 appears to sincerely believe scientific men obtain their convictions without experiment. One can only hint that without rigid tests of this description, one may fall a victim of strange errors. J. Dormer.

LATHE MATTERS.

[43083.]—SEEING your correspondent (letter No. 43043, p. 319) asking for particulars of Britannia Co.'s No. 16 screw-cutting lathe, I should like to say that I have had one in use for some years (the 6in. centre, 6ft. bed), and can assure him he can do plenty of useful work with the foot gear as supplied with the lathe. I have cut square threaded screws 1¼in. dia. easily (by foot, of course), using the back gear. M. S. Don.

[43084.]—I WOULD advise "Screw Cutter" to buy a good 4½in. or 5in. screw-cutting lathe by one of our Manchester makers—a proper mechanic's tool. He will then get good value for his money, and have satisfaction in working same. Also have the usual four bolts on top of slide-rest for holding tools. I am using a 4⅝in. back-geared Manchester lathe, and do not consider it hard work at all.

J. A. C.



GILBERT'S NEW POWER MACHINE.

[43085.]—SEEING that the hardy perennial (letter 43036) Perpetual Motion has cropped up again in the weighted-wheel shape, I have photographed the original drawing of what must be very near its earliest example. The page photographed is from the sketch-book of Willars de Haricourt, preserved in the Bibliothèque Nationale, Paris (Ms. Fr. 19093).

H. H. S.

FLYING-MACHINE.

[43086.]—R. F. MOORE, in his answer to Roderick D. Hall (43038), states that the difficulty in all flying-machines is to get a sufficiently simple and light motor. Now this, even according to his own showing, is not in accordance with actual fact; for let us suppose for a moment that he is somewhat near the truth when he suggests that 1H.P. of force would be sufficient to raise 100lb. in weight into the air, or, as he says, fly 100lb. in weight. Always bearing in mind that before you can fly 100lb. in weight through the air, you must first get it there. This is a fact too often forgotten by men who seem to strain every nerve and their imagination to create a machine that shall fly through the air at some fearfully sharp rate of speed or other. A flying-machine that cannot travel through the air at all speeds from 60 or 80 miles down to one mile per hour will be both useless and dangerous. This simple fact, I fancy, any man will see at once. But to return, Mr. Moore assumes that 1H.P. will fly 100lb. This, I will suggest to him, will be splendid work, and, if true, solves the problem at one, as engines both strong and light have already been made and can be made again in any numbers, under 15lb. to the horse-power, this leaves the very respectable figure of 85lb. as spare weight that the said engine or motor could raise. However, I am afraid that on the principle of the screw, this is hardly correct—at least, it has never been proved, I think; but here I would point out the fact that seems not to be recognised—that the bird uses the screw principle for propulsion only, and that there is a mechanical principle involved in the operation of flying other than that of the screw, and more important in many respects, because, were it not for this other principle, the safety of the bird could no more be insured than the safety of Mr. Maxim's machine could be insured if it should be sent into the air. The wing of the bird works out in the air two distinct mechanical principles—the paddle and the screw. A close attention to its shape and its action in the air will show any capable man this. The grand principle that Nature shows us here seems to be: the paddle to suspend, the screw to drive or propel. Now it would be plain that the screw could not possibly do both at one and the same time; thus, sometimes the bird calls on the screw, and sometimes the paddle; at others, both principles together are required, as when flying through still air; in this case, no doubt, both principles about equally would be used by the bird; but in flying dead against the wind the screw only would be required, the wind being sufficient to support the bird's weight, while the wings being in this case, props artificially twisted and made for the time being to act entirely as screws, the paddle, as before mentioned, not being required. Now, singular to say, if the bird turns suddenly round and flies with the wind, the whole order of things would at once be reversed. The bird would now require the paddle and not the screw, because the wind would no longer tend to suspend the bird's weight, but would tend to drive it forward; in accordance, the bird would be compelled to drop the mechanical principle of the screw which it would no longer require, and take to the paddle in order to prevent its body coming like a stone to the ground, exactly as Mr. Maxim's machine would have done, or Prof. Langley's machine would do under like circumstances; for both these machines may be likened to a huge bird that can call into action the mechanical principle of the screw only. The fly the air either naturally or artificially requires the paddle as well as the screw. This fact most certainly must be reckoned with by any man who expects to imitate the bird. Mr. Moore goes on to say that as soon as we have a sufficiently simple and light motor, the design of the machine is a secondary consideration. This, again, most certainly is not in accordance with actual facts, as everything depends on the design of the machine and nothing else, and, as far as my own experience goes, the motor question has not received a moment's consideration scarcely. I am quite willing to leave that to others. I know there are scores of men both able and willing to provide me with a strong and light engine or motor, therefore I have given my whole attention, lasting upwards of 30 years, to the one thing needful—getting at the secret of aërial flight, how to form the mechanism that is required to act on the air as the birds' wings act; in short, to imitate the bird. And it is through this fact that I am enabled to state, without fear of contradiction, that whenever the flying-machine appears, it will be founded upon the same general principles as my own design is founded upon, because it is founded upon the true principles that Nature shows us must be adopted if we are to fly and carry weight through the air with power, and, above all, with safety.

Thomas George Challis.

STATICAL MACHINES FOR X-RAY WORK.

[43087.]—ON p. 341 your correspondent "M." (let. 43064) refers to the time required to obtain a negative taken through a thick part of the body.

It may be well for your readers to know that I have seen photographs with good detail taken in a few seconds, and others in a few minutes, depending upon the age, &c., of the individual. This last week a well-known doctor at the West End took a splendid photograph through the body of an adult in 4½ minutes.

Users of static machines must, however, remember that there are bad and good influence machines, just as there are bad and good in all things. Some, for instance, are self-exciting, need no drying compounds within their cases, and may be kept in any ordinary living-room atmosphere, the direction of flow of their current never changes, &c. Then we find others which require to be kept in a very dry room, to have dishes of chloride of calcium within their cases, to have a separate instrument to excite them, and even with all this the direction of the flow of the current is never certain.

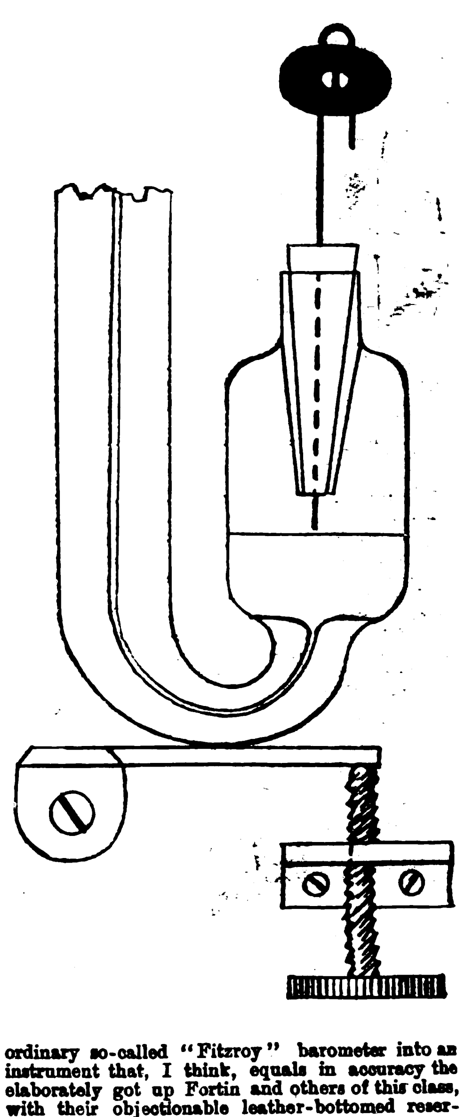
Throughout my experience I have seen no other type than the Wimshurst used for X-ray work; it seems to be *par excellence*, and before long it probably will be the only instrument used for the purpose of X-ray work, for with them the exposure is shorter; there is no troublesome battery or noisy coil, and they run from year end to year end without a penny cost.

Intending users, therefore, should be careful to know that their selection is of the right type, or the investment may lead only to regret.

J. W.

CONVERTING FITZROY BAROMETER.

[43088.]—I SEND you a drawing of a simple method I adopted some years ago of converting the



ordinary so-called "Fitzroy" barometer into an instrument that, I think, equals in accuracy the elaborately got up Fortin and others of this class, with their objectionable leather-bottomed reservoirs, &c. All that is required is to relieve on one side the brass bands that fix the tube upright so as to allow it to move freely up and down by means of the screw working against the plate on which, you will see, the barometer tube rests. The surface of the mercury in the bulb can be readily brought into contact with the point of the wire before the reading is taken as usual. The small paper funnel through which the index wire (steel, iron, or platinum) passes answers the double purpose of guiding the wire, and also effectually preventing any loss of mercury when at any time the barometer is carried from one place to another by a careless person. It may be carried in any position without injury. This funnel is made of paper rolled into shape with gum or glue, and when dry the point is snipped off, so as to allow the wire to pass through freely. It fits

tightly any size or shape of mouth of bulb. From the point of the fixed wire to the scale at the top, of course, measures 27, 28, &c., inches.

Aberdeen. **Alex. Reith, M.D.**

MEAN-TIME DIAL.

[43089.]—If "A. S. L." (letter 43063) will kindly look up back number, 9th (?) Sept., 1887, he will find the simplest method of making a mean-time sundial. G. D.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96864.]—**Knocking in Gas-Engine.**—A gas-engine, if properly constructed—i.e., the small end fitted in the piston a knuckle-joint, it did not ought to play pranks in a lifetime. Take it out, and get a piece of pen steel. Punch or drill a series of small holes in it, and bend it around the pin for a bush. Now, having made that a nice snug fit, lap your joint out that you make a good fit, cut off bush a little bit shorter than width of joint, and put back in its place. But if it is not fitted properly with a good joint, it will kick again.

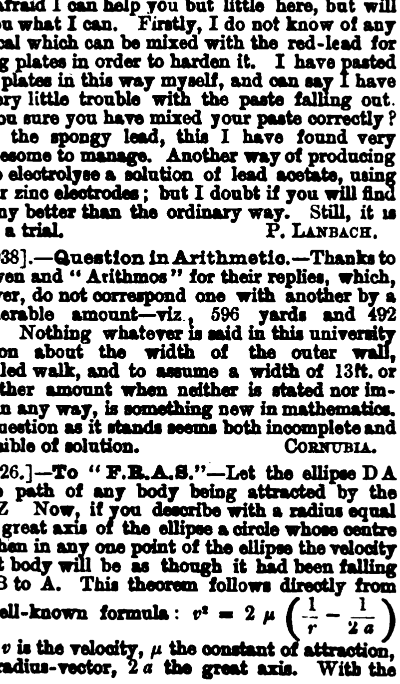
JACK OF ALL TRADES.

[96884.]—**Zincos.**—There are several works on the method of producing "zincos," which have really nothing to do with "printers," except that they are supposed to produce a "work of art" from them. They are simply etched plates of zinc. The drawing is transferred to, or is photographed on, the zinc, and then the parts that are not wanted are eaten away by acid (hydrochloric). The query has been answered many times, and any bookseller can supply a work on the subject, for there are several. Try Dawbarn and Ward, Farringdon-avenue, E.C. PROCESS.

[96912.]—**Pasting Accumulator Plates.**—I am afraid I can help you but little here, but will tell you what I can. Firstly, I do not know of any chemical which can be mixed with the red-lead for pasting plates in order to harden it. I have pasted many plates in this way myself, and can say I have had very little trouble with the paste falling out. Are you sure you have mixed your paste correctly? As to the spongy lead, this I have found very troublesome to manage. Another way of producing it is to electrolyse a solution of lead acetate, using lead or zinc electrodes; but I doubt if you will find this any better than the ordinary way. Still, it is worth a trial. P. LANBACH.

[96938.]—**Question in Arithmetic.**—Thanks to D. Owen and "Arithmos" for their replies, which, however, do not correspond one with another by a considerable amount—viz., 596 yards and 492 yards. Nothing whatever is said in this university question about the width of the outer wall, gravelled walk, and to assume a width of 13ft. or any other amount when neither is stated nor implied in any way, is something new in mathematics. The question as it stands seems both incomplete and impossible of solution. CORNUBIA.

[97026.]—**To "F.R.A.S."**—Let the ellipse D A be the path of any body being attracted by the point Z Now, if you describe with a radius equal to the great axis of the ellipse a circle whose centre is Z, then in any one point of the ellipse the velocity of that body will be as though it had been falling from B to A. This theorem follows directly from the well-known formula: $v^2 = 2\mu\left(\frac{1}{r} - \frac{1}{2a}\right)$ where v is the velocity, μ the constant of attraction, r the radius-vector, $2a$ the great axis. With the



parabola we have $2a = \infty$, and the velocity in the point A essentially corresponding to that which the body would come to while falling from an infinite distance, which velocity notoriously will not be infinitely great. If the body be to describe a hyperbola, its velocity at any distance from Z must be greater than if it be moving in a parabola. It must needs have been put into motion with some certain velocity. From our theorem at once follows that known thesis—viz., that the species of the conic section and the size of the axis $2a$ depends only on the quantity of velocity, and not on its direction.—DR H. W. SCHROEDER VAN DER KOLK, Mastricht, 1863, June 8."—Such is the translation of a theorem in *Astronomische Nachrichten* No. 1426. And now, gentlemen, "F.R A.S." and "Second Differential," up, up! Learn to read German!

Potsdam, Nov. 21. PROF. DR. E. LAMP.

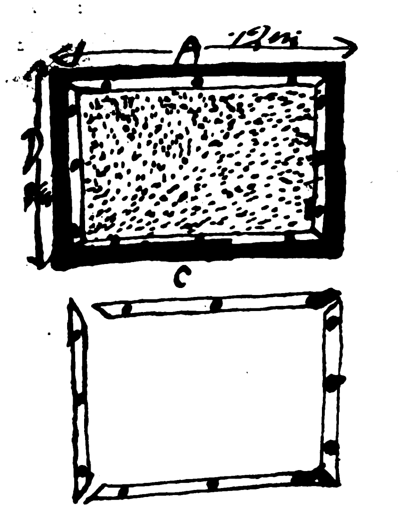
[97019.]—**To Mr. Bottone.**—Thanks for reply in query; but I would have preferred a Gramme or drum armature. Can neither of these be made as small as I require also?—as I can obtain 6 volts 2 ampères from an H armature 1¼in. long and 1in. in. diameter. I do not understand why to produce the same result from a three-legged armature it should have to be 2in. by 2in., wound with about thirty yards No. 22 B.W.G., for the efficiency of this latter seems very small; speed to be 300 revs.

F. C. CHASE.

[97034.]—**Trellis.**—The question of wind pressures on surfaces is still involved in obscurity to a very great extent. The Forth Bridge experiments showed that on a large continuous surface the pressure per square foot is always less than on small surfaces, which would point to the creation of eddies as being responsible for a part of the recorded pressures. The pull due to eddies would be proportional to the perimeter of the plane exposed, and would be smaller in proportion on large planes than small. Mr. Wenham's contribution some time since (not as a letter) on the effect of ribbing the under side of a plane surface seems to point in the same way. Probably, assuming equal areas exposed to same wind, there would be more pressure on the trellis than on the plane surface. Of course, above means solid surface, and not space occupied. THE BOGEY MAN.

[97046.]—**Steam Exhaust.**—The simplest method of condensing the exhaust steam from an engine is to inject it into the lower open end of a standpipe of large diameter. During the ascent of the steam it becomes mixed with a large body of cold air, and is effectually condensed and falls in a continual shower. The water is collected in a receptacle and returned to feed the boiler, which is thus kept free from incrustation. I have adapted this arrangement to several steam-engines, both portable and fixed. The air-pipe or flue should be of large diameter—not under 4in.; in fact, the larger the better. It may consist of cast-iron or stoneware pipes jointed with Portland cement. My first experiment was in use for several years, and consisted of nothing more than a square wooden shoot carried to the top of the building. This arrangement never caused the least trouble, and the updraught being low, no particles of water were projected from the top, from which no steam was visible. F. H. WENHAM.

[97047.]—**X Ray.**—Proceed as follows: Make a frame 12in. by 8in., as per sketch, with wooden



cleats ⅜in. broad, ⅜in. thick. The cleats should be sawn out from each piece of wood B (A, B, C, D), so that when the cleats, after having been sawn out, are placed into their former positions, they being flush with the surface of the wood from which they were sawn out. Having made the frame, a piece of good Bristol board should now be procured from the stationer's. This should be thick enough as to be absolutely opaque to ordinary light. Test this by holding up in strong sunlight with hand behind. This should be cut to right dimensions so to fit into frame. "Novice" should now procure from the chemist a highly fluorescent salt, called barium platinum cyanide, or, if "Novice's" pockets are not very full, he can procure an excellent salt called calcium tungstate. This can be got for about 2s. per ounce. He now takes his Bristol board, and pins the four corners to a drawing-board. Three or four drops of good gum-water should now be poured over the Bristol board, and, with a fine camel's-hair brush, spread the gum equally all over the surface of the cardboard. Any excess of gum-water should be immediately swept off by means of a good boxwood ruler pressed evenly on the board, and drawn from one edge to the other. Some of the calcium tungstate should be immediately sifted all over the gummed surface, taking care to spread equally, so as to leave no patches. The drawing-board should now be reared upon a clean piece of paper, and tapped with the hand. The non-adherent calcium tungstate can then be collected for another screen, if required. When dry, the screen can be placed into frame-cleats placed on top and fixed into position by means of bright round-headed nails, ½in. long, at each corner, and one in the middle. The sieve for sifting the tungstate of calcium can be made out of an ordinary tin with the bottom knocked out, and a piece of very fine muslin spread over the bottom, and tied securely around the tin with a piece of broad tape.

T. B. G.

[97049.]—**Ohm's Law and Decrease of Voltage.**—I fear none of your correspondents have given Mr. Brown much help by their answers. It is with the greatest hesitancy that I attempt to help him, the subject being closely allied to a definition of electrical potential, and I shall never forget the words with which the late Prof. Clerk-Maxwell once commenced his lecture on this subject. He said: "I shall to-day try and explain to you what is meant by electrical potential. I doubt if I shall succeed, because I believe that there are only three men who ever thoroughly understood what it means—I allude to Faraday, Thomson, and —and another." Neatly put, was it not? Before trying to answer Mr. Brown's query, I should like to point out that Ohm's law is too often stated as follows:—"The current is equal to the E.M.F. divided by the resistance." This, however, is not the law as Ohm's stated it. It is, so to speak, the Act of Parliament without the preamble. The whole law is as follows:—"When proper units are chosen for expressing the current C, the resistance R, and the E M.F. E, then the current is equal to the E M.F. divided by the resistance." This law is usually stated in the form $C = \frac{E}{R}$, and since this is an algebraic equation, it is equally true that $E = CR$ and $R = \frac{E}{C}$. The law is undoubtedly true, and not only is it true for the whole circuit, but it is true for any portion of the circuit considered separately, and I think that it is the overlooking of this fact which causes the first difficulty in understanding the law. The next difficulty arises from the false conception that the E.M.F. remains constant throughout the external circuit. It does nothing of the kind: it falls gradually between all parts of such external circuit in the direct ratio which the resistance of such part bears to the whole resistance of the circuit. Let us examine the two terms of our equation which we are capable of understanding—viz., C and R—and we shall find that the third term E, which we are incapable of understanding, is a variable term. First, as to C, without reference to Ohm's law, very little reflection will show that the current passing through the circuit must be the same at all points of the circuit; otherwise, as "Quivis" puts it, there would be a heaping up of the current somewhere. C is, therefore, constant throughout the circuit. Second, as to R, the resistance of the whole circuit must be the aggregate of the resistances of the various parts—suppose we consider the flow of the current in a portion of the circuit whose resistance is r_1 (obviously a fraction of the total resistance R), and let us call the remaining resistance of the circuit r_2. Then, since Ohm's law is true for any portion of the circuit considered separately, the relation of the current in the portion of the circuit whose resistance is r_1 may be expressed by the formula $C_1 = \frac{e_1}{r_1}$ and for the portion whose resistance is r_2 by $c_2 = \frac{e_2}{r_2}$. But since the current is constant throughout the circuit, C, c_1, and c_2 are all equal, and therefore $\frac{E}{R} = \frac{e_1}{r_1} = \frac{e_2}{r_2}$. Whence we see that, since r_1 and r_2 are only fractions of R, e_1 and e_2 must be only fractions of E, and also that the E.M.F. in the portion of a circuit whose resistance is r_1 (or, more properly, the fall of potential along that portion of the circuit whose resistance is r_1) bears the same proportion (or ratio) to the whole E.M.F. of the circuit as the resistance in such portion bears to the whole resistance of the circuit.

H. LATTEY.

[97053.]—**Carbon Paper.**—Lay the paper on a hot plate and rub with the following:—Mix 5oz. lard, 1oz. beeswax, ½oz. Canada balsam. Melt

together, then stir in lampblack till as thick as good crut; mix well while hot, and run into mould till cool. CARBON.

[97055.]—**Californian Grape Growing.**—Think statistics are few and far between. If you cared to ask Methuen and Co., Essex-street, W.C., or Stanford and Co., Cockspur-street, S.W., both London; they are very general publishers; they may have something on their list. "Tropical Agriculture," by P. L. Simmonds, of Spon, London, W.C., 1887, has about a page *re* California. Gives the produce of one acre at 12,000lb. of grapes, worth 5 cents per pound—Mission, white Muscat, Tokay Blassein rose, Peruvian, and black Morocco kinds. The yield, 1872, was 4,000,000gal., in 1873 was 3,800,000gal., besides 176,000gal. of brandy. In 1874 was 7,000,000gal., besides quantity required for distillation of 200,000gal. of brandy, or about 1,000,000gal. of must. In 1875 was 8,000,000gal. Mr. R. Chalmers, of Coloma, has planted on 110 acres 110,000 bearing vines, over 40 varieties of grape. He makes six to ten tons of raisins yearly. It takes 3 tons of grapes to make 1 ton of raisins. Raisin crop estimated for 1876 at 60,000 packages. White Muscat take the lead; sell at 10 cents a pound; Malagas worth 8 cents, &c. "Irrigation," by H. Stavant (O. Judd and Co., New York, 1892), mentions of an experienced vineyardist of Avignon as submitting his vines in winter mild and free from severe frosts to a lengthened irrigation of 30 days, during which a depth of 4in. of water was constantly maintained; in vineyard operation found to considerably diminish the injurious effects of the phylloxera and to greatly improve condition of vines. In Southern California vineyards are copiously irrigated four times only—at starting of first growth, at blossoming, at setting of fruit, and when fruit begins to colour. REGENT'S PARK.

[97060.]—**Alpha Orionis.**—Betelgeuse is certainly variable to the extent of about half a magnitude. I have frequently seen it about equal to Aldebaran; but it is at present, as "G. J." says, distinctly brighter than that star. It is given as variable from 1 to 1·4 in Chandler's Third Catalogue of Variable Stars; but to me the variation is more like 0·5 to 1·0. It has no regular period. J. E. GORE.

[97064.]—**Mitre Blocks.**—Perhaps Stanley's little combination "odd jobs" tool would meet querist's requirements if a mitre box is too expensive. J. D.

[97084.]—**Imitation Gold and Silver Paint.**—Generally made of powdered alloy bronzes, mixed with some kind of spirit varnish. Gold: Platina 7, copper 16, zinc 1. Silver.—German silver: Nickel 20, zinc 20, copper 60, lead 3. Imitation silver: Metallic arsenic 1, copper 9. Or tin ½oz., copper 1lb. Or zinc 1, tin 5, copper 4, lead 1, &c. REGENT'S PARK.

[97089.]—**Pneumatic Covers.**—Hold the inside of the cover in the steam of a boiling kettle till it comes away with a gentle pulling, slowly turning the cover round as it strips. I have stripped several this way, without injuring the canvas. Thoroughly dry canvas before putting new rubber on. REX.

[97095.]—**Photographic Enlarging.**—"H. H. S." will find a full description of a cheap home-made enlarging lantern or box, which was written by myself, and published in the "E. M." of March 24, 1899, p. 135, with diagrams of the same. PHOTO.

[97095.]—**Photographic Enlarging.**—If the enlargements are not of considerable size, the burning of some inches of magnesium ribbon in front of the negative will answer. J. D.

[97095.]—**Photographic Enlarging.**—What you require is a condenser, such as is used in all magic-lanterns. One that will cover most of a ½-plate can be obtained for about 5s. (Spiers and Pond, Benetfink, &c). This is placed close up to the negative, and any light almost, incandescent gas for preference, will serve for illuminating the negative.

Earlsfield, S.W. SILVERPLUME.

[97096.]—**Amyl Acetate.**—Not in water, but is so in alcohol, or spirit, ether, and fusel oil, known as pear essence. Copal soluble in rectified spirits of turpentine and in boiling alcohol; but, as a rule, insoluble in spirit, sparingly soluble in absolute alcohol. REGENT'S PARK.

[97096.]—**Amyl Acetate.**—This is practically insoluble in water. It is very volatile, and boils at 125°. In commerce it is known as "Jargonelle pear essence." It is used for flavouring sweetstuff, and for dissolving different resins; also largely in the preparation of celluloid varnishes, celluloid being freely soluble in amyl acetate.

S. BOTTONE.

[97097.]—**To Sensitise Bromide Paper.**—It will probably save querist both trouble and expense if he invests in one of the photographic manuals which gives the details, for the process is a lengthy one, which requires great care to carry through successfully. He will find a chapter on it in Burton's shilling "Modern Photography," or in special works by Abney and others. He will probably find his output will not compete with the bromide paper purchasable ready made, either in price or quality; but the experience gained will be valuable. J. D.

[97097.]—**To Sensitise Bromide Paper.**—Perhaps the process of converting ordinary P.O.P. into a bromide paper, as given by C. G. Polson in the *Amateur Photographer* of Jan. 27, 1899, may suit the querist. The process may be briefly described thus:—Ordinary P.O.P. is immersed for five or ten minutes in ferric bromide solution, taken out, washed, and dried, all operations being carried out in ruby or yellow light. A good formula for producing a slow bromide paper is as follows:—Ammonium bromide 4 drachms, sulphate of copper 30 grains, water 4oz. This paper can be worked in ordinary gaslight, being a chloro-bromide emulsion. An extremely sensitive bromide paper can be produced by simply immersing the P.O.P. in an ordinary 10 per cent. solution bromide of ammonium for five or ten minutes or more, being more sensitive the longer the bromide bath acts in certain limits. This is the gist of the whole article as contained in the *A.P.*, which I trust will be of service to the querist. IVANHOE.

[97100.]—**Lyddite.**—Picric acid mixed with collodion cotton, dissolved in ether, and formed into cartridges; made in France, called crelinite. Experiments made elsewhere, and found that the best way to detonate molten picric acid was the use of either very strong detonars or primer of dry guncotton. Picric acid was melted at a carefully-regulated temperature in a vessel in oil bath. Used for filling shells, and cast direct from melting-pot into projectiles. After it had cooled, the guncotton primer inserted, called in France as before, and in England lyddite (from the experiments being made at, or near, Lydd, in Kent). REGENT'S PARK.

[97102.]—**Speed Gears.**—I am thinking of putting gear on the market, so regret I cannot oblige you at present with sketch. That a two-speed gear is necessary and of great advantage is shown by results of big race in France last week for cycles without pedals, in which two classes competed, those with extra large and powerful motors, and others with two-speed gears, and all riders with latter were within time limit, and made better average performance, though ridden by inferior men, to higher-powered motors. I advocated use of speed-gears in this paper several times some numbers back, and was glad to see at late shows the matter is at last receiving the attention it deserves. By all means, use magneto-ignition in preference to batteries. Simms's appears to be only one ready for sale. It costs £6, and will outlast the tricycle. Plenty of other makers are experimenting with some form of magnets, but are not ready to supply; it is not a new idea by any means. Perhaps Mr. Bottone will give us definite information as to when his will be ready. MONTY.

[97103.]—**Kitchen Boiler.**—"Kitchen Boiler Connections," D. Williams and Co., New York, gives thus:—Remedy for noisy boilers: In visiting, been much struck by number of cases (owing to improper setting, under-size of water back, &c.) in which boilers rattle and rumble. The number of cases where pipes connecting water-back and boiler are sagged or run so as to form traps is very great, and size of pipes often very small. Wants to know what objection to setting boiler above water-back. In that way there can be easy incline for both pipes. Again, what is gained by making the circulating pipe so small? What harm in using 2in. or 2½in. pipe? It will reduce friction in pipes, and ought to give better results in heating water. Extra cost for larger size of such short length would not be very great, and customers would no doubt gladly pay difference if assured of a better supply of hot water and assist to reduce noise, &c. Then as to crackling in range boiler. The noises probably arise from defective circulation either from deposit in back or trap in pipes between range and boiler. Removal of the impediment or rearrangement of pipes giving freer circulation. If trouble is due to boiling of water, it can be stopped for a time by drawing off some of the hot water and letting boiler fill up with cold. A permanent remedy sometimes effected by placing firebrick in front of water-back and thus reducing area of heating surface. Where there is a strong water pressure, oftentimes on closing water faucet quickly, jar is transmitted to fixtures with such force as to cause trembling and rattling. Also due to the generation of steam where pressure of water to supply boiler is very light, which allows steam to accumulate at top of boiler in water-back and in circulating pipe. Immediately on opening of hot-water faucet, cold water rushes into boiler, steam at top of boiler at once cooled and condensed, leaving vacuum which is filled by rush of cold water, and where water meets result is very similar to bringing a hammer down upon an anvil with same force. Condensation and vacuum may be formed in return pipe from water-back, or in water-back, by steam coming in contact with cold part of pipe or cold water entering water-back, and much more.

REGENT'S PARK.

[97103.]—**Kitchen Boiler.**—If apparatus has been recently fitted, the trouble arises from imperfect arrangement, as the water does not circulate properly. Either of the following defects may be the cause. (1) A dip in either of the pipes; (2) The "flow" pipe projecting into the boiler or not standing high enough up into the tank or cylinder; (3) The cold water supply being connected to the "flow" instead of the return pipe. If the apparatus has previously given satisfaction, the present trouble arises from the pipes becoming stopped with fur, most likely at the boiler.

161, Albion-road, N. A. CLARKE.

[97104.]—**Eight - Plate Wimshurst.**—"K. M. C." will find that 20 sectors, each 4½in. length, ⅝in. broad at one end, and ¼in. broad at the other end, will give the best all-round results. The end of the sectors should be about ½in. from the edge of the plates. The combs should extend to about the inner end of their sectors; their points should be closely spaced. J. W.

[97105.]—**Bran Tea.**—Infuse in hot water, and sweeten to flavour. REGENT'S PARK.

[97106.]—**Induction Coil.**—To MR. BOTTONE.—No alteration would be needed beyond still greater care in the insulation, especially as regards the tube that separates the primary from the secondary, and the change of the gauge of the wire wound on the secondary, from No. 35 to No. 38 silk-covered wire. S. BOTTONE.

[97107.]—**Steam.**—(1) If there were no leakage, the quantity of water would not diminish. (2) Part, or all, of the oxygen of the steam would combine with the red-hot iron, and the hydrogen would remain in place of the original water.

W. J. G. FORMAN.

[97108.]—**Cold Glue.**—Liquid glue: Soft water, 1 quart; best pale glue, 2lb. Dissolve in a covered vessel by the heat of a water bath, cool, and add gradually of nitric acid (sp.gr. 1·335) 7oz. When cold, put into bottles. Very strong, and does not gelatinise. REGENT'S PARK.

[97109.]—**Dynamo.**—The amount of iron in the armature should be such as will conveniently hold the wire required to produce the desired voltage and current at the given speed; and the amount of iron in the F.M.'s and pole-pieces, irrespective of the yoke, should weigh at least seven times that of the armature. S. BOTTONE.

[97109.]—**Dynamo.**—Modern practice dictates that the flux density in the armature core shall not exceed 125,000 lines per square inch. For cast-iron 70,000 lines per square inch only is admissible, and note that in the fields the total flux is composed of the useful flux multiplied by the leakage coefficient for that particular type of machine. The above figures are the highest to which it is advisable to go. Personally, I find it (where weight is not a consideration) preferable to work at a lower flux density, and put more iron into the magnetic circuit, thus reducing enormously the amount of copper required in the magnetising coils. So few people realise that cast-iron is cheaper than copper.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97109.]—**Dynamo.**—A somewhat intricate series of calculations are required relating to the number of magnetic lines required and the reluctance of the complete magnetic circuit. Such books as "Dynamo-Electric Machinery" by J. P. Thomson, or "Dynamo Construction" by Urquhart, will give the required information.

W. J. G. FORMAN.

[97110.]—**Dynamo.**—A drum armature 3½in. long by 1½in. diameter, wound with about ¼lb. No. 20, running in a tunnel of suitable size, as mentioned by you, the field-magnets being shunt-wound with about 2¼lb. No. 22 d.c.c., might reasonably be expected to give 2 to 3 ampères, at about 15 volts pressure, if driven at 2,500 to 2,800 revs. per minute. It would be well under control of a ¼H.P. engine. S. BOTTONE.

[97110.]—**Dynamo.**—Armature wound with 8oz. No. 22, fields with 7lb. No. 20, connected in shunt; speed 2,500 revs. per minute; output 30 volts 3 ampères; ¼H.P. will be ample power to drive it. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97111.]—**Norton's Door Springs.**—Why not use rising (viz., self-closing) butt hinges?

161, Albion-road, N. A. CLARKE.

[97114.]—**Telephone.**—If there were no objections otherwise, a single-line wire could be used, any individual station being called up by the number of times the bell is rung. Such a method would, of course, also allow of any one station communicating with any other, but would admit of no private conversation. If such a method be not admissible, then a separate line-wire must be run to each station, a switch provided at the home station,

and a means of ascertaining which station is ringing up. The cost would be about £16 to £18 for the instruments, exclusive of line-wire and cost of laying, &c. If "E. H. B." cares to write to me, I will let him have diagrams of connections, &c.

Moffat. W. J. G. FORMAN, C.E.

[97115.]—**Dynamo Construction.**—The proposed winding is quite disproportionate to the output and size of machine. To begin with, unless the bare iron of the armature were kept very small, which would be bad, it would be practically impossible to get 250 yards = 35½lb. of No. 11 on it. Besides, you do not want to use No. 11 at all to carry 22 ampères. Such a wire on a ring armature will carry 50 ampères easily. Use about 12lb. No. 14 (about 200 yards) on the armature, and 100lb. No. 18 (50lb. on each limb) for shunt-winding the field-magnets. This will give you a serviceable machine. S. BOTTONE.

[97115.]—**Dynamo Construction.**—This machine, as it stands, should give very good results. But there appears to be an enormous amount of copper on the fields—over 250lb.! With one of my Lahmeyer dynamos I get the same results with but 36lb. of copper in the field windings.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97117.]—**Medical Electricity.**—Better to have no Leyden jars; but, having them, the next thing is to see that they are not connected to the combs, or that their outside coatings are not connected together. And failing these, then keep the terminal balls close together; but this latter system is not safe because they may get shaken asunder. Use guttapercha-covered wire for the leads, and yourself try that the sparks are not too powerful. There is no danger to life, supposing the Leyden jars are not large. J. W.

[97117.] — **Medical Electricity.** — To MR BOTTONE.—If you keep the spark gap balls at a distance of ⅛in. from each other, you need be under no apprehension of giving or taking an injurious shock. No wet strings, &c., are required. If ⅛in. gives too weak a discharge, increase the spark gap till the desired intensity is obtained; and before going any further read carefully Dr. Monell's splendid work on "Electro-therapeutics," and there you will learn how he used an eight pair of 32in. plates machine.

S. BOTTONE.

[97118.]—**Cylinder for Oil-Engine.**— This you appear to want for stationary engine—should say, 4½in. dia. of cylinder by 5in. stroke, run 450 to 500 revs. per min. Do not exceed this speed with flywheels size you mention, as you would be getting near safe limit of circumferential velocity which may be taken at 80ft. per second for cast iron. Don't let engine race, and, to avoid accidents, use a good governor. Your flywheels appear heavier than necessary, as they would weigh about 2cwt. each size you give. Shaft should be 1¾in. diameter at least for this size; but a good deal depended on method of construction, whether bent, built up, or carved out. The new 4H.P. French motor is practically a dead copy of the 1¾ Dion, with all sizes increased proportionately one-quarter size larger, cylinder being 3⅛in. diam. by 4in. stroke; but valves are very large, being about 1⅜in. diam. It has done over 40 miles per hour on the road a few weeks since, and has a curious device for cooling by holes through cylinder, which, I am told, is very effective, though I wait further particulars, as sketches sent to me are not clear, showing holes round bottom of cylinder when piston is at top of stroke. This is new to me, and I want to know where oil goes and dust. Longuemare carburator in general use with these engines. MONTY.

[97120.]—**Electric Light.**—To MR. BOTTONE.—Suppose you use a 10-volt lamp, you will need five chromic-acid cells, double-carbon, single-zinc type, about pint size. These will run the lamp for three hours with one charge. You will find a description of this type of battery, with the arrangement to make it portable, in my book "Electrical-Instrument Making"; or you may arrange to cover the cells (the zinc and carbon being previously lifted out) with a lid faced with indiarubber.

S. BOTTONE.

[97122.]—**Small Motor Winding.**—Rewind the fields with 4lb. of No. 18; or, if there is not room for that, with 1½lb. No. 20, and you will find a vast improvement. A. H. AVERY, A.Inst.E E.

Fulmen Works, Tunbridge Wells.

[97123.] — **Wireless Telegraphy.** — To MR BOTTONE.—Immediately on reception of the wave, the decoherer strikes the tubes and decoheres the filings. This must be so, because the cessation of the wave from the transmitter could not decohere. Hence the dash is really produced by a very rapid succession of small dots, which simulate a continuous dash. S. BOTTONE.

[97124.]—**Medical Coil.**—To MR. BOTTONE.—If you connect a 50-sheet condenser with tinfoils about 3in. by 5in. to the vibrating hammer and platinum contact pillar respectively of the coil, you will, with two bichromate cells, get from ¼in. to ⅜in. spark. The dials do not mark the strength; they simply show how far the sliding brass tube has been pulled out. A gut passes from the tube round a pulley fixed to the same axis as the pointer on the dial. At the other end of the gut is a weight or spring to pull it back again. As the tube is pulled off the core, so the index turns round on the dial; but this indicates no real current, since the index is pulled round just the same, whether the coil be connected to a battery or not. S. BOTTONE.

[97126.]—**Problem.**—From the given equation, we have—

$$x^{\frac14} = (x+1)^{\frac14} - (x-1)^{\frac14}.$$

Squaring both sides—

$$x^{\frac12} = (x+1)^{\frac12} + (x-1)^{\frac12} - 2(x^2-1)^{\frac14}$$

or— $$x^{\frac12} + 2(x^2-1)^{\frac14} = (x+1)^{\frac12} + (x-1)^{\frac12}.$$

Squaring both sides again—

$$x+4(x^2-1)^{\frac12}+4x^{\frac12}(x^2-1)^{\frac14} = x+1+x-1+2(x^2-1)^{\frac12}$$

or— $$4(x^2-1)^{\frac12}+4x^{\frac12}(x^2-1)^{\frac14}=x+2(x^2-1)^{\frac12}$$

or— $$2(x^2-1)^{\frac12}+4x^{\frac12}(x^2-1)^{\frac14}=x.$$

$$\therefore (x^2-1)^{\frac12}+2x^{\frac12}(x^2-1)^{\frac14}=\frac{x}{2}$$

Completing the square on the left-hand side of this quadratic, we have—

$$(x^2-1)^{\frac12}+2x^{\frac12}(x^2-1)^{\frac14}+x=\frac{x}{2}+x=\frac{3x}{2}$$

$$\therefore (x^2-1)^{\frac14}+x^{\frac12}=\pm x^{\frac12}\sqrt{\tfrac32}$$

or— $$(x^2-1)^{\frac14}=\pm x^{\frac12}(\sqrt{\tfrac32}\mp 1)$$

$$\therefore (x^2-1)^{\frac12}=(x^{\frac12})=x(\sqrt{\tfrac32}\mp 1)$$

and— $$x^2-1=x^2(\tfrac32+1\mp 2\sqrt{\tfrac32})^2$$

$$x^2-1=x^2(\tfrac52\mp 2\sqrt{\tfrac32})^2$$

or— $$x^2-1=x^2(\tfrac{25}{4}+\tfrac{12}{2}\mp 10\sqrt{\tfrac32})$$

$$x^2-1=x^2(\tfrac{49}{4}\mp 10\sqrt{\tfrac32})$$

$$\therefore x^2(1-\tfrac{49}{4}\pm 10\sqrt{\tfrac32})=1$$

or— $$x^2\left(\frac{\pm 40\sqrt{\tfrac32}-45}{4}\right)=1$$

$$\therefore x^2=\frac{4}{\pm(40\sqrt{\tfrac32}\mp 45)}$$

$$x^2=\frac{4}{\pm(\sqrt{2,400}\mp 45)}=\frac{4}{\pm(\sqrt{400\times 6}\mp 45)}$$

$$\therefore x=\pm\frac{2}{\sqrt{20\sqrt{6}\mp 45}}$$

J. E. GORE.

[97126.]—**Problem.**—Prof. Chrystal's result appears to me to be quite accurate, for if—

$$x^{\frac14}+(x-1)^{\frac14}=(x+1)^{\frac14}$$

$$\div x^{\frac14}\quad 1+\left(1-\frac1x\right)^{\frac14}=\left(1+\frac1x\right)^{\frac14}$$

Put— $1-\dfrac1x=y^4$ And, therefore, $x=\dfrac{1}{1-y^4}$

Then— $$1+y=(2-y^4)^{\frac14}$$

Raise to fourth power.

$$\therefore y^4+2y^3+3y^2+2y-\tfrac12=0.$$

Put— $y=z-\frac12$ Then— $z^4+\frac32z^2-\frac{15}{16}=0$

And— $$\therefore z^2=\tfrac14(-3\pm 2\sqrt6)$$

And— $$z=\pm\tfrac12(-3\pm 2\sqrt6)^{\frac12}$$

$$\therefore y=-\tfrac12[1\mp\sqrt{(-3\pm 2\sqrt6)}]$$

$$\therefore x=\frac{1}{1-y^4}=\frac{2}{\mp(1\mp\sqrt6)(-3\pm 2\sqrt6)^{\frac12}}$$

$$=\frac{2}{\sqrt{[(-3\pm 2\sqrt6)(7\mp 2\sqrt6)]}}$$

$$=\pm\frac{2}{\sqrt{20\sqrt6-45}};\ \pm\frac{2\sqrt{-1}}{\sqrt{20\sqrt6+45}}$$

West Norwood. HENRY T. BURGESS.

[97127.]—**To Electricians.**—Though an accumulator would work with ordinary commercial sulphuric acid or oil of vitriol, it is advisable to use pure sulphuric acid (free from arsenic and other impurities), as otherwise the impurities will ultimately ruin the accumulators. It is false economy to use the cheaper acid. P. LANDACH.

[97127.]—**To Electricians.**—The acid used in accumulators is known as "brimstone sulphuric acid," and is quite distinct from either the pure acid or the commercial.

A. H. AVERY, A.Inst.E.E.

[97127.]—**To Electricians.**—The oil of vitriol used for accumulators is ordinary commercial—not pure. But you must specify brimstone oil of vitriol—not from pyrites, as this latter contains arsenic, &c., which is detrimental to accumulators.

S. BOTTONE.

[97128.]—**Rate of Interest.**—Presuming that the interest is payable half-yearly, the £1 10s. represents 4½ months' accrued interest, which will be repaid out of the first dividend of £2 receivable in 1½ month time. There will then remain £6 10s. of premium to be repaid in ten years, which, if spread equally over the ten years = 13s. per annum. The interest received, therefore, on £106 10s. will be £4 less 13s. = £3 7s., being at the rate of 3·15 per cent. But this is not quite a fair way of paying off the premium, and the problem is to find what rate per cent. will provide a sinking fund to pay off the £6 10s. gradually in ten years. This is a difficult problem to solve mathematically; but in the present case the rate is 3·23 per cent., as will be seen from the following table:—

Year.	Total Amount at Commencement of Year.	Annual Dividend.	Amount Required for Interest at 3·23 per cent.	Sinking Fund for Repayment of Premium.	Amount of Premium Remaining at End of the Year.
1	£106·50	£4	£3·44	£0·56	£5·94
2	105·94	4	3·42	·58	5·36
3	105·36	4	3·40	·60	4·76
4	104·76	4	3·38	·62	4·14
5	104·14	4	3·36	·64	3 50
6	103·50	4	3·34	·66	2 84
7	102·84	4	3 32	·68	2·16
8	102·16	4	3·30	·70	1·46
9	101·46	4	3·28	·72	0·74
10	100·74	4	3·26	·74	0 00

OMEGA.

[97128.]—**Rate of Interest.**—I think "Chercheur" will find the following method simple and accurate, though not scientific. As the price is 108, and £1 10s. of dividend has accrued, the true price paid is 106½. The return at this is $\frac{400}{106\frac12}$ = £3·75587 nearly. Then calculate the annuity, which in ten years will amount to £6 10s., and subtract it from the above. Of course, the rate of compound interest can be assumed—say at 3½ per cent, or at any other rate preferred, provided it is reasonably near the rate of interest on the stock. A. O. S.

[97128.]—**Rate of Interest.**—The actual cost of the security (after deduction of accrued interest) is £106 10s. Thirteen shillings per annum sinking fund must be put away to make up the £6 10s. premium in ten years. So the amount available as interest is £3 7s., which is, as nearly as possible, £3 2s. 11d. per cent. R. B.

[97129.]—**Wheeled Carriages.** — If, as you state, three-wheeled carriages are more stable than four, then a one-legged man should be better off than one with two. But it seems against common-sense and ordinary reasoning to expect such to be the case. The much-advertised three-wheeled American vehicle collapsed a few weeks back, through single front wheel not being so good as four, and being also carried in weak form of cycle-fork. Railway authorities say engines with high centre of gravity run much better than ones with it low, for which you can consult Mr. Stretton, who is an expert on such matters. For road purposes conditions are vastly different. Certainly, the longer wheel-base is productive of a steadier running vehicle, as it reduces vibration. The smaller wheels are more a matter of convenience, and are cheaper to make as regards tyres, &c. Rear-steering is objectionable, and renders carriage very unstable.

MONTY.

[97130.]—**Drawing Wire.**—According to Bucknall Smith on wire, the Hadfields of Sheffield have introduced carbon steel, containing 7 to 20 per cent. of manganese, giving tough, hard non-magnetic metal. REGENT'S PARK.

UNANSWERED QUERIES.

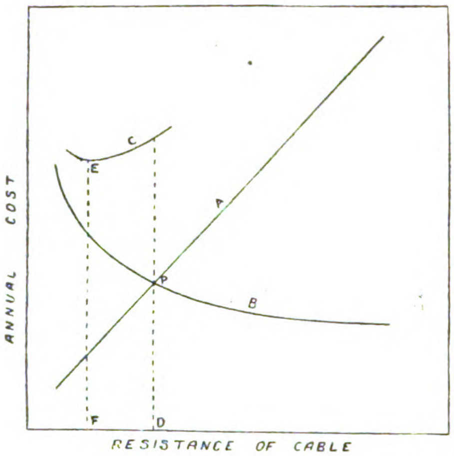
The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

QUERIES.

[97131.]—**Metal Polish.**—Will some reader kindly inform me how to make metal polish for cleaning brass and silver-plated instruments?—A CONSTANT READER, Oldham.

[97132.]—**Dry Inhaler.**—I should be glad if one of "ours" could tell me how to replenish a menthol dry inhaler which has become exhausted, as it is very useful in helping to cure a cold? In the one I bought, a piece of blotting-paper was impregnated with menthol, which was contained in a glass tube, supported by springs in a metal case. If the menthol is to be dissolved, kindly state by what means.—SUTTON.

[97133.]—**Kelvin's Rule for Size of Feeders.**—"The size of the feeders must be such that the interest for one year on money lying idle in their cost and laying, together with depreciation, must be equal to the value of the energy wasted in them during one year." (Joyce's examples in *Electrical Engineering*.) In the diagram A is the "curve" of cost per annum of energy wasted in cables of different resistances. B is the curve of interest on cost of cable as laid. According to above



rule, the point P of intersection of these curves will give D, the most economical resistance of cable; but the total cost per annum of the feeder will be: interest, &c. + cost of waste energy—that is, the sum of the ordinates of A and B. The curve C is the sum of A and B, and the lowest point E on C should give the most economical resistance F—a much smaller resistance than D. What is the explanation of this?—ERG.

[97134.]—**Vox Humana.**—Please describe the method of making a vox humana, and fitting same into an American organ, containing four sets of reeds as follows:—Diapason, double diapason, celeste, and melodia.—C. J. PLATER.

[97135.]—**Expansion Rate of Metals.**—Please inform me, *re* the above, the expansion of aluminium compared to wrought or rolled iron, in length, for a given rise in temperature. I cannot find a table in my books with the information desired. Any hints respecting the first-named metal will be thankfully received?—G. W. GRANGER.

[97136.]—**Multiple-Plate Wimshurst.**—I am about making a Wimshurst, chiefly for X-ray work, and I would feel greatly obliged if Mr. Wimshurst would kindly advise as to the following points—viz.: (1) Would a machine made with eight 36in. glass plates be much better than one made with twelve 28in. glass plates? Which machine would he recommend? (2) What should be the thickness of glass for (*a*) 36in. plates, and (*b*) for 28in. plates? (3) What sort of condensers would he recommend? (4) What distance should front and back plates be from the trunnions?—T. M. C.

[97137.]—**Grammaphone.**—Would Mr. Bennett be so good as to state number of teeth in the various pinions and wheels of motor of grammaphone so fully described by him in the last volume?—T. M. C.

[97138.]—**Polishing Specula.**—I have spent very many hours trying to polish an 8in. specula with a paper polisher on glass tool, but cannot get a good polish. The surface seems granular under magnifying glass, and does not seem to progress beyond a certain stage. In polishing metal, glass, &c., a rapid motion of the polisher, instead of the slow movement, seems necessary. Any hints from workers will oblige. Is pitch and rouge quicker and better than paper and putty-powder?—ASTOR.

[97139.]—**Rearing and Keeping Goats.**—Can any of "ours" give reliable information as to above (for milking), such as best breeds, and when to breed to obtain strong kids, best kinds of food, when goats have to be kept penned in, and list of foods that are not suitable or poisonous, age at which milking should begin, how to tell age, &c.? I am living in a country village, and would be glad to hear of any book (cheap) on above subject, with names of publishers (if Editor will not object), as any such information in this neighbourhood is extremely difficult to obtain. I have been told there is a Goat Society which will supply responsible cottagers with goats, but cannot obtain name or address, or whether they publish any work on the subject or not.—HENRY SALTER, Wroughton, Wilts.

[97140.]—**Dynamo.**—I have a horizontal engine of 1/8N.H.P. working at 40lb. steam pressure. Could any reader advise me as to what pattern and size dynamo could be satisfactorily run by it? Any hits most acceptable.—DYNAMO.

[97141.]—**Glass Blowing.**—I have tried often to join bits of barometer tubes, and have cooled the joints in cotton wool slowly, but almost invariably they have broken or snapped across at the joining, sometimes even before they have been removed from the wool. Perhaps some of your practical readers would kindly lend a helping hand. I have "Shenston." Is there any better work on the subject?—A. R.

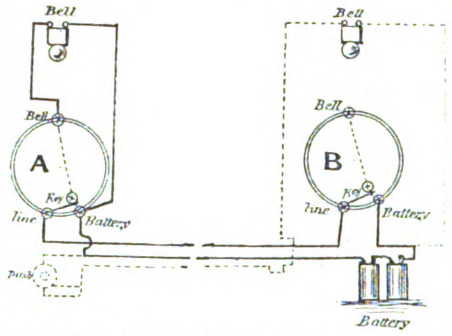
[97142.]—**Telescope.**—(1) Can anyone suggest a crucial test as to whether the lenses in my home-made 2in. simple telescope are correctly mounted—that is to say, whether they are square with axis of tube, and whether their centres are in a straight line? (2) Can anyone suggest a method of erecting an inexpensive home-made stand for above? The length of telescope is 48in.—ALGOL.

[97143.]—**Induction Coil.**—Will Mr. Bottone kindly tell me the lengths of No. 42 s.c. platinoid wire for a switch with 16 contacts to act as a resistance in primary circuit of shocking coil? The coil to give a very weak shock on first contact, and full power on last. Size of coil:—Core, 5/16 diam., 4in. long; primary, No. 22 d.c.c., 4 layers, 57 turns each layer; ¾in. total diam. of primary; secondary, 3½oz. No. 36 s.s.c., wound on cardoard bobbin to slip over primary. I presume the contact-breaker would have to be very delicate to work with one bichromate cell. A water resistance does not work in secondary circuit. Will he also say if it is possible to make a coil with No. 42 d.s.c. wire, if well insulated? Also, what is cause of water resistance not acting when put in circuit with secondary of a coil to act as shock regulator?—J. B. BANK.

[97144.]—**Acetylene Cycle Lamp.**—I find a great trouble to keep the water-valve of this lamp tight. Although screwed down, the water still leaks through. Could any of your readers tell me how to remedy this? The valve-rod goes down through the water chamber, and the seat is at the bottom.—C. A. P.

[97145.]—**Ampmeter.**—Could any reader tell me how to make a simple ampmeter for a 10-volt 4-amp. dynamo?—PERPLEXED.

[97146.]—**Stanley Telephones.**—If Stanley telephones are similarly joined up, I get a continuous current on the bell circuit. So to avoid this I am running a third wire (which is shown by dots on the drawing) with a push at A end to operate the call-bell at B end. Am I right in



so doing? The line and bell terminals are joined when the receiver rest in the grooves provided for it on the transmitter.—PERPLEXED.

[97147.]—**Britain v. United States.**—Can Mr. Editor or any reader of the "E.M." tell me which country, Great Britain or United States, owns the most people worth 1,000,000dol., or, say, £250,000?—A READER.

[97148.]—**Isle of Man Steamers.**—Can any of "ours" supply me with particulars of the paddle-steamer *Ben-my-Chree* — particularly date she was built?—J. M. S. P.

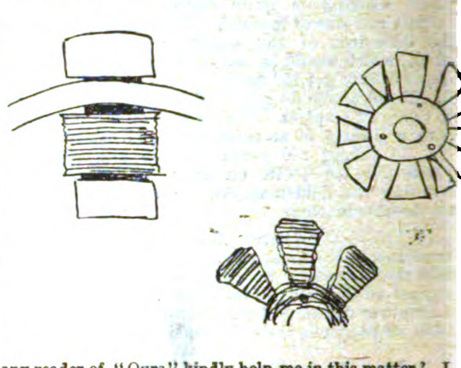
[97149.]—**Manchester Dynamo.**—To MR. BOTTONE.—I have made a Manchester dynamo, supposed to be 55 volts 8 ampères, from instruction in Vol. LXIV., commencing at No. 1659, but cannot get machine to excite when the fields are connected in series. I have connected the fields in parallel, but only get enough to light two 16-candle 30-volt lamps. Having 60 yards of active wire on armature, I ought to get 60 volts. The armature is a laminated drum, with 36 pins to divide coils, and wound with 18 coils four wires deep, making 30 conductors in each coil, making 540 conductors altogether = 60 yards active wire; armature core 4in. long, 4⅜in. diameter (finished 5⅛in.); armature wound with 5lb. No. 17 S.W.G. The field-magnet cores are 5½in. long, 2⅝in. diameter, wound with 11lb. No. 20 5½in. on each core; the cores are ordinary bar-iron. The pole-pieces are of soft cast-iron, 15in. long, 4in. wide, 2in. thick; tunnel bored out to 5¼in.; fields connected shunt, comutator 18 parts, speed 1,800. Any information will greatly oblige.—TRY AGAIN.

[97150.]—**Wireless Telephony.**—Can Mr. Bottone or some other electrician oblige with information about this subject over and above wireless telegraphy, which is understood? The distance that it is wished to use the telephones over is only seventy yards.—TELEPHONES, Birmingham.

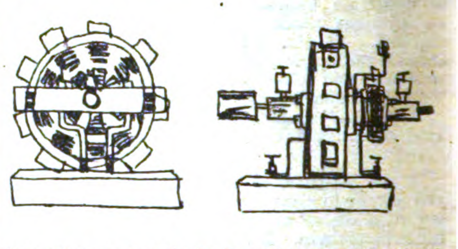
[97151.]—**Oil Engines, &c.**—Could any of our readers oblige me with the following? (1) What size and kind of foundation is required for a ¾B.H.P. oil-engine? (2) Would a piece of York stone 2ft. 3in. by 18ft. 6in. be suitable for a 50-volt 4-amp. dynamo-bed? (3) Having a 1in. leather belt, is that strong enough to drive dynamo? If not, what size should I require?—PERPLEXED.

[97152.]—**Coherer.**—I am about to construct a couple of coherers, using glass tube about ⅛in. bore. Should the terminal wires fit the tube so that the filings are only in the small space between the ends? What should this space be? I purpose using nickel filings and German silver terminal wires. Will this be correct? I purpose using a 6in. spark-coil. Should the contact-breaker be removed, and a key or switch substituted? Can I purchase a book with fairly full particulars? Distance required to signal about one mile.—COHERER.

[97153.]—**Building an Alternator.**—In the October 1st, 1897, number of the ENGLISH MECHANIC appeared an article on building a small alternator. I have started to build one on something the same principle, only a large one, for lighting purposes. I want the machine to give a high-tension current single-phase for supplying transformers in parallel at some distance, the current being carried on overhead bare conductors. I should excite field-magnets off 100-volt mains. Would



any reader of "Ours" kindly help me in this matter? I am in charge of a private continuous-current electric-light plant, and I wish to build this machine in my spare time, only, of course, it must be cheap, or I cannot do it. The parts I have already got are: one soft iron ring, 4in. wide ⅜in. thick, internal diameter 20in.; nine soft iron bolts 7in. from face of head to end of screw, head and nut 2⅝in. by 2in.; one soft iron bolt same dimensions, only 1in. longer, to go through bed-plate; twenty brass discs to form field-winding bobbins to slip over bolts; four steel bolts 11in. long, to bolt frames to ring; two brass rods, 2in. diam. 5in. long, ⅜in. hole for bearings, to be brazed on to frames; one brass rod 2in. diam. 3in. long for armature hub, also bored with ⅞in. hole for shaft; two oil-cups; one steel shaft ⅞in. diameter; four brass plates for side frames, 24in. long 4in. wide by ⅛in. thick; two iron washers for holding armature plates together. I give sketch of arrangement. In the first



place, what more parts do I want to complete the job beside thin iron plates to make armature, laminated with paper? What wire should I use for poles and armature, and how many turns, &c., and what voltage is best—say 1,000—how would that do? Of course, I want the output to be as big as possible. What resistance should I insert between 100-volt mains and pole winding? I should be glad of any information enabling me to do this job, as I don't know much about the theoretical part and the calculations; simple explanation would be most acceptable. It must be high-tension, as the current will have to go some way to its work. Please say what is about right, taking into consideration expense of insulation on armature windings.—LIGHTNING.

[97154.]—**Bone Bearings.**—Will "Jack of All Trades" kindly answer the following with regard to his letter on bone bearings? (1) Do you run bone bearings without oil, or do you feed them with oil as in ordinary bearings? (2) What animal supplies the best bones for bearings—boiled, or baked, or raw? (3) How do bone bearings act in damp places, as for turbine bearings, &c., and what effect has water on them? (4) Up to what pressure per square inch is it advisable to run bearings? (5) Would they do for spindles running at 4,000 to 5,000 revolutions per minute? (6) How do they run when in a high temperature, as per gas-engine? (7) Are they suitable for oil-engines of about ½ to ¼ B.H.P. for connecting-rod, main bearings, &c.? Also small steam-engines, launches? I notice you say they are "everlasting and clean." What is the cause of them being everlasting, that most desirable quality? I suppose bone bearings being porous, its surface gets worn down, filling up the pores, and also rubs some off the revolving shaft, thus forming a smooth and well-fitting journal. (8) Is bone self-lubricating? (9) What is the best method of burnishing bone, and with what powder? Also what tool-angle is the best for turning bone?—O. G. A. P.

[97155.]—**Catch Question.**—Can any reader explain *why* 30 articles at 3 for a penny, plus 30 at 2 for a penny, are not equal to 60 at 5 for twopence?—DAMON.

[97156.]—**Stereoscope.**—I shall be greatly obliged if anyone can give me the description of a stereoscope of the reflecting form to look at large stereoscopic pictures? I have seen radiographic stereoscopic pictures of bones. How is it possible to obtain them?—F. M.

[97157.]—**Silver-Plating Aluminium.**—Forks and spoons of aluminium are very light, and very nicely made and cheap. Can these be electro-silver-plated with advantage?—ELECTRO.

[97158.]—**Bichloride of Mercury Disinfectant.**—I have a Staffordshire earthenware w.c., white hopper and trap, the base of whose glaze is copper. The trap is connected by a soldered joint to a length of about 3ft. of lead pipe, which connects with a thin cast-iron soil-pipe. I am desirous of using bichloride of mercury as a disinfectant in the glazed trap, so diluted that it will, when mixed with the water in the trap, be in proportion of one part to one thousand parts of water. Will this by long-continued use have any injurious effect on the glazed

earthenware trap, the solder joint, the lead out-go pipe, or the thin cast-iron socket soil-pipe? Be it noted that it will remain in the trap for considerable spaces of time without disturbance, but will only pass through the lead and iron pipes.—R. P. W.

[97159.]—**Piano Strings.**—Can any reader give me any information as to making a simple machine to make pianoforte covered strings?—TUNER.

[97160.]—**Automatic American Organ.**—Any information as to the construction of automatic playing American organs, particularly the description of motor used to wind the perforated music will be appreciated.—TUNER.

[97161.]—**Ship's Surveyor.**—Please give me any information as regards the exam. for ship's surveyor, Board of Trade—such as amount of knowledge required, what books best to study, where these are obtainable, or such other information as experience suggests.—B. J. J.

[97162.]—**Dynamo as Motor.**—Having tried to run an Elwell-Parker dynamo (designed for 25 amps 300 volts) as a motor, from 100-volt circuit, I find that, although taking 35 amps, it produces no power to speak of. All connections appear to be perfect, and machine runs well as a dynamo at its proper load. Can any electrical reader kindly explain the reason of this?—SENBAR.

[97163.]—**Aluminium Gas-Engine.**—Could any reader inform me if it is possible to construct a satisfactory aluminium launch engine to be driven by compressed gas? What would be the probable weight of 5H.P. and 10H.P. engines, and boilers of same H.P., in weight?—W. M.

[97164.]—**Zinc Connection.**—What is the best method of making connection with zincs, the bulk of the connection being below the surface of the solution. Soldering, I find, does not hold to amalgamated zinc, and, if riveted, would not a galvanic action be set up between the zinc and copper or iron rivet? I know a mercury connection is best, but it is not possible to use it in my case.—FARADAY.

[97165.]—**Drill Makeshift.**—I have a variety of braces and drills, and a vice securely fixed to a carpenter's bench, but find it very great labour to drill small holes in thick zinc plates, &c., with the ordinary brace and a drill. Can anyone suggest an arrangement where a greater pressure can be produced with the same guiding power? I tried an overhead lever, having a loop to put the foot in to bear down on the drill, but the drill "wobbled" fearfully, making a wretched-shaped hole.—IMPATIENT.

[97166.]—**Chromic Battery Without Acid.**—From my small knowledge of this acid, I conclude sulphuric acid is used in its preparation; therefore, would it do to use in a double-cell merely mixed with water, and dilute acid with the zinc as usual? If so, what proportion should the water bear to the powder? I want to use these batteries in lieu of Leclanchés, but the zinc consumes away so in a Fuller through the strong chromic acid working through the porous cells.—SUBSCRIBER FROM VOL. II.

[97167.]—**Backstay for use with Traversing Mandrel.**—Will Mr. Evans or some other reader help me in a difficulty? I have fitted to my lathe, which has a traversing mandrel, a backstay to take the thrust when boring, similar to that recommended by Mr. Evans on p. 455, Vol. LVIII of "E.M.," so that the screw in the stay bears against the head of the screw in the end of the mandrel; but I find that the result is to tighten the screw in the end of the mandrel until the mandrel becomes locked. How is this to be avoided?—E. L. H.

[97168.]—**Flare Spots.**—I have two lenses which have flare spots, and sometimes cause dense spots on negatives. Can anything be done to improve the lenses?—OPTICAL J.

[97169.]—**Oil-Engine for Launch.**—Would "Oil," "Monty," or any other of your numerous correspondents be so kind as to supply me with a sketch and few particulars of a simple tube-ignition oil-engine for launch?—one to use paraffin preferred.—O TOM OBILE.

[97170.]—**Grammaphone Records.**—Can anyone tell me how these are made?—I mean the black celluloid ones such as are used in the streets.—FRED. DAVIS.

[97171.]—**Stone.**—By what chemical tests can it be ascertained if stones contain lime?—CHEMICAL.

[97172.]—**Holtz Machine.**—To MR. BOTTONE.—Would you kindly say what length spark the Holtz machine, described in your book "Electrical Instrument-Making," would be likely to give if well-made? Are these machines difficult to excite? Could they be excited by a Wimshurst? If so, please give directions. Would such a machine be of practical use for X rays? If not, would you kindly give modifications or directions of one of this type that would be?—HOLTZ.

[97173.]—**Pigeon-Post Photographs.**—I shall feel obliged if any of your correspondents can give me any information as to the detail process of making these microscopic photographs? The ordinary collodion process does not yield a satisfactory result.—S. J.

[97174.]—**Water Power.**—I should be glad if some of your correspondents who have experience would inform me what power I should be likely to get from a water supply delivered through a 6in. pipe and having a fall of 4ft? Also, what size of turbine and dynamo would give the best results? I want to fit a few electric lights in my house by this means, if possible.—J. S. S.

[97175.]—**Watch Repairs.**—Can any reader give me sketches of a rocking-bar and shifting-sleeve keyless works, with full particulars how to examine same?—G. S.

[97176.]—**Cement for Vulcanite.**—Can some reader kindly tell me of a cement for vulcanite? I do not want it so much for fastening pieces of vulcanite together, as they will be screwed, but for making joints that are impervious to water and acids.—W. N.

[97177.]—**Cold Feet.**—Would any reader kindly give me a remedy for cold feet? Have tried heating compresses, and cold water bathing followed by brisk rubbing, without benefit.—IRON TURNER.

[97178.]—**Joint and Piston Packing.**—Kindly tell me how to make a joint such as the one on the cylinder end, and how to pack piston-rods of portable engines?—E. J. P.

[97179.]—**Lyddite Shells.**—Can any of "ours" tell me the construction of the explosive cap which is placed between the clapper-stick used in pantomime, and when the stick strikes that part of the anatomy which will do the most good? There is a loud explosion.—SONHUD DIE.

[97180.]—**Marine Navigation.**—Will any reader kindly explain the following? I don't mention the "line" or the paper, but it is stated that a well-known Transatlantic liner can steam at four knots with the main throttle shut, by the use of the exhaust steam of the auxiliary engines only. About 30 tons per day is the necessary consumption for auxiliaries, and the exhaust steam is sufficient to propel the ships at four knots and keep the machinery ready for immediate increase of speed to 20 knots.—M. E. V.

[97181.]—**Giddiness.**—Will some reader recommend a remedy? I have been troubled with it three weeks. It is worse when moving about. Objects appear unsteady, and I am liable to fall if I turn aside briskly.—VERTIGO.

[97182.]—**Extra-Hardened Grammaphone Needles.**—I have a considerable number of extra-hardened needles from America. 1. I am told they injure the records; is this correct? 2. What is the best means of softening them? 3. For how many records should they be used as hard and as soft needles?—S. N.

[97183.]—**Painting on Silk or Satin.**—How is silk or satin prepared for painting upon with oil or water-colours for the production of such articles as fire-screens, &c.?—F. J. G.

[97184.]—**Portrait Painting in Water-Colours.**—I have hitherto confined myself to small views landscapes or sea-views, &c.—with which I have got on fairly, but I now wish to try a portrait, size about 10in. by 7in., in which the head would be about 3in. or less. I understand from a manual that for the shadows of the face madder brown and French ultra are used; also for the flesh tint (fair) Roman ochre and pink madder; and for finishing touches, madder brown, raw sienna, lake, &c. How are these tints laid on? Are they blended upon the paper (shadow and flesh tints) while wet? If so, it would appear that the whole face must be painted very rapidly. Or are they laid on separately, and softened off by some after-process? In this case, which would be put on first—the shadow or flesh tint? Also, as to the "finishing touches"—what is the method adopted? Is stippling used, or cross-hatching, or simply washes? A few hints on the proper procedure would be very acceptable.—F. J. G.

[97185.]—**Bookbinding.**—Could any reader tell me how to do up binding of a set of books?—half calf, dark brown leather, gloss for the most part rubbed off, exposing the rough leather through.—BOOKS.

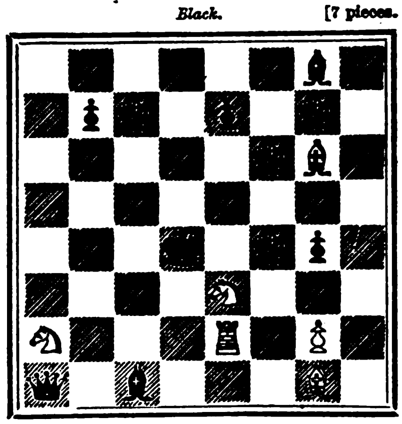
[97186.]—**Speculum.**—I have in my possession a 6in. metal Gregorian speculum, which I intend to bracket on to the side of my 4in. refractor and use without a tube. The length of my refractor is 5ft. 9in., and focus of speculum is the same, so that I shall have to get focus shortened, say, about a foot. I would like to know what "H." thinks of this arrangement. I have no small mirrors, but intend to match large speculum with ordinary glass concaves till I get one to suit, and then get a true glass concave made of the same focus as that which seems to perform best. In altering focus of large speculum, is there anything special to note about the required figure to give best results with simple concave small mirror? I may say I know very little practically of Gregorians, and any advice will be welcome.—GREGORIAN.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1703.—By B. VALLE.

Black. [7 pieces.



White. [8 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Dec. 11.*)

Solution of PROBLEM No. 1701.—By C. FARUFFINI.

Key-move, Kt-Q3.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1701.—Correct solution has been received from Frank Gowing, S. Woollen, Richard Inwards, A. Tupman, F. B. (Oldham), Alfred E. Oxley, Jas. Mason, Rev. Dr. Quilter ("Very clever"), J. E. Gore ("Pretty"), Quisco, T. Clarke.

H. B. F., P. H.—Only solution as above.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Nov. 29, and unacknowledged elsewhere:—

M. GLOVER AND Co.—T. M. C.—Shaver.—W. J. Rogers. A. J. H.—F. J. Buxton.—Rotos.—Lux.—E. Jones.—D. J.—J. F. H.—Electro.—Voltage.—Fleur de Lys.—Jack of All Trades.

W. R. RICKMERS.—Really we do not see that your letter in the slightest degree adds to present information with regard to the subjects you deal with!

ARTHUR E. GILBERT.—We have no objection to free discussion, but your style of arguments will not do! The letters were neither "puerile," nor do the writers "lack mechanical knowledge." We want facts, not flippancy.

JAMES PARIS.—We know nothing of the advertiser, and have never had any complaint against him. Pardon us for again saying we cannot interfere. In all cases of dispute as to quality or right description of goods, we should first have to satisfy ourselves, by inspection, that there was reasonable ground of complaint. You cannot seriously expect the editor of any newspaper to do this.

G. E. TURNER.—There have been many articles, &c., about model yachts in the back volumes; but a series of articles appeared in LXIV., commencing with No. 1639, the first in that volume. See pp. 1, 26, 49, 77, 101, 123 of Vol. LXIV.

J. GIBSON.—Any of our advertisers dealing in electrical apparatus would supply a suitable list with prices. Most of the firms who supply the apparatus also sell textbooks to match the sets of apparatus. But why not let the boy read up the subject in our pages, with the aid of the elementary work he has?

S. WHITAKER.—The paragraph on p. 337 is definite. The investigations to be carried out are for determining the possibility of ascertaining the "absolute zero of temperature." "Heat" and "temperature" are two different terms, as explained in the textbooks, and many times in back volumes. At present no one can answer your question.

LENA WALTERS.—In some of the textbooks there are glossaries, but we do not know of any special dictionary. The "Dictionary of Scientific Terms," by W. Rossiter, published by Collins, Sons, and Company, may suit, and the special terms can be found in most cyclopædias. There is a "vocabulary of definitions" in G. F. Chambers's work, Vol. II., "Instruments and Practical Astronomy," published by the Clarendon Press, Oxford.

J. J. G.—We believe it is the firm mentioned. You will understand that it was impossible to answer before, as the printing of the number was nearly completed when your note was received.

E. C.—Thanks; but the subject of the sailing of birds has been discussed to rags in back numbers, and we cannot reopen the controversy.

GLASS plates cast with wire gauze inclosed, submitted to tests in Vienna, have been found to possess consistency as well as resistance to pressure, shock, and the effect of heat, the resistance being 361lb. per square inch, and the consistency 3,610lb. per square inch of the transverse sectional area. The figures given are peculiar.

DR. LUDWIG MACH is reported to have successfully alloyed aluminium with magnesium, and thereby obtained a compound which can be worked like brass, and which is lighter than aluminium. A 10 per cent. magnesium alloy resembles zinc, a 15 per cent. alloy is like brass, and a 25 per cent. like a compound bronze. It is stated that the alloys can be soldered, and that they keep well in dry and damp air, and give good castings. The old proverb about the pudding comes in.

IN connection with the electric-supply stations in the County of London, it is stated that the boilers in use are divided as follows:—Water-tube, 75·5 per cent.; marine, 11 per cent.; Lancashire, 5·5 per cent.; miscellaneous, 8 per cent.; while the engines are:—High-speed, 62·5 per cent.; low-speed vertical, 25 per cent.; low-speed horizontal, 6·25 per cent.; special, 6·25 per cent. Direct coupling is universal.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 60c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent One Month before expiration, in order to give them time to forward fresh remittance before subscription expires.

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

For advertisements on inside pages, except page facing leader, for less than a quarter-page; per inch single column—

1	6	13	26	52 insertions
7s. 0d.	6s. 6d.	6s. 0d.	5s. 6d.	5s. 0d. each.

Per Column.—

1	6	13	26	52 insertions
£3 0s.	£2 15s.	£2 10s.	£2 5s.	£2 0s. each.

	1	6	13	26	52 insertions.
	£ s.	£ s.	£ s.	£ s.	£ s.
Per Page	8 8	7 0	6 0	5 5	5 0 each.
Half-page	4 10	3 15	3 10	3 0	2 10 „
Quarter-page	2 10	2 5	2 0	1 15	1 10 „

Back Page, £10 10s. A few dates open during 1899.

ORDINARY ADVERTISEMENTS.

	£ s.
Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the English Mechanic Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to The Strand Newspaper Company, Limited, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

Special Notice. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

Printing Press and Type, outfit complete, value 50s. Offers, cash or exchange.—Apply Adams Bros., Daventry.

1-horse **Engine and Boiler**, £12 or exchange for Screw-cutting Lathe.—Parkes, Alexandra-road, Richmond, Surrey

Wanted, **Magneto Generator**, with Bell. Give Howe Treadle Needle-work Machine.—9, Stuart-street, Luton, Beds.

Reflecting Telescope Mirrors made to order for cash or exchange.—David Booth, The Fall, Bramley, Leeds.

6½in. **Equatorial Reflector** (Calver), heavy iron stand, slow motion, fine instrument; exchange refractor, or sell. Seen by appointment.—C., 16, Sunningfields-crescent, Hendon, N.W.

In exchange for 1s. 2d. you will receive the best Engineer's Pocket Book published. Read on.

In exchange for 1s. 8d. you will receive the "Practical Engineer" Pocket Book and Diary. The greatest marvel of engineering literature published. Read on.

The Technical Publishing Co., Ltd., publisher of the "Practical Engineer" Pocket Book, 31c, Whitworth-street, Manchester.

"Ross" Microscope (new) and accessories; want, Back-geared Screw-cutting Lathe.—Miles, 57, Ashbourne-street, Leicester.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of Screws, Bolts, and Nuts for model work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—Morris Cohen, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—Clegg, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—Jarratt, Queen-street, Leicester.

Eyesight.—All whose sight is in any way defective should send to Horne and Thornthwaite, 416, Strand, for—

"Hints on Spectacles" (Why the Eyes want Help), by Overstall, F.S.M.C. (with distinction), post free.—Above.

Rubber Outer Covers, 8s. 6d. **Prepared Canvas,** 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—Pemberton.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—Pemberton.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—Pemberton.

Detachable Outer Covers (Licensed), 12s. 6d. each; all cycle accessories and cycle rubber goods stocked.—Pemberton and Co., 1, Cardwell-place, Blackburn.

50,000 Choicest Microscopical Objects.—Bargains. Catalogues free. Microscopes, cabinets. Collections purchased.—Suter, 10, Highweek-road, Tottenham.

Nuts and Bolts for Model Work. Illustrated List, 2,800 varieties, 3d.—Butler Bros., Haggerston, London.

Screws, Screw-plates, Taps, round and hexagon special steel brass and iron rods. See list.—Butler.

"Simplex" Gas and Oil-Engines, new series, "Otto" principle, ½B.H.P. to 2B.H.P., from £9. Guaranteed.—Below.

"Demon" Gas-Engines, awarded prize medal, ½B.H.P. to 12B.H.P., low price, high efficiency, economical. Guaranteed.—Below.

"Demon" Gas and Oil-Engines are thoroughly reliable. First-class workmanship.—Pasley and Co., Sherborne, Dorset.

Rubber Outer Covers, average 16oz., Para rubber 5s. each.—Franklands.

Rubber Outer Covers, 8s. 6d. each, 36s. per dozen.—Franklands.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—Franklands.

Air Tubes, best quality rubber, 2s. 9d. each. Fitted with Dunlop valve, 3s. 9d.—Franklands.

Air Tube, Para rubber. Marvellous value. Large stock to clear. Perfectly air-tight., 2s. each.; 21s. per dozen.—Franklands.

Cycle Capes, 3s. 6d., 4s. 6d., 5s. 6d. Also a few cycle Capes, guaranteed waterproof, 2s. 6d. each.—Franklands.

Detachable Outer Covers, licensed, 12s. 6d. each.—Franklands.

Saddles.—A clearing line in ladies' and gents' saddles, 2s. 6d. each, 24s. per dozen.—Franklands.

Inflators, 18in., 1s. 6d. each, 15s. dozen.—Franklands.

Bells.—Special line, double gong, usual price, 12s. dozen, will clear 6s. per dozen.—Franklands.

Prepared Canvas, 90 by 9, 1s. 3d. each, 12s. per dozen.—Franklands.

Pedal Rubbers, 6d. per set of four, 4s. 6d. per dozen sets; no rubbish.—Franklands.

Spanners, nickel, usual price, 13s. per dozen. Will clear a few dozen at 7s. 6d. per dozen.—Franklands.

Cycle Accessories and Cycle Rubber Goods. We hold the largest stock in the North.—Franklands, Astley Gate Blackburn.

Brass and Gunmetal Castings of finest quality. Prices on application.—Daniel Young, Witney, Oxfordshire.

Mail Cart Wheels and Perambulator Furniture.—Walker Bros., Primo Wheel Works, Sheepscar, Leeds.

A STITCH IN TIME SAVES NINE.

But you will save more than that by smoking the *Weekly Times and Echo* Cigar which only costs *twopence*, and is equal, if not superior, to any other cigar which costs three or four times the price. We are selling (and tobacconists all over the country can supply you if they like) this cigar as a gigantic advertisement, because we know that wherever the cigar goes the marvellous value we are giving smokers will be a matter of universal comment and astonishment. See that every cigar has the *Weekly Times and Echo* band round it, and is sold from a box similarly labelled and branded: otherwise you will not be sure of getting for twopence a cigar which would otherwise cost from three to four times the price.

"Speeco" Belting Syrup prevents slipping, and keeps belts in good condition; 1lb. sample tin, post free, one shilling.—Speeco Ltd., Suffolk-place, Bermondsey, London.

Gas-Engine Oil, 1s. 6d. gallon. Cheaper grade, 1s. Cotton Waste, Tallow, Packing, &c. Correspondence invited.—Under.

Polishes, Varnishes, Paints.—Large or small quantities, by rail or post. Benzoline, Gasoline, Mechanical Rubber Goods.

Why Burn Dangerous Oils? We have Safety Kerosene in barrels or drums. Refined quality only.—Under.

Lamps and Stoves Repaired. Wicks and Glasses of every kind. Low prices.—Jones Company, Bethnal Green.

"Electricity" is a bright, chatty, and practical journal, which everybody interested in the science should read. Fridays 1d. Of all bookstalls and newsagents.

Engines, Lathes, Dynamos, &c. See illustrated catalogue, price 4d.—W. Leather, Vernon-street, Hightown, Manchester.

"B" Oil-Engine Castings and Forgings. Easy to make; no complicated parts; very reliable.—Barkers, Leyton.

"B" Oil and Gas-Engines are fitted with silent gears, sensitive governors, adjustable bearings.—Barkers, Leyton.

Original Testimonials can be seen at any time, together with English and Colonial Press opinions.—Barker.

"B" Gas and Oil-Engines. Supplied the word over. Particulars stamp.—A. and S. Barker, Engineers, Leyton, E.

Launch Oil Engines a Speciality. New designs. High speed. Very reliable.—A. and S. Barker, Engineers, Leyton, E.

Money Saved is Money Earned.—The cheapest house for electric bells, telephones, light material, &c.—Write for catalogues, post free 3d., to C. W. Tebaches and Co., 165, Queen Victoria-street, London.

"Acetylene: its Characteristics, Generation, and Uses," with Descriptive Catalogue of "Incanto" Apparatus; just published, 3d. post free.—Thorn and Hoddle 1 Tothill-street, Westminster, S.W.

Gas and Oil Engines.

Steam Engines.

Dynamos.

New Designs. New Patterns.

Latest Improvements.

Send at once for Latest Catalogue.

H. Warsop, Launder-street Works, Nottingham.

Simplex Typewriter, 14s. 6d., delivered. Thousands in use. Illustrated particulars free.—Atkinson and Co., Harehills-avenue, Leeds.

Model Boiler Fittings and Material, seamless copper tubes, 5-32in., 3-16in., ¼in. up to 8in. diam.—Below.

Steam Gauges from 1in. dial, 60lb., 6s. Warranted ¼in. Wheel Valves, 3s. 11d.; Water Gauges, &c.—Below.

Injectors, Cylinder Lubricators, Lever Safety Valves, Copper Rivets and Sheet Brass and Steel Rods, &c.—Below.

Illustrated Catalogue of above high-class gun-metal fittings, 2 stamps.—Bert Garside, Golborne-street, Warrington.

Brass Casting Made Easy by using Wells' specially prepared Moulding Loam. Brass casting a pleasure.—Below.

Sold in 5lb. canisters, 2s. 3d.; 10lb., 3s. 9d.; 20lb. 6s., carriage paid, with instructions.—Below.

Plumbago Crucibles, with instructions for melting brass, sixpence each post free.—Geo. Wells, Needham Market Suffolk.

Best Carbide, 28lb. 8s. 6d. Acetylene Burners, 1s. 6d. dozen. Generators, Limelights, &c. List, stamp.—Houldershaw, Liversedge.

"Suter" for Accumulators. 4-volt, curved, 5-hours light, 4s. 6d.; 4-cell charging battery, 4s.—Below.

Large Illustrated List. Electrical and Mechanical Novelties, two stamps.—T. W. Suter, Highweek-road, South Tottenham.

A Perfect Portable Home Turkish Bath, folds into 3in. space, weighs 7lb.—Gem Supplies Co.

The Folding Quaker Bath Cabinet. Cleanses and invigorates, cures diseases without nauseous drugs.—Gem Supplies Co.

A Turkish Bath for a Penny. "E.M." pamphlet free.—Gem Supplies Co., 6, Bishop's-court, Chancery-lane, London.

"Perfect" Pocket Oiler, emits one drop at a time, never leaks, 1s. each.—Gem Supplies Co.

"Perfect" Pocket Oiler.—Best oiler for bicycles, typewriters, or sewing-machines, 1s. each—Gem Supplies Co.

"Perfect" Pocket Oiler, 1s. each. Trade terms on application.—Gem Supplies Co, 6, Bishop's-court, Chancery-lane, London.

Phonographs, new Gem, take standard records, and are fully licensed, £2 2s.—Below.

Phonograph Records, Bands, Songs, Instrumental Speeches, 2s. 6d. each, post free 2s. 9d.—Below.

Phonograph Accessories, &c.—T. G. Woods and Sons, 51, Spencer-street, Clerkenwell, E.C.

Astronomical Telescopes bought, sold, or exchanged.—Clarkson and Co.

Astronomical Telescope Parts, eyepieces, finders, Barlow lenses, repairs.—Clarkson and Co.

Astronomical Telescopes on Loan.—Clarkson and Co., 28, Bartlett's-buildings, Holborn-circus, London, E.C.

Astronomical Telescopes to view the shooting stars.—Clarkson and Co.

Astronomical Telescopes, 2¼ Dollond, £4 10s.; 2¼ Wray, £6 10s.—Clarkson and Co.

Astronomical Telescopes.—3in. Solomon, £4 10s. 3in. Newton, £4 10s.; 3in. Hughes, £4 10s.—Clarkson and Co.

Astronomical Telescopes.—3¼ Lancaster, £12 10s. 3¼ Wray, £16 10s.—Clarkson and Co.

Astronomical Telescopes.—4in. Wray, £25.; 4in. Crichton, £18 10s.; 4in. Cooke, £30.—Clarkson and Co.

Astronomical Telescopes.—4½in. Browning reflectors, £6 10s. 6½in. Browning, £20. 8½in. Browning, £25.—Clarkson and Co.

Astronomical Telescope, 4in., Cooke equatorial, and Driving Clock, on iron column complete.—Clarkson and Co.

Astronomical Telescope, 3in., with equatorial mount and garden stand, £15.—Clarkson and Co.

Astronomical Telescopes.—Full details on application to A. Clarkson and Co.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 8, 1899.

INLAYING.—IX.

Brackets, &c.

THE two designs of brackets are to give an idea of a support, yet avoiding any appearance of clumsiness. The object of a

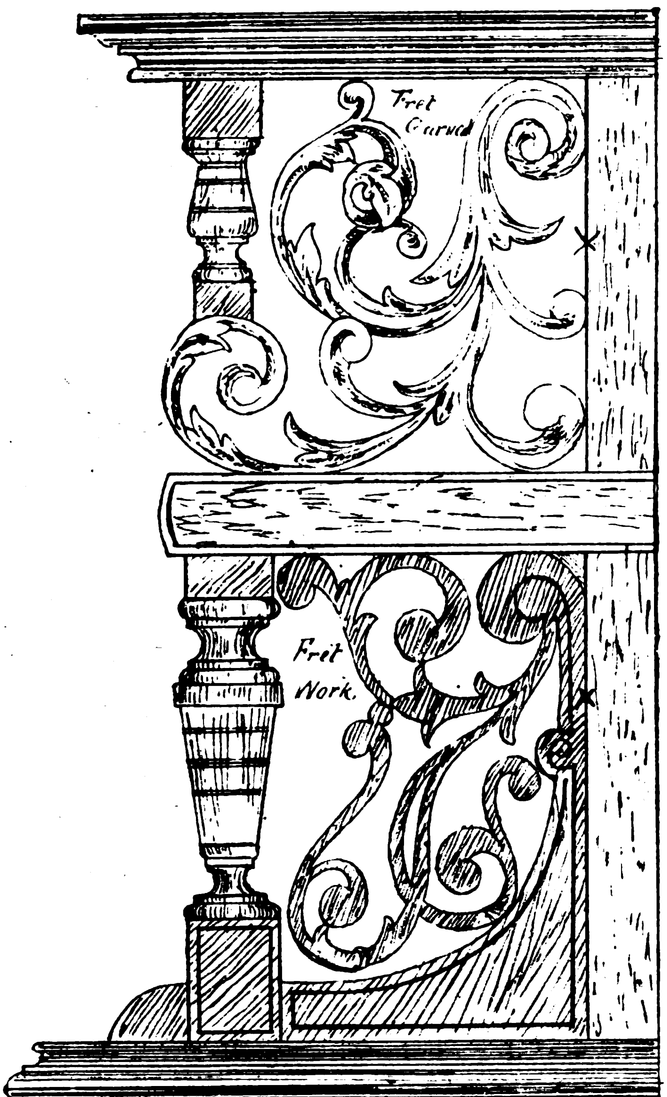


Fig 144

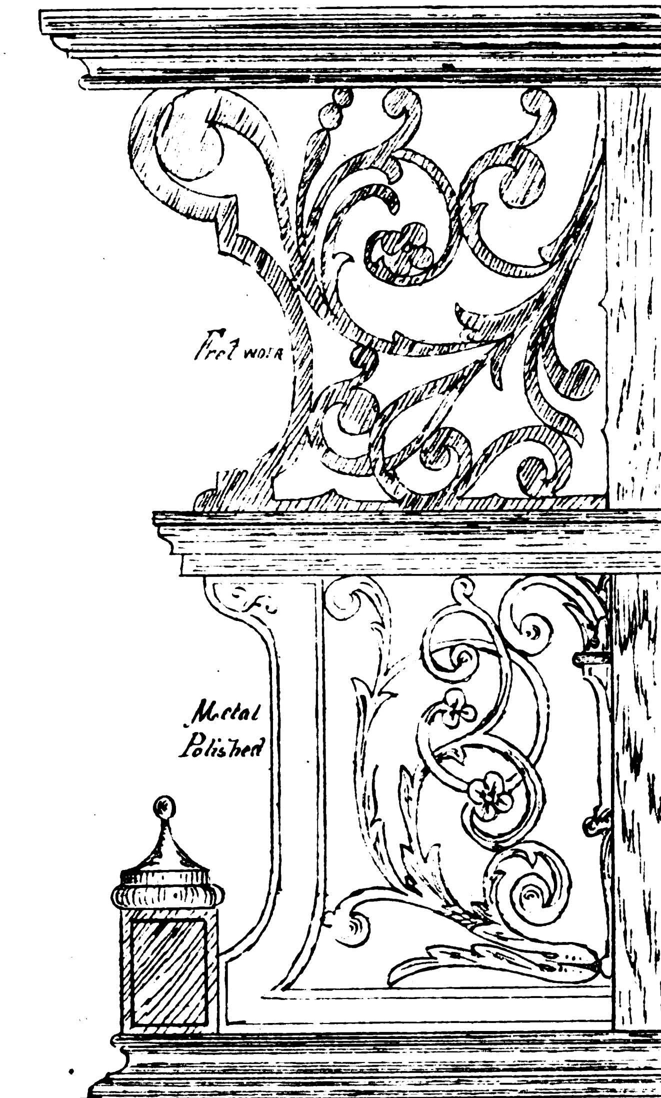


Fig 145

support can always be got, that looks and gives strength yet does not look heavy.

The upper portion of Fig. 144 is intended to represent fretwork carved on its outer faces, and should be of such substance as to admit of the little short column, the bottom of which is hollowed out to follow the sweep or curve of the ornament. A little short pin or dowel should be turned on the top and bottom of the column, which can be put in position when the two shelves are fixed together. The same applies to the bottom ditto. With this exception the bottom square of large column can be opened to receive the fretwork panel, or a little ¼in. round block can be glued afterwards. The black line represents a little inlay or stringing; not the lines X X—they are the face of the bracket-back. Fig. 145 gives the upper part fretwork only and the bottom panel in metal, polished and engraved. The bottom block should have a little stringing, the same as Fig. 144. The turned pinnacle is fixed with a short dowel entering into the block.

The work itself can be in mahogany or any other dark wood, but not light wood with brass. If a lighter wood is used, then copper, polished and lacquered, should harmonise. Much will be gained by trying the effect of different colours, as to blending, &c. The four examples are of richer repeating designs, and can be cut in either wood or metal; but the bottom, Fig. 149, is intended to be in metal and richly engraved.

The two chair-backs (as shown in Fig. 150) are respectively of "Sheraton" and "Hepplewhite" styles, and are given as typical fretwork cutting with carved enrichments. The cutting will require chopping in, or cut in a ground and carefully veneered to the back. The other two, Figs. 152 and 153, are merely to give an example of doing away with a plain part, existing on old chairs as a rule, and substituting the better or nearer approach to the work of the old masters.

The above are given because the demand for imitations of the works of the last century is greater now than in former years; consequently they are foundation examples of other modifications that may occupy the attention of the student at future times. The addition of a little stringing has often the effect of decidedly enriching and enhancing the value of the furniture, independent of the good practice that it gives.

Where the frames are so contracted as to admit of a little corner bracket under the seat frame, it is but little trouble to add it. Especially is that the case if fretworked, either carving or letting in a little stringing. Much can be done to beautify an otherwise plain piece of furniture, and what is the cost?—trivial at the most, compared with the satisfaction that it must give.

At Fig. 154 will be seen a centre, or group of musical instruments. Such groups were much in vogue, and were not only cuttings in different kinds of wood, but metal was introduced, which gave an effect that stamped it at once as art work. The music and finer portion are supposed to be engraved, but we have seen the notes, signs, &c., actually cut in, and beautiful work it was. The aim, as in all cutting, is to get as much relief as possible, and if, in choosing the different wood to suit each instrument, the contrast is not too great yet sufficient to fully depict each article, the result must undoubtedly give entire satisfaction.

For instance, the music-book would naturally be in white wood; the centre single-reed horn of peartree, the old guitar in darker pear, with satinwood bands interposed in the body as at A A. The clarionet could be in darker pear (dyed a shade darker) with the keys and other appurtenances of a light wood to gain a fair contrast. The cornet could well be in a wood of yellowish tint so as to approach a brass colour, and the other ancient-looking guitar should be yet a shade darker in the border with a black stringing or line let in to gain an equal

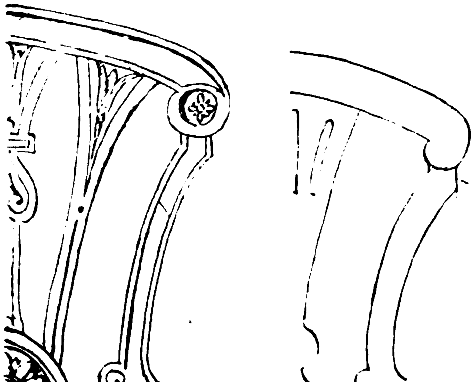


Fig 152

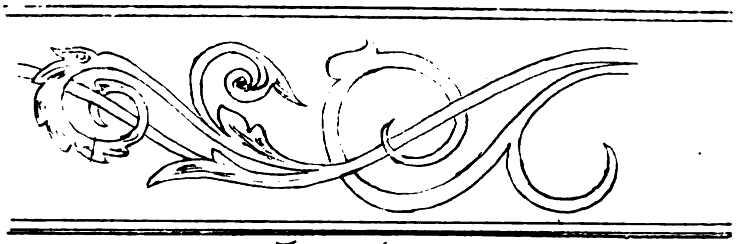


Fig 146

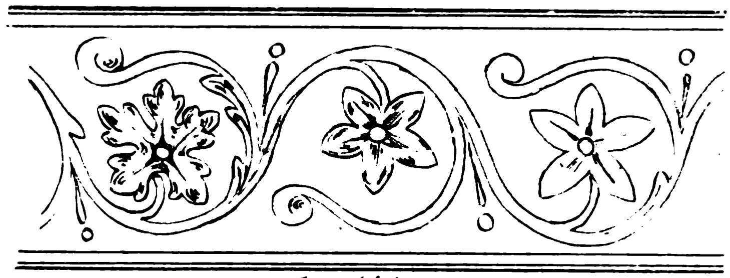
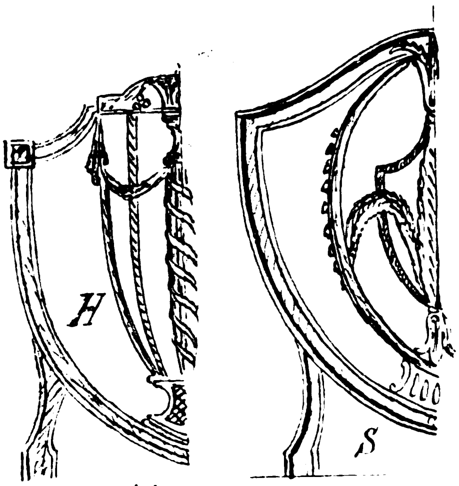


Fig 147



Figs 150

Fig 148

Fig 149

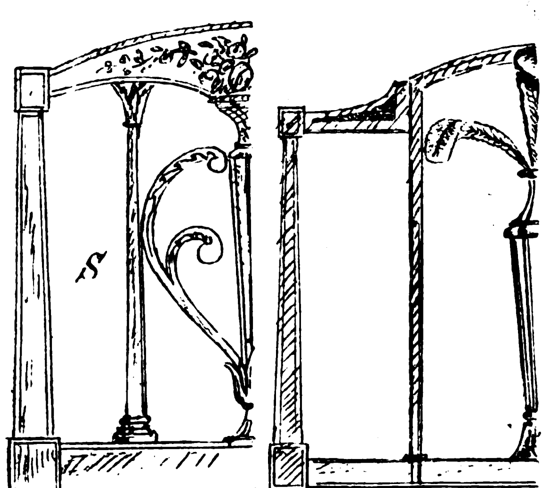


Fig. 151

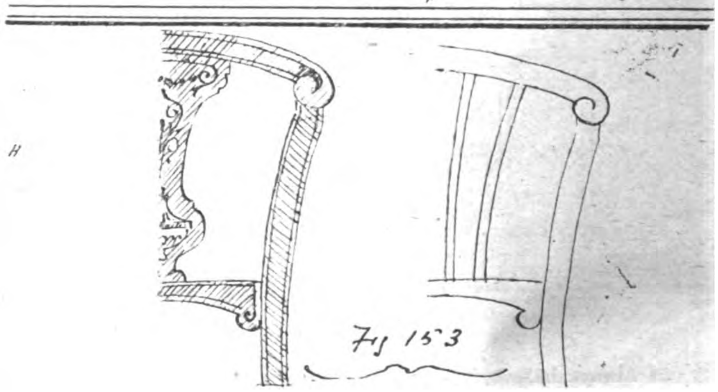


Fig 153

margin, and the strings themselves bodily cut in, using black lines to show up boldly. The pipe could be in satin or boxwood, well shaded with bands of blue (dark) or a deep violet. Although not usually seen as described, the slight enrichment will not tend to gaudiness. The riband and bow can be in a rich blue, and if carefully shaded should give a fair result. The outer border can be in yew-tree, and the ground in rosewood.

Mosaic.

The preparation of the medium can be either marble, imitation stone, or of glass. Whichever is resorted to, many colours and shades or tints of the different colours are needed. It will scarcely be necessary to say much about marble, as any colour can be got in the natural state; that is to say, thin slabs of marble in all variety of colours are procurable, and are cut up into minute squares with tools of chisel form so fixed in a sliding frame, permitting the veneer or slab to be scored, afterwards to be broken up into the small square form that is necessary for assembling. Glass will have to be scored with a diamond, in the same manner as grating lines or divisional lines used in microscopic and telescopic work, one set of lines on one side, the other at right-angles on the other; the diamond should not cut across the cuts already scored.

The pigmented tissue, or medium, is made with the finest sifted Portland cement, and while in the liquid state, extra fine dry colours are added to obtain the colour necessary. Upon a clean sheet of glass, smear over the surface some vaseline. Upon your glass bed—which, by the way, should be at least ¼in. thick—attach, by means of varnish or other medium that is not soluble in water, two thin strips of either glass (which is certainly preferable) or wood just 1/16in. thick. The distance between the strips is governed by the quantity of artificial coloured stone intended to be made up. A piece 3in. square will cut up into many little squares, and leave a fair margin for breakage. The medium of coloured plaster being ready, and well fluid, is spread carefully over the glass bed; a thin layer at first, and when just a trifle set another application will be needed until the medium is perfectly level with the two glass guide slips. Be sure and have the thickness even, for reasons to be explained.

When the bulk is semi-dry, which can easily be tested with separate slabs (they

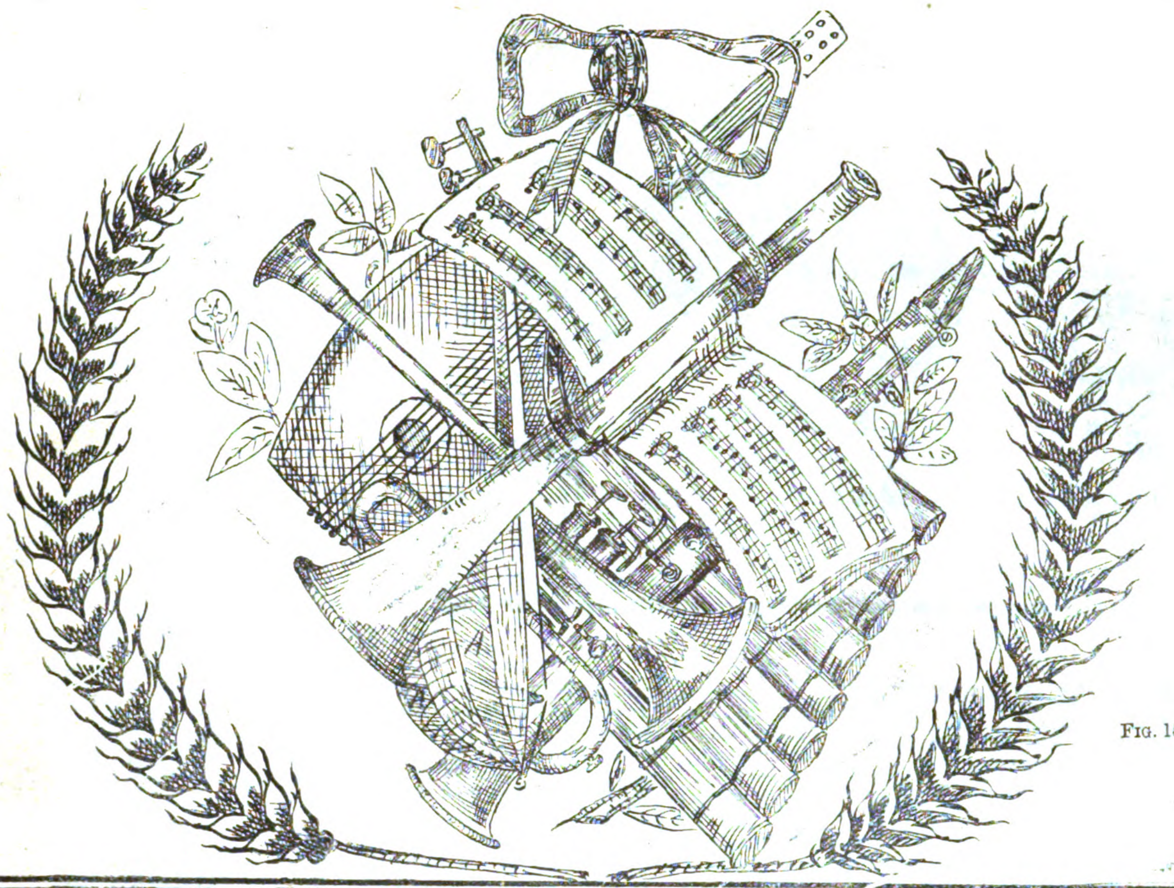


FIG. 154.

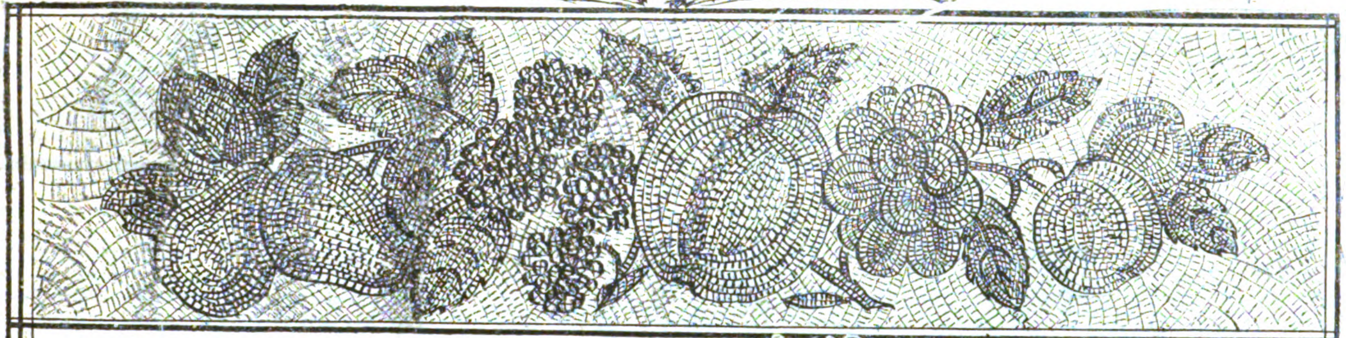
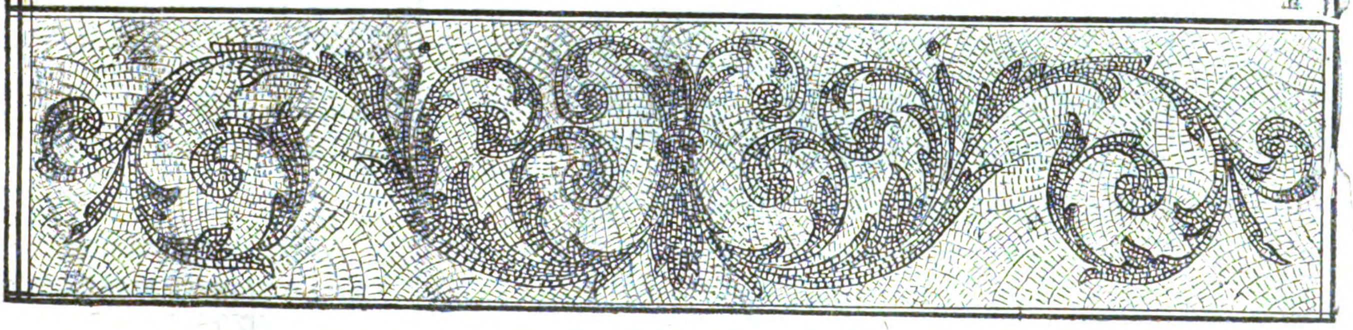


FIG. 155.

FIG. 156.



need not be more than about 1in. square), a simple contrivance must be made to divide the medium ere it is too dry. The easiest and quickest way is by laying a guide-piece at the left-hand opening in the slips. Against the guide a number of small strips are packed side by side until they cover the whole of the 3in. square. With a thin knife, not necessarily sharp, a cut is made across the medium. By lifting a strip in its turn, the cuts will consequently be the substance of the strip apart—viz., $^1/_{16}$in., and so on in rotation, lifting a strip each time a cut has been made. We shall then get a slab of coloured cement with 48 cuts $^1/_{16}$in. apart; if the cuts have been carefully made they should still retain their position on the glass bed. The same course of operation must be made the reverse way, or, rather, at right angles. The medium should be set aside to dry and harden; it will be found an easy matter to separate them afterwards.

A shallow tray will be wanted, with divisional pieces to form a number of small square boxes. As the coloured cements are made and cut, so should they be placed each in its respective box; otherwise it will be a difficult job to pick out the different tints from a bulk of mixed pieces, irrespective of the time lost in searching.

The first stage is to trace out the design upon the paper spoken of in the first part of this treatise. A piece of glass will now be wanted, which should lie upon the design. On the exposed face of the glass smear or spread some adhesive matter; for our uses, white of egg or gelatine will answer well—to which is added a trace of glycerine, because it must not dry too quickly. Yet we shall be obliged to keep on adding a little as we progress in our work. Two friezes are given in Figs. 155 and 156, and, if copied, will enable the student to get out any others he may want. When the whole of the surface is covered, it should be placed aside. To get it off the glass, a very thin blade should be passed between the glass and the mosaic; or, if it is desired to have it as a specimen, a layer of ordinary cement can be spread upon the assembled mosaic. When that is thoroughly dry, the glass bed can be warmed in hot water up to a degree of heat that will enable the mosaic to strip easily.

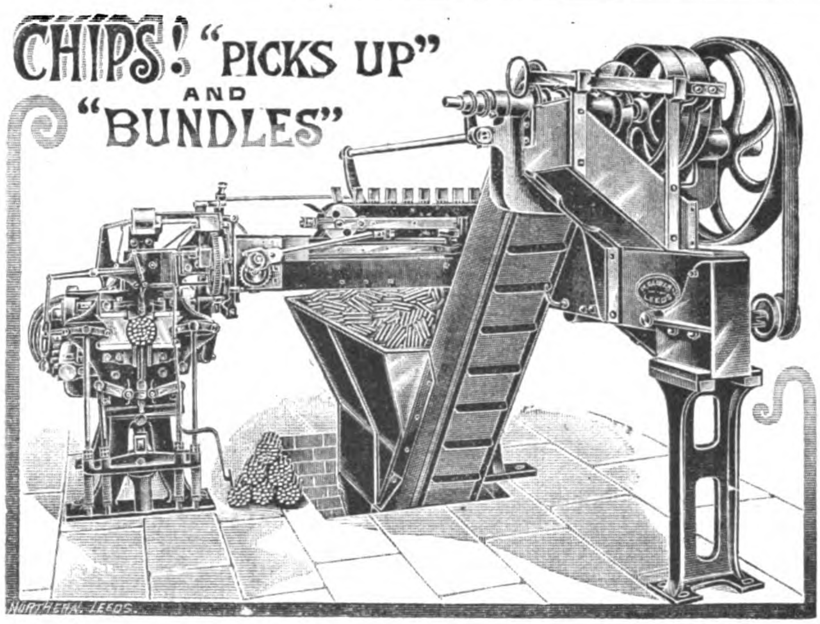


FIG. 1.

WOOD-WORKING MACHINES.

MESSRS. M. Glover and Co., wood-working machinists, Leeds, keep to the front with their novelties and improvements in connection with machinery for "sawing," "splitting," "picking up," and "bundling" firewood, &c.; but it is quite impossible to describe them in a short article like this, and, therefore, we would advise our readers to personally inspect the various appliances in operation, which would much interest and repay them.

Messrs. Glovers' "patent mechanical chip, picking-up, and arranging machines" are capable of a variety of modifications to suit various premises and positions of plant. This work is generally done by hand, and is found most tedious and expensive, and for many reasons a complete nuisance to employers, and, until recently, it has been considered impossible that such difficult manipulations could ever be accomplished by anything short of a mind. These appliances are, however, now a perfect success, and in practical use, though it has taken Messrs. Glover several years of thought and experimenting, as sticks may only be "coaxed," and not "coerced."

Our first illustration shows one of these patent chip arrangers. As the sticks are sifted, they drop into narrow spouts, compelling them to assume a uniform position lengthways, in which direction they are shot forward by quick travelling belts into narrow travelling boxes, working on the top of a belt, approximately as wide as the sticks are long. By an ingenious arrangement of "clapper" the sticks are placed perfectly straight in these boxes, or else are made to drop out, in which case they travel back, and are made to do the journey again. Though the apparatus saves so much labour, it is most compact and simple to work, occupying very little floor space.

The illustration marked Fig. 2 shows the patent "Ideal" saw-guard made by this firm, which, though quite a new invention, has already met with a large sale, owing, we believe, to the fact of its being a thoroughly practical and well-designed arrangement, having been tested and

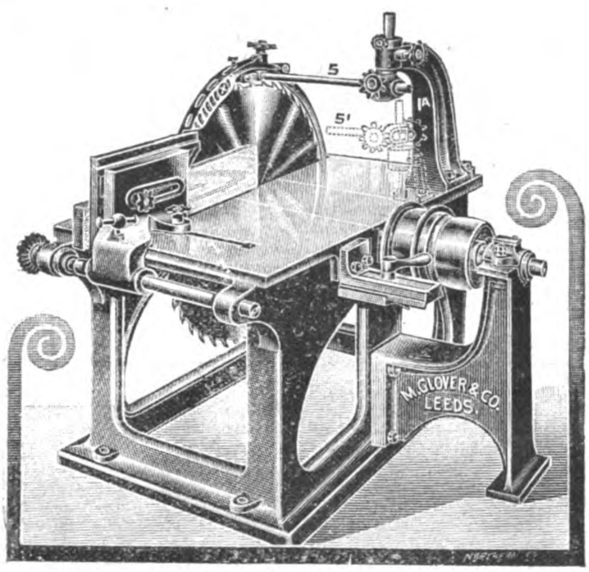


FIG. 2.

adopted by many firms previously prejudiced altogether against guards, and we are given to understand that Messrs. Glover and Co.'s "Ideal" guards have time after time given perfect satisfaction when other guards have been found quite useless, obstructive, and, in several cases, dangerous.

In saw-guards, especially, we consider the greatest care is necessary in selecting the most perfect appliance possible, both in the interests of men and masters. Guards to be valuable should not hinder the work in the slightest, nor give sawyers extra labour, and should protect whilst the saw is being used. Some guards only appear able to "box in" the saw when the saw is not being used, which is just when the saw is not dangerous: but the "Ideal" claims to give the greatest possible protection when working, and it allows of sawing as deep as ever the saw will cut.

Various styles of brackets are supplied, as may be preferred, and, if desired, these guards can be supported from above or at the side, leaving top of bench quite free.

Fig. 3 shows an improved saw-sharpening machine, also made by Messrs. M. Glover and Co. By aid of this machine "punching" and its attendant evils may be entirely dispensed with. This is a great saving, as saws will, in consequence, last considerably longer, and "hammering" is almost entirely done away with. The most experienced "hand-saw sharpener" is obviously only able to file the teeth of the saws quite straight, and, certainly, the frequent liability is for him to file them round, whereas by means of the circular revolving emery-wheel in this machine the teeth are compelled to be slightly hollow, like a skate-blade. Thus they are rendered much sharper, and, therefore, cut sweeter and remain sharp longer than if sharpened by hand. By very easily adjustable contrivances all the various "angles" and "leads" required in the saw-teeth

FIG. 3.

may be secured, and by a "stop motion" (the emery-wheel lowered to a given point for each tooth) the teeth are accurately sharpened to one height; thus each tooth must do an equal amount of work, whereas in the most usual irregular hand-sharpening it is of necessity all guesswork, and not infrequently it may be found that more than half the teeth in a saw are simply doing no work at all, as they are topped shorter than others. In this improved machine "Glover's Special Emery Wheels" are used, and the temper of the saws is kept intact by a fine cold spray of water ejected exactly on the tooth being operated upon. There is also one long, continuous leather belt driving the emery-wheel, thus preventing the stopping of the emery-wheel when cutting. We recommend our readers to write to Messrs. M. Glover and Co., patentees of the above inventions, to their address at Holbeck-lane, Leeds where fuller particulars may be obtained.

MILLWRIGHT'S WORK.—XIX.

ROPE-DRIVING is having a good innings now, and it has advantages in many respects. But the assumption that it is going to displace leather for ordinary service would be too gratuitous. For certain purposes it is admirable, but not for every kind of service. Though ropes are cheaper than belts, their pulleys are much more costly. Then there is the difficulty of getting every rope to do its proper share of the work, which has resulted in the use of tightening pulleys, an awkward arrangement when many ropes are engaged in driving. Besides, the belt makers have not been asleep, and they now understand better than they did the most suitable conditions under which belting can be driven. Nevertheless, rope transmission has so many advantages in the case of long drives, drives of great power, and twisted drives, that it has taken a place that will be permanent in the work of the millwright.

Manila hemp and cotton are the two materials

TABLE OF HORSE-POWER OF MANILA ROPES (C. W. HUNT AND CO., NEW YORK).—SPEED OF THE ROPE IN FEET PER MINUTE:—

Diameter of ropes in inches.	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	6,000	7,000	8,400	Smallest diam. of pulleys in inches.
½	1·45	1·9	2·3	2·7	3 0	3·2	3 4	3·4	3·1	2·2	0	20
⅝	2·3	3·2	3·6	4 2	4·6	5 0	5·3	5·3	4·9	3 4	0	24
¾	3·3	4·3	5·2	5 8	6·7	7·2	7·7	7·7	7·1	4 9	0	30
⅞	4·5	5·9	7·0	8.2	9 1	9 8	10·8	10·7	9·3	6·9	0	36
1	5·8	7·7	9 2	10·7	11 9	12·8	13 6	13 7	12·5	8·8	0	42
1¼	9 2	12·1	14·3	16·8	18 6	20 0	21·2	21·4	19 5	13 8	0	54
1½	13·1	17·4	20·7	23·1	26·8	28 8	30·6	30 8	28 2	19 8	0	60
1¾	18 0	23·7	28·2	32 8	36·4	39 2	41·5	41 8	37 4	27 6	0	72
2	23·1	30·8	36·8	42·8	47 6	51 2	54·4	54·8	50 0	35 2	0	84

NOTE.—The above Table assumes an arc of contact of not less than 170°.

used for ropes. When properly made, and used under suitable conditions, there is little, if anything, to choose between the two. These conditions are of so great importance that they make, in extreme cases, a difference between a few months, and six, eight, or ten years in the life of the rope.

A rope differs from leather or chain in this: that, though subject to direct tension, the fibres, yarns, and strands are twisted. The amount of twist permissible has been settled by experience. But in any new rope, some amount of stretch results, which has to be taken up by resplicing two or three times, after which it stretches no more. In manufacture, the yarns, the strands, and the completed rope are successively twisted in opposite directions, in order to neutralise the twists as far as possible. The strain on a rope tends to untwist the strands in one direction, and yarns in the other direction, until the two are approximately balanced. Ropes are made of three or four strands; some prefer one, some the other. A four-strand rope must have a heart, or core, a three-strand none. A four-strand has a section more nearly circular than the three.

It is clear that a rope is, in two respects, more unfavourably constructed than a belt to endure bending over pulleys. In the first place, its thickness is much greater; in the second, its fibres are more delicate. The practical issue is that the pulleys for rope must be much larger than those used for leather belting, and that their grooves must be smooth and polished to prevent fraying of the delicate rope fibres. There are, therefore, internal and external friction to be minimised.

The fibres of which the rope is built up rub over one another within the rope, tending to break up its structure and reduce it to powder. This is the evil which has given most trouble to rope users. To prevent or diminish the internal friction of the fibres of the rope, which on small pulleys is rapidly destructive to the fib es—grinding them to powder—is the reason why the pulleys must be as large as possible. There are minimum diameters which are fixed by experience, but it is better to exceed these when possible. Besides this, manufacturers lubricate the ropes when in process of manufacture. The C. W. Hunt Co., of New York, employ plumbago mixed with tallow. This renders the rope also partially waterproof, and, after a little wear, it becomes permeated and coated externally, and hardened by the lubricant. In addition to this, it is well to apply a preparation to the outside of the rope from time to time, especially when it is exposed to weather.

An approximate rule is, that a pulley should not measure less than forty times the diameter of its rope. Mr. Coombe gives the following sizes as agreeing well with practice:—

1¼in. diam. rope,	3ft. diam. pulley,	ratio	1	to	28·8
1½in. „ „	4ft. „ „	„	1	„	32 0
1¾in. „ „	5ft. „ „	„	1	„	34 3
2in. „ „	6ft. „ „	„	1	„	36·0

When the size of a pulley must be reduced much below proper proportions, then an alternative is to reduce the diameter of the ropes, and to increase their numbers.

Another important point in rope-driving is the speed. This ranges most economically at between 3,000ft. and 5,000ft. per minute, and experiment has demonstrated that nothing is to be gained by going beyond 5,000ft., because the centrifugal force increases more rapidly than the additional power gained, and so reduces the latter.

The following useful table by the C. W. Hunt Co., of New York, gives the horse-power of their manila ropes, and the diagram (Fig. 123) shows the same results plotted. The basis is a working strain of 200lb. on a rope 1in. in diameter, and is about one-twentieth of the breaking-strain at the splice.

In calculating the table, the effect of centrifugal force has been estimated, and the curious result is seen that the horse-power lessens rapidly as the speed gets beyond about 80ft. per second. The total stress on the rope is the same at all

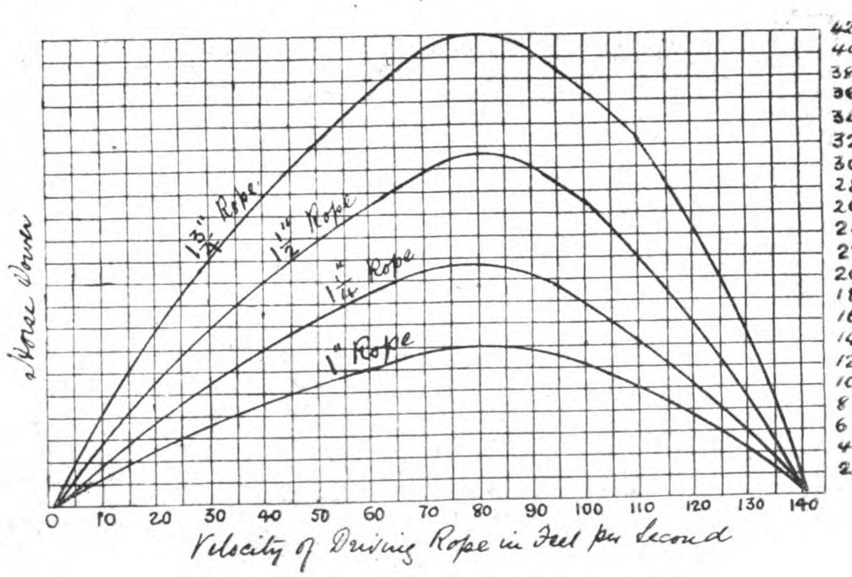


FIG 123

speeds given in the table. With a given velocity, the *weight* of rope required for transmitting a given horse-power is the same, no matter what size rope is adopted. The smaller rope will require more parts, but the gross weight will be the same.

Another and most important point is the stress on the rope. About 7,000lb. is the ultimate strength of a rope 1in. in diameter; but the

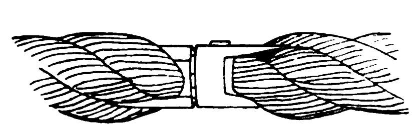


FIG. 124.

working strain should not be more than 200lb., giving the enormous margin of 35 times. Actually it is less than this, because the strength of the splice is less than that of the solid rope; but the working stress may be taken here as being from $\frac{1}{20}$th to $\frac{1}{25}$th the strength of the joint. This is an enormous margin; but experience of short-lived ropes has demonstrated its necessity. The question is not so much one of static strength as of dynamic working—conditions which cannot be calculated, but which are found to produce rapid wear.

If a rope is overstrained, the result is seen in the strands becoming loose, due to the partial untwisting of the rope. A rope may wear badly on the outside, even though the pulleys are of ample size, due to the roughness of the pulley grooves, or to their running out of truth, or to adjacent ropes chafing against each other, caused by the bad fitting of pulleys, or too fine pitch of the grooves, or too much sag.

In rope driving there is a large amount of sag to be allowed for. If a rope is pulled up too tightly, it will not last nearly so long as when slack. The limit to sag and slackness is that at which the rope begins to slip. The sag on the driving side is taken as a constant for all speeds, because the tension should be always the same. But the sag on the slack side varies with speed, increasing as speed diminishes.

The splice of a rope is its weakest part, and generally goes first. It must be long, measuring not *less* than from 6ft. to 12ft. It must be so made that the diameter at that part shall not be sensibly larger than the diameter elsewhere. The C. W. Hunt Co. give the following table for the length of splices:—

Diam of rope.		Length to allow for splicing.
¾in.	....	9ft.
⅞in.	....	10ft.
1in.	....	12ft.
1¼in.	....	14ft.
1½in.	....	16ft.
1¾in.	....	18ft.
2in.	....	20ft.

This firm insert a coupling, Fig. 124, in their ropes by which the resplicing under ordinary conditions is avoided. The coupling is fitted to the rope-ends, and permits of the rope being shortened by twisting it. The coupling is of aluminium bronze, to reduce weight, and, being smaller than the rope, is not open to the objection of striking the pulley grooves. A minor advantage of this is that twisting the rope slightly enlarges it, so compensating for wear. J. H.

LIGHTNING: THE "DARK" FLASH.

FOR some years past notes and letters have appeared in several of our science reviews about what has been called "dark" flashes of lightning, or simply "dark" lightning. To say the least about this supposed meteorological phenomenon, it is as difficult to conceive the physical constitution of such a flash as the special conditions necessary for its production.

The various phenomena of an electric storm are susceptible of explanation in general terms by considering the two charged bodies—say, a pair of clouds, or a cloud and the underlying surface of the earth—as the two coatings of a large condenser, the intervening mass of air constituting the di-electric. As in the analogous case of a Leyden jar, when the strain produced in the glass by the opposite charges becomes sufficiently great, the jar is perforated, so when the strain to which the air is subjected exceeds its "di-electric strength," it suddenly gives way along a line of minimum resistance. The displacement of electricity constituting the discharge gives rise to violent surgings forward and backward along the line of rupture, which surgings continue until the potential difference that caused them has been wiped out. This is effected in an exceedingly small fraction of a second.

The energy of this oscillatory discharge is communicated to the surrounding air, which becomes heated accordingly. We are made aware of this only when the released energy is sufficient to heat the air up to luminescence. It then affects our sense of sight, producing on the retina an effect depending on the form and intensity of the flash.

So far, then, as the eye is concerned, every flash of which it is cognisant is necessarily accompanied by some degree of luminosity. But, on the other hand, we have the testimony of persons whose veracity is as unimpeachable as their accuracy of observation is beyond dispute, that they several times saw in the sky tracks of discharges which were unmistakably dark. Such observations naturally demanded some consideration; the possibility of dark flashes was, therefore, entertained for a while, and theories put forward to explain their occurrence.

It was not long, however, before the astronomical idea of a "personal equation" suggested a retinal effect as a possible explanation. To many it appeared to be not only a possible, but a plausible explanation; and, indeed, the only one.

So, too, thought Lord Kelvin, when, one evening last August, at Aix-les-Bains, he was favoured with a vivid display of lightning. The opportunity was too good to be neglected, and he forthwith proceeded to put the retinal theory to a test. Looking out at the sky, a discharge occurred which gave rise to two well-marked flashes. He saw these distinctly as brilliant zigzags of light; but, on turning a few seconds later, to a part of the sky which was illuminated by another discharge, he saw—just as he expected—the former double flash dark on a luminous background.

To confirm this observation, he returned to the brilliantly-lighted drawing-room, where, on suddenly looking at one of the walls, he noticed precisely the same reversal. There was the dark double flash complete in every detail. This conclusively shows that the so-called "dark" flash is not a real physical occurrence, but merely a subjective effect. The part of the retina affected by a first flash is in a state of comparative fatigue, so that when a second one occurs it fails to respond as actively to the stimulus caused by the general illumination as do the surrounding nerve filaments, thereby giving the observer the impression of a well-defined dark flash.

However strong the evidence afforded by such observations, it was still urged by some that the case against dark lightning was not conclusively made out. They held that the matter could not be considered as finally settled until a satisfactory interpretation was given of the dark flashes noticed occasionally on photographs of lightning.

The photographic plate is, indeed, far more sensitive to the ether ripples that constitute light than is the network of filaments which form the retina. It is, moreover, neither nervous nor impatient, nor are its impressions inaccurate or evanescent; it is ever ready to give a faithful record as well of the invisible trail of a flying meteor as of faint specks in the star depths, whose very existence the largest telescopes fail to detect.

It was thought, then, that such a highly sentient recipient of radiant energy might possibly afford some information in favour of the objective reality of the dark flash.

This view was, however, finally negatived (*Proc. Phys. Soc.*, Vol. X.) by the researches of Mr. Clayden, who, knowing that the bright parts of a photograph could be reversed by exposing the plate before development to the action of diffused light, showed that the darkening of the flash was purely a chemical effect in the film, and that it could be reproduced at will. If the lens of a camera be covered the moment after a flash occurred, the developed image will always come out bright, feebly or strongly, according to circumstances. Mr. Clayden found, however, that if the plate be exposed after a flash has acted upon it, either to the continued action of a feebly diffused light, or to the powerful glare arising from one or more subsequent flashes, then on development the image of the original flash will probably come out black. This effect can be obtained not only with a lightning flash, but also with a spark from a Wimshurst machine or an induction-coil. "It is merely necessary," writes Mr. Clayden, "that the plate should be exposed to the action of a certain amount of light after it has received the impression and before development."

This interesting subject has been examined anew—quite recently—by Dr. William Lockyer. In studying photographs of lightning, especially some taken by himself during the past seven years, he noticed two varieties of the "dark" flash which he failed to detect in any photographs of laboratory lightning at his disposal. These were flashes which he describes as dark with bright cores and others, which are bright but with decidedly dark borders. For the full acceptance of Mr. Clayden's explanation, it appeared, therefore, necessary to produce these two types artificially, and it is precisely in this reproduction that Dr. Lockyer has been successful.

We now know the exact meaning of the black zigzags and their lateral ramifications which may be found in photographs of lightning, and we know also how the dazzling flash of our skies may be made to yield a dark retinal impression. The mystery has at last been cleared up. The term "dark" lightning is, therefore, a misnomer, corresponding to nothing real in nature, and as such it deserves to be dismissed for ever from our scientific nomenclature.

We find a few other terms in our literature which so richly deserve a similar fate that it is a wonder they were not long ago relegated to the profoundest depths of the limbo of oblivion—e g., thundertube, thunderbolt, thunderstorm.

Thunder is in no way concerned in the formation of the peculiar conical cavities sometimes formed in sandy soil by an electric discharge, and which early writers unwittingly called thundertubes.

Again, there is no such thing as a thunderbolt distinct from the lightning flash pure and simple. "A bolt from the blue," in the popular mind, means, we readily admit, an intensely hot solid mass which comes down in the wake of the flash. Now, everyone knows that meteoric masses visit us at all hours of the day and in all seasons of the year, as well before as during and after a storm. If, perchance, a mass rendered red-hot or white-hot by its rapid passage through a hundred miles or so of our gaseous envelope should chance to follow in the rarefied wake of a flash and crash down upon the earth, it is none the less a lump or matter of cosmic, and not atmospheric, origin. It is not a fireball of electrical formation, but simply a glowing mass of brute matter similar to the stuff of which this and other worlds are made.

Shakespeare, in "Cymbeline," Act IV. Scene 2, makes Guiderius bid his friend

> Fear no more the lightning flash,

to which Arviragus promptly adds

> Nor the all-dreaded thunder-stone.

Here the dramatist simply adopts the popular notion of his time. With all his intuition, he could no more have anticipated the meteoroidal views of the German Chladni, and Hubert A. Newton, of Yale, than the protective system against lightning recommended by Maxwell and developed by Lodge.

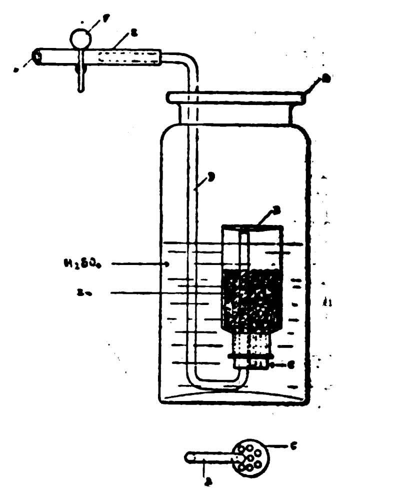
Even the term thunderstorm is objectionable, inasmuch as the crash or the peal, or the rolling noise that usually accompanies the electric discharge, is by far the less important characteristic of the phenomenon. Who speaks of a shower as a "patter" storm? Who would venture to describe a hailstorm in one of our daily papers under the title of a "rattle" storm? Is it not equally belittling and improper to speak of an impressive electric display as a "thunder"-storm?

We commend these curiosities of our scientific literature, together with such strange improvisations or importations as "black electric sparks," "X-light," "Becquerel light," and "dark light" (la lumière noire of Le Bon), to the careful consideration of our leading writers on physical science. A reform is obviously needed. They alone can carry it out.—*Engineering.*

AN IMPROVISED HYDROGEN GENERATOR.

ALMOST every laboratory makes certain modifications or adaptations of well-known pieces of apparatus, formulæ, and methods, such changes being often convenient for conditions under which they are applied. Very often these changes would not be improvements under other conditions, and not uncommonly the individual who devised them regards the changes trifling in character, and presumes that, of course, someone else has similarly applied the idea involved, and that it might be presumptuous on his part to publish so simple a thing. The pieces of apparatus to be described, we have no doubt, have been utilised by other workers, in one form or another, but we are unfamiliar with any publication which has been made on the subject.

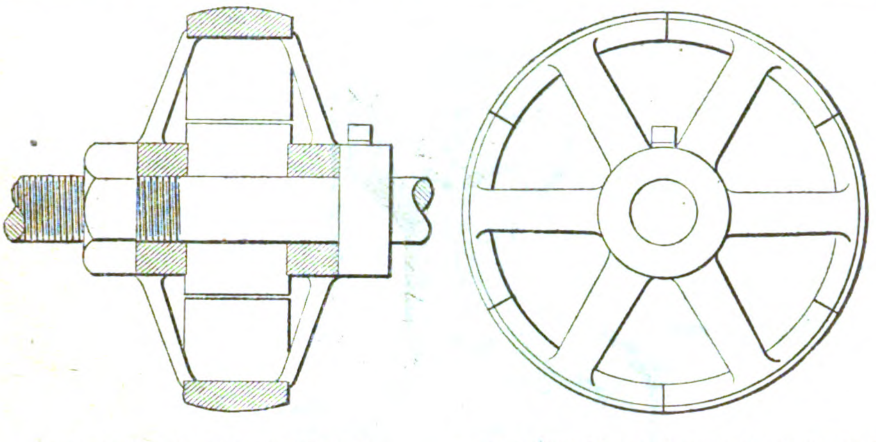
During the progress of some work on the bacillus of tetanus there was constant need of a hydrogen generator, which could be thoroughly controlled, and at the same time one which could be depended upon, under all conditions, to afford sufficient hydrogen for any anaërobic apparatus in use. Of the many forms of hydrogen generator, none seemed at the time available, and so the apparatus shown in Fig. 1 was, after some experiment, devised by Dr. Coplin. It can be constructed anywhere, and under almost all conditions. All that is needed is a bottle, preferably a salt mouth bottle of from 8oz. to 16oz. capacity (bottle shown at B in illustration). A stopper with perforation, or corrugated at the side by cutting out pieces, is a convenience, but not a necessity. Such a stopper may be of cork or wood, or, what is best, of rubber. It should fit with sufficient tightness to prevent the submerged bottle from coming loose, spilling the zinc, and rising as a result of the buoyancy of the contained gas. A glass or rubber tube (such as shown in the illustration at D) is passed through a hole in the cork so that the end within the bottle reaches to the bottom of the bottle, B; the length of the projecting end of the tube will depend upon the depth of the outside container, and the distance to which it will be desired to conduct the gas to other apparatus. It is best to make this tube of glass, although rubber tubing will do; where fragility is an objection, lead might be substituted, although the authors have never used anything but glass. The conducting-tube D should have an internal diameter of ·5cm. to 1cm., and should be sufficiently heavy not to break easily. The outside container, A, may be a wooden bucket, crockery jar, ordinary battery-jar, or Whitall-Tatum museum jar, with a perforation in the lid through which the tube can be passed; a large-sized Millville gas-jar, such as made by Whitall-Tatum, will be found most convenient. We used such a jar for some time, but it was accidentally broken, and since that time we have used an ordinary museum jar; when the apparatus is not in use we lift out the bottle containing the zinc and set it to one side, and stopper the jar containing the sulphuric acid. To use the apparatus, a sufficient quantity of scrap zinc, or zinc turnings is placed in the bottle, B, the bottle is then laid upon its side, to permit of the insertion of the tube and stopper. The bottle is now turned upside down, as in the illustration, and inserted into the



A, container filled with sulphuric acid up to the level shown; B, 8oz. to 16oz. bottle turned upside down, and closed by perforated stopper shown at C. Through this perforated stopper passes the short arm of the conducting-tube D. It will be observed that the end of the tube within the bottle B extends above the acid level. Just below the large drawing is an end view of the stopper, showing perforations, and the conducting-tube D passing through the stopper. The horizontal arm of the conducting-tube D is connected with a large piece of rubber tubing, E, and the flow of gas controlled by a Mohr's pinch-cock, F. Any piece of apparatus may be connected to the rubber tubing at *a*. If the connecting-tube D be bent in the shape of an S at the point where the letter D is shown, this S may be hooked over the top of the container to hold the bottle B out of the fluid when not in use.

diluted sulphuric acid in the outside container. The height of the liquid in the outside container should be so adjusted that when the bottle containing the zinc is pushed down as far in the sulphuric acid as it will go (and the acid permitted to rise to its own level within the bottle containing the zinc), the acid will not come nearer than 2cm. of the end of the tube within the bottle B. The object of this precaution is, of course, apparent. Should the acid be admitted sufficiently near the bottom of the bottle (which is now the top) it would run over into the tube and form a trap at the bottom; or if the tube is small, it might be carried on into the apparatus with which the tube is connected. At the external end of the tube a piece of thick rubber tubing, E, is attached, and a Mohr's pinch-cock, F, is adjusted so as to collapse it. The rubber tubing may be attached to anaërobic culture apparatus of any kind, or to any other piece of apparatus which it may be desired to use. If, at any time, the exit of the gas from the tube be prevented, the acid is forced away from the zinc by the continued generation of gas, and in a very short time chemic action is arrested. The apparatus may may be used for the generation of sulphuretted hydrogen, or, with slight modification, of carbon-dioxide, &c.

The points which have recommended the apparatus to us are:—(1) Its simplicity; (2) its cheapness; (3) any student can make such an apparatus from materials always available; (4) it may, by some of the suggestions already given, be kept practically always ready for use; (5) it is not easily broken, and all the parts may be replaced quickly and cheaply; (6) it is efficient.—*Journal of Applied Microscopy*, N.Y.



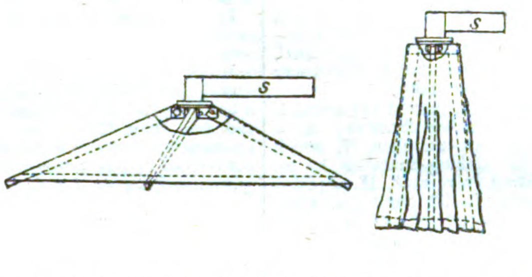
AN EXPANSION PULLEY.

THE accompanying sketch is that of an expansion pulley designed by Mr. Florence, master mechanic of the Newnan Cotton Mills. This special pulley was designed for a yarn winding-machine, and was to regulate the speed of the traverse which guided the lay of the yarn on the ball. It was desired to lay the yarn side by side, with no space between, so fine yarns had to be laid closer than coarse yarns. It was thus necessary to change the speed of the traverse, and it was found that the change from the finest to the coarsest yarn to be wound only required a variation in diameter of a 6in. pulley of less than $\frac{3}{100}$ths of an inch, so it was impossible to get change-gears to make the difference, and cone-pulleys would not give satisfactory results; so this very simple, and yet very efficient, pulley was designed.

It will be seen from the sketch that the pulley consists of two sets of spokes connected to a common rim, but to different hubs. The rim is cut midway between each set of spokes, so that when the two hubs are compressed together by means of the nut on the shaft upon which they are mounted, the rim will be forced out. The spring in cast iron was found to be sufficient to give ample variation in the size of the pulley.—JIB, in *American Machinist*.

COLLAPSIBLE PROPELLERS OR PADDLES.

THE invention patented by Mr. A. R. Upward, of London, relates to "collapsible" propellers adapted to be reciprocated under water for the propulsion of light craft. It may be of interest to some readers, for the idea has been put forward in various shapes. In the present form (No. 20,269, 1898) the patentee describes the apparatus shown,



which is adapted for attachment to the end of a pole (a punt pole for example) when it is desired to navigate in deep water. The pole is alternately used with a backwards and forwards motion, and is attached by a hinged joint to the rod S, which passes through bearing blocks on a travelling guide, in which blocks the rod turns, thus providing for steering by allowing the propeller to be set or thrust through the water at any angle which may be given to the pole.

LONG AND SHORT-DISTANCE PROJECTION LANTERNS.

IT will be manifest that an instrument more especially designed for use in a private dwelling-house would be practically of little utility for projection purposes in large halls or theatres. Therefore, in the selection or purchase of a lantern, it is important that some consideration be bestowed upon the special purposes for which such lantern will ultimately be required. In the event of a lantern being desired for home use only, the optical arrangements will differ materially from such as would be required in a lantern designed more particularly for long-distance projection.

In the latter, not only are long-focus objectives required, but the condensers to converge the pencils or rays of light passing from the lime ball through the picture or slide must also be of longer focus than would be the case were an objective employed for moderately short-distance working. It is just here where much misconception exists among amateur lanternists, the belief being very general that all that is necessary to to adapt any well-constructed lantern for the use at varying distances from the screen is the substitution of long or short-focus objectives in proportion to the distance it is desired to work from, whilst the equally important bearing which the candenser plays in such projection is entirely overlooked, for a condenser that yields admirable results in converging rays of light when employed in conjunction with a five or 6in. objective will fail to give anything like results in connection with, say, an objective of 12in. focus.

Nearly all the trade or stock lanterns supplied by even our best opticians are fitted with what may be termed short-focus condensers and short-focus objectives, the idea, doubtless, being to adapt same more particularly for short-distance working, such as would be required in dwelling-houses, where the aim is to obtain the largest possible size of picture within the shortest distance from the screen. Such lanterns will be found in all likelihood, to be fitted with double plano forms of condensers of about 4in. focus when measured from the centre of the combinations, or 3in. from the back lens to the lime ball when the jet is finally adjusted in its proper position for focussing the light upon the screen, with the aid of, say, a 5in. or 6in. objective.

Now, there is really no difficulty in converging all the rays of light from a spot of, say, $\frac{3}{4}$in. (such as an ordinary lime cylinder yields with a good mixing jet at fairly high pressure) at a distance of 6in. in front of the condenser, and such an optical arrangement will be found to work admirably, but the moment we come to change the 6in. objective for one of much longer focus—say, 12in. or more—we introduce a radical change in the whole optical arrangements of the lantern. The jet which has hitherto been placed in its best position for the convergence of the rays at a distance of 6in. in advance of the condenser will require to be placed considerably nearer the back lens of the condenser to converge the light at a greater distance than 6in. in advance, and, as we have seen already, that to gain the necessary amount of convergence with the short-focus condenser that is being employed, a distance of only 3in. is available as an angle of incidence for the rays to spread over the face of the condenser, not only would the jet or lime ball be too near the back lens of the condenser, and hence very liable to fracture the same, but the corners of the picture would be improperly lighted. It therefore follows that, if we are to use long-focus objectives, we must provide suitable condensers, in order to so converge the light that they may be employed to their best advantage, and this is a most important point when selecting a lantern for long-distance projection. Strange to say, many of our salesmen with opticians, and who are supposed to be expert in lantern matters, are seldom found possessing a knowledge of this fact.

Another important matter in connection with long-distance projection is the diameter of the back lens of the objective. In short-focus lenses, say, of about 5in. to 6in., the diameter of the back lenses is generally found to be about $1\frac{5}{8}$in. Now, with short-focus condensers, it is quite easy to converge all the rays from a lime ball into a cone of such diameter at a distance of 6in. in front of the condenser; but the moment we attempt to converge the rays into a similar cone at varying distances in advance, so soon do we find our difficulties beginning, and a point is soon reached when lenses of the diameter above stated—viz., $1\frac{5}{8}$in.—will fail to grasp or pick up all the rays transmitted by the condenser. At this point such an objective will begin to lose light, and therefore, with the longer focus objectives, there must be provided larger diameter of objectives. Up to 8in. or 9in. in front of the condenser, objectives of $2\frac{1}{4}$in. will be found ample; but when much longer-focus lenses are employed as objectives, then their diameters must likewise be increased, and every aid rendered by the employment of suitable longer-focus condensers.

In the early days of the limelight, when we had nothing like the pressure we have at present from gas cylinders, the practice of working so as to project as large a disc as possible from a short distance was quite a necessity so as to get the utmost amount of illumination, and no doubt this old practice has done much to foster short-distance projection even in the present day; but limelight procedure is quite a different matter now to what it was 25 years ago. Compressed gas has enabled improved jets being employed, and now, with suitable apparatus, it is possible to project a picture in a brilliant manner which at that early period was practically impossible.

The advantages of long-distance projection over short-distance working are many, not the least of them being the comfort to an audience provided by their having no interruption in the form of the emission of light from the lantern placed in advance of them.

Speaking generally, but few schoolrooms or country halls will be met with that do not contain a floor space of at least 50ft., and, whenever such have to be used for lantern entertainments or lectures, there is no better size of screen to employ than one of 12ft. or thereabouts, and to use a 12in. objective at a distance of about 45ft., which will yield a suitably sized picture on the 12ft. sheet.

By working from the back of the audience, an operator can always depend upon less interruption than is the case when he finds himself surrounded and cramped by numerous inquisitive onlookers; and, further, he is enabled to take more licenses with the doors and ventilator of his lamp than is possible when working in front of the audience.

As to brilliancy of light, if a good mixing jet be employed, there need be no anxiety; of course, the same results are not obtainable with a blow-through, but, then, no operator of experience nowadays ever thinks of employing such in long-distance projection. A well-packed mixing jet with a bore of $\frac{1}{20}$in. or $\frac{1}{25}$in. will yield all that is required in the way of light, and at the same time not overheat the lamp, as larger bores are very liable to do.

During recent years there has been a distinct movement on the part of lantern-makers to reduce the size of the shells in both the single and double forms of lanterns, until it is safe to assert that the thing has been ridiculously overdone. There may, indeed, be no need for such clumsy shells as were in vogue some thirty years ago; but a lantern of good size will work much cooler than some of the small-sized articles now so prominently on the market, and it by no means follows that for single-lantern projection wooden-lined bodies should be employed—these wooden bodies keep in the heat that would otherwise escape; a metal body will work cooler than a wooden-lined one, in so far as being less destructive to condensers.

The theory that light is lost by using long-focus condensers may be entirely discarded; any loss of light arising from the jet being drawn further back when long-focus condensers are employed is fully compensated for by the better class of jets now in use, and they are easily pushed to a greater extent without hissing than was formerly the case.—T. N. ARMSTRONG, in *British Journal of Photography*.

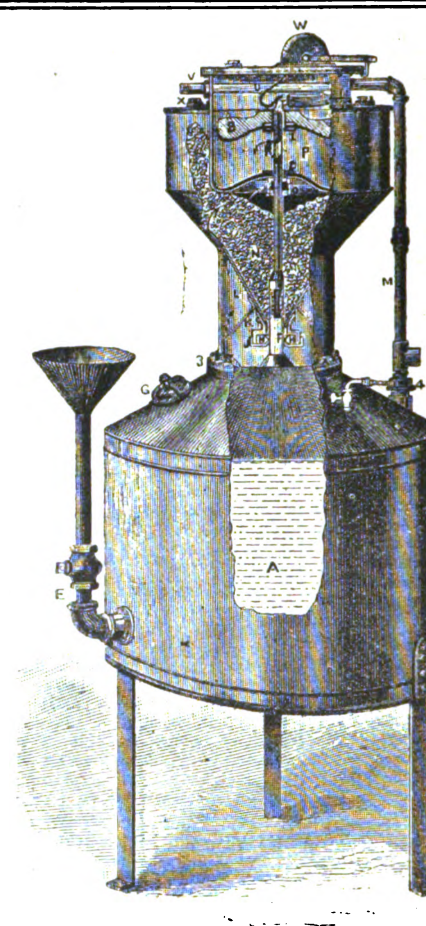
COLOUR PHOTOGRAPHY.

AT a meeting of the Columbia Photographic Society, Philadelphia, the editor of the *Camera*, assisted by Mr. P. A. Mitchell, gave a demonstration on "Colour Photography by the McDonough Process." Over fifty slides (made by the process) were shown, and the manner of making the exposures, &c., was demonstrated. The following extracts from Mr. Chambers's lecture may be of interest:—Colour photography, which has been much in experiment in this country and abroad for years past, has now practically reached a state of perfection. Few of us realise the difficulties encountered by the inventors of the processes on the market, and the most simple, the one easiest understood by the amateur, is the one we here demon-

strate this evening, the McDonough process. The expense in using this is very small, the cost of fitting up a camera but a trifle, and the results gratifying. The method of photographing colour by this process is on the scientific principle of the mixed coloured light. Many scientists have demonstrated that the elementary or primary colours of a ray of sunlight are red, green, and blue, and the mixture of these on the retina of the eye produces the colour sensation of white, and all the various shades of colour are the resultant of these three fundamental sensations. In the McDonough process the essentials employed for making a negative are a "taking screen," "chromatic balance shutter," and erythro dry-plates, the latter being the Seed 26 x normal plate orthochromatised for the red wave-lengths of light. The "taking screen" is a plate of glass coated with gelatine emulsion and ruled in red, green, and blue parallel lines from 300 to 600 to each inch, in the order named. This "taking screen" is adjusted in a metal frame inside the camera, and attached to a lever conveniently placed outside the box, where it can be used to throw the "taking screen" in contact with the erythro dry-plate when slide of plate-holder is withdrawn to make exposure. The "chromatic balance shutter," which is placed on hood of lens, is made with sectors of lemon-yellow and orange-coloured glass or mica, actuated by a metal finger, and its office is to balance the varying conditions of illumination, there being less blue in bright sunlight than with cloudy skies or when photographing indoors. The adjustment of the shutter for the difference in illumination is by moving the metal finger to open or close the coloured sectors. A negative made under conditions noted will show in duplicate the lines of the "taking screen," but with different degrees of opacity according to the light value that has fallen upon the silver haloids of the sensitised erythro dry-plate through the "taking screen" and "chromatic balance shutter." Their colour-value lines are transferred to the positive, which is made in the ordinary manner, by superposition, using any good transparency dry-plate, and the transparency or positive so obtained is placed in contact with a "viewing screen," which is made exactly like the "taking screen," only on thinner glass, the red, green, and blue lines corresponding in number to those used on the "taking screen," and the lines on positive or transparency and "viewing screen" being in parallel or register, the colour appears as in the object photographed. When this is done, fasten the two together with spring clips, bind the edges with adhesive strips, and the positive is ready for the window or projection in the lantern.

Several things are peculiar to the McDonough process regarding the matter of development. There is no choice as regards a certain developer being used—any kind may be employed; the only thing is that it is necessary to use it slightly weaker, and with reduced quantity of alkali; that is to say, if you were to use a developer requiring 4oz. of water, you would add 50 per cent. more, making it 6oz. Then, if the completed mixture would make, say, from 8fl.oz. to 10fl oz. of developer, we add ½oz. of a 10 per cent. solution potassium bromide; we do this owing to the extreme sensitiveness of the plate, and in order to prevent fog from over-exposure and development. I might say that, in all my experiments with the process, I have not had one fogged plate in my developing, and, in cases where I have deliberately over-exposed, I have been able to control it, and secure a perfect negative by the use of my bromide. The erythro plate employed is extremely sensitive to the red light in the dark room; my plates were developed in practical darkness, and after two tests I found that I could employ time developments and secure absolutely perfect results. The other evening I purposely tested one of these plates under the red light; one-third of the plate was covered, and the other two-thirds developed with the red light shining upon it. The result is that two-thirds of the plate exposed to the red light is most beautifully fogged. The one-third of the plate which was partly shielded does not show this trouble. In my method of exposure I found a Wynne meter a great boon; in fact, I should have been totally at sea without its aid at first, as these plates require a more lengthy exposure than the normal Seed's 26 x, owing to their special preparation. The International Colour-Photo Company, of Chicago, to whom I am indebted for the manner and form of testing this process, furnished me with a formula for developing my transparency plates. I not only find this excellent for my work with the colour-process transparencies, but it is also fine for ordinary slides.

I will give it to you:—Water 24oz., hydroquinone 180 grains, sulphite of soda (crystals) 5½oz., formaldehyde (40 per cent.) 3 drachms. This is the stock solution. For use, to the 4oz. of the stock solution add 2 drachms of 10 per cent. bromide of potassium. This may strike you as rather peculiar, as no alkali is mentioned in the shape of soda or potash; but the formaldehyde fills all the requirements of an alkali, and it also prevents shrinkage in the films.



THE "BECKLIGHT" ACETYLENE-GAS GENERATOR.

FEW industries have experienced a growth so rapid as the manufacture of acetylene-gas generators. When the production of calcium carbide was made a commercial possibility by the Willson process, a host of machines sprang up, which, as in most early forms of apparatus, were crude in construction and often wrong in principle. Gradually manufacturers began to investigate and apply the principles which should govern acetylene generation, and which would insure the safe and cheap production of the new illuminant. Of the many forms of apparatus constructed with a view of meeting these requirements, we may mention a machine made by the Acetylene Generator Manufacturing Company, of 106, Bell Block, Cincinnati, Ohio, a machine which is the result of no little study on the part of the inventor and makers.

The "Becklight," as the improved apparatus is termed, consists of a slaking-chamber, A, a gasometer, P, and a carbide-chamber, N, which communicates with the slaking-chamber by an opening having a yielding valve-seat, H, adjusted in position by a screw-cap, J. Through the valve-seat H a feed-plunger, F, passes, which is connected with an elbow, T, secured to a connection, U, for the gas-outlet. The carbide feed is locked by means of a lever and sheave connected with the elbow and contained in a housing, W. The stem of the feed-plunger F is provided with four indentations for feeding carbide, and with a passage, R, to conduct gas to the service-pipes. At the lower end of the carbide-chamber, a condensing-chamber, K, is arranged, which also provides a drying space, L, through which the gas passes upwardly. To force the gas through the pipes and regulate its pressure, a counterpoise, S, is secured to a gas-bag.

In operating the machine, the gas is first shut off from the service pipes and the lever operated to lock the feed mechanism. After the residue is removed from the water-chamber, water is introduced. The generator is then entirely closed by shutting the various valves, and carbide is introduced by removing the plugs X. After releasing the feed-mechanism by means of the lever and sheave, the generator begins to work by pressing gas out of the gasometer, thus lowering the feed stem, so that its indented portion passes the valve-seat H. An opening being formed, the carbide drops in a circle to the water below. The pressure of the resulting gas naturally seeks the point of least resistance, which is that side of the gasometer exposed to the atmosphere. The gas, therefore, passes up first against the condensing surface K, depositing its moisture on the cold surface, then through the reduced inlet between the lower edge of the surface K and the outside generator wall, into the drying space L, thence into the carbide-chamber, as shown by the arrows, through or over the carbide, whereby it is both screened and dried, into the passage of the stuffing-box O, and finally through the passage R, the hollow elbow T, and the connection U into the service-pipe V. If the consumption fall off, the inflated gasometer forms a cushion for the weight S, thus locking the feed-mechanism until the amount of gas in the gasometer P is reduced.

The weight, feed-stem, and gas-bag being integral, no gas can possibly pass into the gasometer without at once closing the feed-opening. The gas is resisted by the weight S, and when the pressure is excessive the weight is raised.

It will be seen from our illustration that the carbide and slaking-chambers are so arranged with respect to each other that the apparatus is far more compact than most others of the same class. The carbide is fed into the water in small quantities, for it has been found that the gas thus generated is cool and free from the dangerous benzine and other hydrocarbon vapours which always accompany the gas formed by generators operating on the dripping system.—*Scientific American.*

A FEW FACTS ABOUT LYDDITE AND CORDITE.

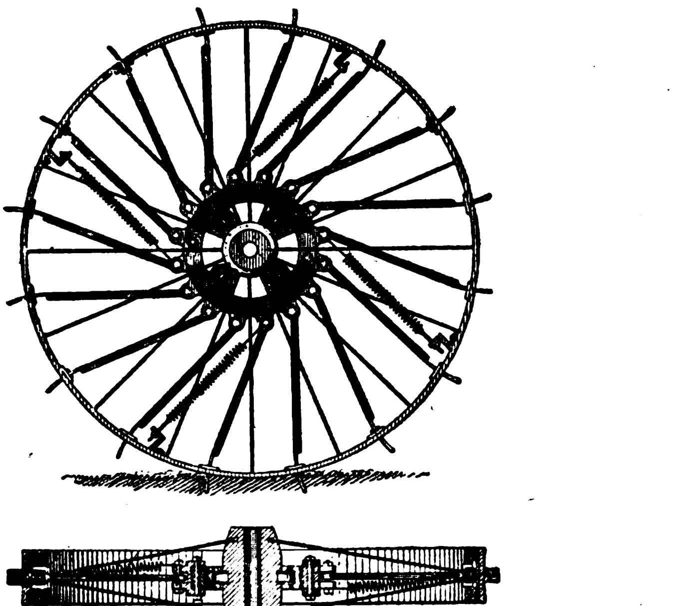
LYDDITE, the latest and most powerful of artillery explosives (for references apply to General Joubert, says the *Daily Mail*), takes its name from the little town of Lydd, near Hythe, where it was first manufactured. Picric acid is the base, with certain proportions of sulphuric and nitric acids, the secret being known only to the British Government.

When in the crystallised state lyddite resembles powdered sulphur in appearance. Its explosive force is terrific. At Omdurman, where it was first used in warfare, by the impact of its explosion—not by the fragments of shell—it blew men and fortifications to pieces. Lyddite is largely used by dyers [?].

Of other explosives, cordite is in origin and composition akin to the familiar dynamite or "giant powder." It is prepared from gun-cotton and nitro-glycerine.

Gun-cotton is cotton-wool or other cotton fabric treated with a mixture of three parts of sulphuric acid to one of nitric acid. This was discovered by a chemist named Schonbein in 1846, but its manufacture and use were surrounded with great danger and disaster, until Sir Frederick Abel perfected the method of making it in 1863.

Cordite is made at the Government factory, Waltham Abbey. To 27¾lb. of gun-cotton is added



43½lb. of nitro-glycerine, and these compounded in a brass-lined box become cordite paste. It is transferred to a kneading-trough, and for three hours and a half thoroughly mixed and incorporated with 15lb. 10oz. of acetone. Vaseline to the amount of 3½lb. is added, and after a further three hours' manipulation the cordite dough is ready.

Placed in a cylinder, it is pressed out in a thin string and wound round a drum. From its resemblance to string or cord comes its name of "cordite." The reels on which it is wound are dried, and the cordite, cut into required lengths, is ready for its deadly work.

It can be handled with perfect safety; lighted and burned in the hand. It consumes itself slowly with a yellow flame. It is only when burning in the confinement of a gun-barrel that it becomes explosive, the gases then generated occupying a volume a thousand times greater than when burned in the open.

Seventy grains of black gunpowder fired from a rifle give a muzzle velocity of 1,350ft. a second. Thirty grains of cordite give a muzzle velocity of 2,000ft. In cannon 1lb. of cordite gives a greater velocity than 5lb. of gunpowder. It is smokeless, and does not foul the gun, though apt to corrode it if the barrel is not carefully cleaned. It is rather sensitive to changes of temperature, and if kept a very long time, loses some of its power.

BIRD SENTINELS.

THE following notes, by Mr. F. G. Aflalo, in the *Morning Leader*, are interesting:—*Le Chenil*, which is the weekly publication of the Paris Acclimatisation Gardens, has just given a most interesting article on sentinel birds, in which, besides enumerating the various cattle and rhinoceros birds, some warning even the lion, while a species of cuckoo watches over the fortunes of the ratel, assigns the same duties to the well-known crocodile bird. Now, I thought all the skill of travellers had been exhausted in supplying fiction about this little lapwing, where fact failed to do all that was required of it; but I did *not* know that it was in the habit of warning the crocodile of the approach of man. And I venture to doubt it for two reasons. In the first place, I have passed crocodiles about which all manner of birds were running (and no doubt this same spur-winged gentleman among them), and on no occasion that I remember did they slide off into deep water at my approach. My second reason is, perhaps, even more valid than this. The fact is, crocodiles have not, at least among the natives of these parts, enemies enough among mankind to make it worth while for nature to have specialised a bird for that sentry work. I am quite ready to give the crocodile its due as a scavenger, and to regard it as fully worth preserving for its services; but, until the white man came on the scene with his rifle (in his last book Mr. Kirby tells of a lucky shot that killed a crocodile with a *rook-rifle!*) there would have been simply nothing for the lapwing to do, and it has certainly not learnt its new duties in the course of a century.

Two additional steam turbines at the Halifax Corporation electric-power station have been started. It is intended to use them for the tramway service. The enlarged premises will give accommodation for machinery equal to 25,000H.P., in place of the existing 2,500H.P.

A CURIOUS TRACTION-WHEEL.

THE traction-wheel shown in the annexed engravings is rather a curiosity, and we reproduce it from the *Scientific American*, but whether it is patented or not is not stated. It is thus described:—The traction-wheel which we illustrate is the invention of Clarence Grosseclose, of Sylvia, Kan., and is particularly adapted for traction-engines, automobiles, and harvesting-engines. Surrounding the hub of the wheel is a ring carrying rollers which bear upon the bottom of a groove formed in the hub. Arms pivoted to lugs on the outer side of the ring extend outward tangentially to the ring, and carry at their free ends blades which project through openings in the rim, and which adapt themselves to the nature of the ground —hard or soft—over which the wheel must travel. Some of the blades are provided with stop-pins passing through holes in the arms; the blades are thereby prevented from moving too far outward. Springs are connected at their inner ends to the ring, and are adjustably secured at their outer ends to brackets on the rim.

Should the wheel travel over hard ground or bridges, the blades, as they engage the ground or floor, will be forced inwards, causing the ring to rotate on its bearing-rollers. Upon reaching soft ground the blades will be moved outwards by means of the springs, acting upon the ring, so that they will engage in the ground. By arranging the arms at a tangent, the bearings formed upon the ring will be at one side of its vertical centre line, thus insuring the rotary movement of the ring mentioned.

PIN-POINT JOINTS.

EXPERIENCED fretworkers will readily agree with the observation that the work of fixing up articles is usually more difficult than cutting out the pattern. Beginners rarely realise this, and the result is that, while their sawing may be accurate, their preliminary attempts in the cabinet-making line are far from brilliant. This is partly due to want of practice in the handling of tools, but it is also largely due to a very childish desire to see the article completed before it is properly begun. This is why we often see pieces of fretwork which betray the neglect of sandpaper, and reveal the clumsiness of the amateur's fingers. The finished article may indeed be strong, but in fretwork, unless strength and neatness go hand in hand, the work can never look attractive.

For small articles, where delicate fixing is required, ordinary household pins may be employed to considerable advantage. The points should be cut off with a pair of wire-cutters, about ¼in. or ⅜in. from the end, and these used instead of nails. Over nails and screws they have a double advantage; being headless, they are almost invisible when driven in, and as they are practically as fine as needle points there is rarely any danger of splitting the wood. Of course, pin-points in themselves cannot be expected to give a strong hold, but used along with glue they are very serviceable.

As pins will bend if they are driven in with a hammer, it is better to hold them with a small pair of pliers and press the points into the wood. A gentle rub with sandpaper is usually sufficient to hide any trace of the broken head. With white woods, such as sycamore and holly, it is better to adopt a different plan. When, for example, a bracket support is to be fixed to a shelf, and where it may not be desirable to drive the pin-point right through the latter, the point of the pin should be held in the pliers, and the blunt end forced into the wood. The other piece is then pressed against the sharp point, which has been allowed to project about an eighth of an inch, and the two parts thus joined. This is merely an example suggested to show the principle.

The chief value of such a method is felt when overlay ornaments are being mounted. The difficulty of fixing these neatly is often experienced, even by advanced workers, who find that the applied ornament is apt to start if exposed to the sun or placed near a fire. If a few pin-points are fixed in the background, and the glued overlay then pressed on to these, the hold of the pin will usually be sufficient to prevent the glue from giving way.—*Hobbies.*

BALLOONS IN SOUTH AFRICA.

THE question has been raised whether advantage cannot be taken of Marconi's system to use balloons as actual engines of war, and whether decisive results could not be obtained by their use. Doubtless there is in this case, as in most branches of work, a certain amount of information which is jealously guarded as confidential, but we believe (the *Engineer*) that it would be found chiefly to refer to methods of application and practical details which hardly affect the broad question as to the power at our disposal, which is no doubt sufficiently startling and suggestive. Expressed in popular language, we have by the application of wireless telegraphy the power to drop and fire an explosive at a great distance, say, ten miles off. This may be carried out in the following way:—A free balloon may be charged with the explosive, and with gear for releasing it and firing it. It may, for example, take the form of a shell charged with high-explosive and with a percussion fuse. The sensitive apparatus which responds to the electric discharge at the directing point is also set up in the balloon, and with a suitable wind this balloon is set free, no living occupant being in it. Its position may be followed by observers stationed at the extremities of a sufficiently long base line to give some measure of accuracy, and on the signal being given the shell is released. This sounds formidable enough; there are, however, various difficulties and objections. First, it is very difficult, perhaps impossible, to cause the balloon to travel exactly over the desired spot. If the directing or starting-point is ten miles off, it may be questioned if the balloon would ever travel over a desired mark of small area; and if the mark is of large area, it may be questioned what good would be effected by it. We know, in fact, that it has been deliberately laid down by high authorities that, in the attack of a fortress, all shells are wasted which do not strike an actual gun or a magazine. This must, no doubt, be subject to some modification; but it is generally true that the useful targets are very small objects, such as it would be hopeless to get a free balloon plumb overhead from a distance approaching ten miles. Thus the balloon attack would resolve itself into one of general bombardment. This is open to grave objection. It generally means a useless destruction of life and property, for rarely indeed has any reasonably strong place been captured by such means. Further, at the Hague Conference, if we remember rightly, this particular form of attack was one given as an example of brutal, unpermissible warfare. For purposes of conflagration, it might be effectual. Even at very great range a town might be set on fire; but the gain is questionable, and under most circumstances would be an unjustifiable act, and one which would provoke the condemnation of civilised nations. At a comparatively short range, probably a more definite and less general blow might be struck; but the question then arises whether it would be as effectual as shell fire. A much larger charge of explosive might probably be employed; but a charge out of proportion to the case or shell which it bursts may effect very little. A 6in. gun discharges a projectile of 80lb. or 100lb. weight; a 4.7in. gun, of 45lb. weight. Thus a balloon load is soon made up with the weight of shell and other necessary gear. The strong point in favour of such attack is that the shell having no onward velocity is specially adapted for searching behind cover which is difficult to reach with high angle fire, and impossible with shrapnel, from ordinary field guns. There are circumstances probably, then, when something might be done by balloon attack of this kind; but whether it would be considered legitimate warfare is doubtful. Probably many of our readers may think with us that it may be better to employ balloons in the unquestionably valuable work of observation and direction by signals from captive balloons, which have already performed most important functions in discovering the position of guns whose smokeless discharge renders it peculiarly difficult to locate them. A somewhat similar case may be found in the adoption of the dynamite gun fired from the United States vessel *Vesuvius*. The shell of this

gun had appalling explosive power. The gun was employed in the attack of Cuba; but the total failure in accurate direction so discredited the gun that its development during three or four years ended in complete disappointment.

DO ANIMALS FEEL PAIN LESS THAN MEN?

WHAT we call "an ear for music" is almost an added sense in some people as compared with others. Even in animals of relatively high intelligence, such as dogs and monkeys, there seems to be reason to think their perception of pain is much less acute than in humans. After serious operations under chloroform they are often frisking about a few minutes after recovering consciousness, and even jumping from the floor on to the operating-table in a way which forbids the notion that they are then suffering. In all animals the skin is probably less sensitive than the human skin is. It is covered with insensitive hair, and though, no doubt, more sensitive than any other part of the body, it is presumably on a quite different plane of sensitiveness to the human skin. In human beings the sensitiveness of the internal organs is very small as compared with that of the skin. Examples of this are familiar to everyone While in health no one knows anything of his "inside"; he has no sensations from it. Even disease of a very serious kind can, and often does, go on for years in the internal organs without causing any sensation. The nerves of the internal organs are much more concerned with regulating functions, and controlling the size of the blood-vessels, than with the conveyance of sensory impressions to the brain. Life would, in fact, be unbearable, if the functions in of animal life in a normal condition caused sensation, and they would cause it if the organs were richly supplied with sensory nerves. Every surgeon knows, for example, that the human intestine is, when its muscular coat is at rest, almost as insensitive as the hair or nails. In the operation of opening the intestine, often required in the presence of malignant disease, the cut in the skin and the business of fixing the gut to the skin would be very painful, and deep anæsthesia is required. Two days later, when the gut in its new position has to be opened, the patient is told to shut his eyes, and he feels nothing—he does not even wince—while a wound nearly two inches long is made in the intestinal wall with either knife or hot iron. This has been proved by many hundreds of cases, and certainly it is not to be explained as due to stoicism on the part of the patient. Other important operations have been done without anæsthesia except for the skin cut, and without giving rise to suffering of at all a severe kind. It is most improbable that even the highest of the lower animals would feel pain where man feels none. On the contrary, from their smaller brain development, they probably always are less sensitive than man.—*Edinburgh Review.*

A RAIL-JOINT hydraulic press is being introduced in America for the purpose of driving the splice bars home to a good bearing on the rail while the bolts are being put in, thus preventing trouble from the lack of tightness in new joints. The machine is especially intended for the deep heavy splice bars of street railway girder rails, some of which have twelve bolts, in two rows.

The Last Memorials of Lunar Life.—Some suggestions as to the cause of the dark areas on the moon, the so-called "seas," are given in the November issue of *Knowledge*, by Mr. J. G. O. Tepper. Referring to our satellite as a dying world, the writer says:—With the diminution of the water, and the atmospheric gases, the decay (disintegration) of dying organisms would be at first more and more delayed until all were dead besides the *mould* of the soil, the last memorials of organic life. . . . Since the total disappearance of the atmosphere no currents can possibly exist, and the finest, lightest dust must remain eternally undisturbed, except by the rude shock of a colliding meteor, or when ploughed aside by such, if gliding along after a very oblique impact. It is well known that there is no body more absorptive of light than finely-divided carbon particles, hence their intensely black aspect. At the same time, dust, or loosely-cohering matter, reflects little light, except at very oblique angles of incidence. In the 'seas' of the moon we may, therefore, have large areas covered by carbonaceous dust, the last remains and the last evidence of the former vegetable and animal organisms of our satellite, for the one class cannot possibly exist without the other, unless in the lowest forms, known as Protozoa and Protophyta (i.e., the the same organism discharging the function of both, in absorbing carbon and nitrogen exclusively). As an hypothesis the above appears to me to fulfil most, if (perhaps) not all, the conditions demanded in the works perused by me, and I shall be glad to learn wherein it fails.

SCIENTIFIC SOCIETIES.

BRITISH ASTRONOMICAL ASSOCIATION.

THE first ordinary meeting of the tenth session of the British Astronomical Association was held on Wednesday, Nov. 29, at Sion College, Thames Embankment, Mr. W. H. Maw, F.R.A.S., the President, in the chair.

The President said that before the regular business was proceeded with he had an announcement to make, and he did so with much regret. Since the previous meeting they had lost, by death, their late President, Mr. N. E. Green. As many present doubtless knew, Mr. Green was one of the founders of this Association; he had served on the council as vice-president, as director of the Saturn Section, and was his (Mr. Maw's) immediate predecessor in the chair. In all these offices he fulfilled his duties in a most conscientious manner, and not only so, but he fulfilled them with an unfailing courtesy which endeared him to them all. As an astronomer, Mr. Green was a representative of the very best type of amateur observer. He never sought to make sensational discoveries, but he was a keen and accurate observer, and recorded all his observations with the utmost care, and with the greatest skill. His training as an artist enabled him to do this in a way with which the members of this Association were well acquainted. It would, he (the President) thought, be admitted that Mr. Green's planetary drawings had become classic. He had had an opportunity himself of examining many of the originals, and could say without hesitation that none of the reproductions in any way did justice to the beauty of the original work. For fidelity to detail and delicate rendering of colours and shading, these drawings had rarely been equalled —they certainly had never been surpassed. At the council meeting that afternoon a resolution was passed containing a vote of condolence to Mrs. Green and her family. It read as follows:—"The council and members of the British Astronomical Association had learned, with the greatest regret, of the death of Mr. Nathaniel E. Green, formerly president of the Association, and director of the Saturn section, and they desire to express their deep sense of the loss which the Association and astronomy have sustained thereby, and to offer their sincere sympathy to his widow and family in their bereavement." In order that the members of the Association generally might join in the vote, it was proposed to add the words "and members" after the word "council," and he would therefore put to the meeting a resolution that such addition should be made.

The resolution was passed unanimously.

The names of eight candidates for membership were passed for suspension, and the election by the council of 15 new members was confirmed.

An interim report on the Meteoric section, dealing with the November Leonids of 1899, was first presented. The director, Mr. W. F. Denning, announced the receipt of a large number of reports of this shower from observers in various parts of the country. These reports were from both members and non members of the section, and testified to the widespread interest awakened in the event and to the earnest efforts made to witness it. But there was a general failure. The meteors did not appear in the numbers expected; in fact, the display was not more rich than an ordinary shower of the August Perseids. The comparatively negative results were due to several circumstances. Primarily, no doubt, the cause was that the earth traversed a tenuous region of the swarm in front of the denser part, which gave rise to the brilliant displays in 1833 and 1866. At many places the weather was very unfavourable; there was bright moonlight except for a brief interval, and quite possibly the shower was at its best during daytime in England. But from telegraphic reports in the newspapers it would appear that the phenomenon similarly disappointed observers in other countries. No intelligence had yet come to hand of a really brilliant display in any part of the world. The observations of the recent shower were somewhat at variance in regard to several of the more important features, but they led to the following conclusions:—(1) The duration of the shower was from Nov. 8 to Nov. 18 inclusive; (2) the maximum occurred on Nov. 14 in the hour between 17h. and 18h., when, however, not more than 25 Leonids were visible to one observer; (3) the radiant point was at $151\frac{1}{2}° + 22°$; (4) the radiant was probably a fixed position according to the paths of several early Leonids, but the evidence they afforded was perhaps not conclusive. One of the finest meteors observed was that seen by Sir W. J. Herschel, at Littlemore, near Oxford, on Nov. 14, 17h. 40m. It left a streak for 5 min. It was also recorded by several undergraduates at Jesus Coll., Oxford, who described it as large and very brilliant, and leaving a train for 3 minutes. The same meteor was observed in other parts of the country.

Dr. Johnstone Stoney said that while we have to regret the absence of the great Leonid display for which we had hoped, it is some consolation that the risk of what has actually happened was clearly foreseen, and that we are in a position to say with considerable confidence what it is that has kept the earth from this year receiving one of the greater Leonid showers. This is due to the new position into which the meteoric orbit has been shifted since 1866, owing to the quite abnormal amount of the perturbations to which the meteors in the dense part of the stream have been exposed since that year. We are able to follow with accuracy what has happened to the meteors which occupy one special position in the great procession—namely, that portion of the stream through which the earth passed in 1866. The late Prof. Adams succeeded in determining what was at that time the form, the size, and the position of the immense elliptic orbit round the sun along which these meteors travel. Each of the meteors occupies $33\frac{1}{4}$ years in performing its circuit round this great elliptic orbit, which we may call Adams's orbit. Meanwhile the orbit itself is constantly undergoing slight changes in its form, size, and position, owing to the perturbating forces which are incessantly attracting the meteors towards the planets of the Solar System as well as towards the sun. Fortunately, the alterations which Adams's orbit has in consequence undergone within the last thirty-three years have been accurately followed by the skilled computers of the *Nautical Almanac*, acting under Dr. Downing's instructions and supervision, and it has thus been ascertained that the changes of the orbit due to perturbations have been of unusual amount during this revolution, chiefly because the great planet Saturn approached close to the meteors upon their outward journey, and Jupiter while they were returning. From these computations we now know fully what has happened to these meteors. The amount by which their orbit has been shifted, though of entirely abnormal amount during this revolution, is nevertheless too small to be easily made visible upon a diagram. To make it visible, imagine a sheet of diagram paper of the size and shape of a large hall-door, so large as to be 8ft. in height. Upon it draw the largest ellipse which it can take, 8ft. long and of the full width of the door. This will represent the meteoric orbit upon a scale such that every inch of the diagram represents 20,000,000 of miles in nature. A point $4\frac{1}{2}$in. above the lowest point of the ellipse will represent the position of the sun; and if we draw round this point a small circle about the size of a small dessert-plate, it will represent upon the same scale the earth's orbit. In the diagram, the two orbits have to be drawn upon the same plane; but in nature they lie in two intersecting planes which are inclined to one another at an angle of 16°. In 1866 the great elliptic orbit, accurately intersected the earth's orbit at one point. The ellipse has since shifted its position by an amount which, on the diagram, would be represented by about $\frac{1}{16}$in., but which, in nature, is 1,300,000 miles; so that at six o'clock on the morning of Thursday, Nov. 16, when the earth came closest to the meteoric orbit, the nearest point on that orbit lay inside the earth's orbit at the above distance from the earth—that is, it was more than five times as far off as the moon. Thus we know that one point in the ortho-stream—the dense part of the Leonid stream—was at this distance from us. Now the ortho-stream is known, from the duration of the great meteoric showers, to be about 100,000 miles thick; but from dynamical considerations it is known to be of immensely greater width, and we entertained the hope that its width might have carried part of it 1,300,000 miles farther from the sun than the point in it whose position we have been able to determine. What the non-appearance of a great shower this year establishes is that, wide as is the ortho-stream, it has not extended far enough beyond the point whose position is known, through which the earth passed in 1866, and which this year lay at the above-mentioned distance inside the earth's orbit. But there is a further matter of much interest. Though the earth has not passed in any considerable degree within the ribbon-shaped stream, the observations recorded in Mr. Denning's report seem to give reason to hope that we may have passed through the extreme outward fringe of it. He mentions that one observer counted a considerable number of Leonids in an opening in the clouds early on the morning of the 16th November. If other observers more favourably circumstanced confirm this observation, and have recorded the hour at which the maximum occurred, it will furnish information of real value. In fact, we know from dynamical considerations that the stream has the ribbon shape spoken of above. We also know that 17 centuries ago the width of this ribbon lay in a direction perpendicular to the earth's path; and we know that perturbations have since tended to shift it a very little round in the retrograde direction; but we cannot learn from theory what this small shift has amounted to. We shall, however, be able to determine it by observation, if the earth this year passed close to the edge of the ortho-stream, and if the time of the maximum of the somewhat aug-

mented display consequent upon this has been adequately observed.

The President asked Dr. Downing to give the meeting what information he possessed with reference to the shower for next year.

Dr. Downing said he need not detain the meeting for many minutes, as he merely wished to state the results at which he had arrived in looking forward to the conditions that would obtain on Nov. 15 next year. Unfortunately those conditions were still worse than those which prevailed on Nov. 15 just passed. That situation in the dense part of the stream, which would reach the node next November, and whose position they had been able to calculate, instead of being about 1½ million miles, would be about 1¾ million miles nearer the sun than the earth would be at the time, so that he was afraid that there was less chance than on the present occasion of there being any large display. The time when the phenomenon ought to be visible was 3 o'clock in the afternoon of Nov. 15 next, assuming that the ribbon of which Dr. Stoney had spoken lay in the direction from the sun to the earth. If, however, it were inclined, as they found reason to believe, the display would be retarded, and would come some time in the night between Nov. 14 and 15. Unless the distribution of matter round the dense part of the swarm at that part of the orbit was different from what it was at the part which we had just passed through, he was afraid there was very little chance of there being any such display as was seen in 1866. It was regrettable that the present generation should not have the opportunity of seeing such a display about which they had been reading all their lives. He was afraid that the next time the phenomenon came round, 33 years hence, many of them would not be in a position to look for it, so that this was the only time for very many of this generation, and it was really very unfortunate that it had turned out to be such a bad chance.

Captain Steele said he had some doubts whether the stream really existed. If it were a stream of any size and any dimensions, it should reflect light, and that reflected light should be shown on the photograph, if not seen by our eyes. Until he saw that the photograph had shown that this stream reflected light, he could not believe it really existed, but rather that these meteors were simply the creatures of our earth.

Mr. G. J. Newbegin said he had a feeling that we had lost the Leonids, and he would explain why. Since 1866 it was quite possible that the orbit of the Leonids might have been very much retarded and contracted by the action and influence of our major planets, such as Saturn and Jupiter. If such should be the case, the orbit had assumed lesser dimensions than it had had in past times, and in future the earth would miss the Leonid stream altogether. He only hoped he might be wrong, but that was the feeling he had about the matter.

Captain Noble thought it was to be regretted that the researches of Dr. Downing and Dr. Stoney were not made a little more public than they were. Up to the last moment they had many newspapers and magazines holding out hopes of something amazing in the shape of a display. There was no doubt there had been a great deal of penny-a-lining, as there always was on these occasions. He confessed that having read much that was written, he himself was not particularly hopeful. "Blessed," said a wise man, "is he who expecteth nothing, for he shall not be disappointed." He (the speaker) did not know that he expected anything. He was up on the morning of the 15th from midnight until two o'clock, and he thought he saw five meteors; but whether they were all Leonids or not he would be very sorry to say. When he said he expected nothing, he was bound to qualify that statement, for he was hardly in that condition. Perhaps his state of mind could be more accurately illustrated by the statement of the gentleman of the agricultural persuasion, who, when asked how much his pig weighed, said "Well, it didn't weigh as much as I expected it would—I always thought it wouldn't."

The Rev. G. Castleden thought they had had a rich harvest as a result of all the looking for the Leonids this time, in the tremendous interest which had been devoted to the matter, especially in such publications as the *Strand*, the *Windsor*, the *Standard*, and the *Echo*, and others. Although it might be said that those often got most out of it who made most ado, he thought astronomy had reaped a very rich harvest owing to this agitation. His object in rising, however, was to ask a question in reference to two phenomena which he had noticed, the first on November 13 and the other last Sunday night. He referred to very remarkable sunsets—sunsets of a brilliant golden crimson with a green sky, reminding him of those splendid sunsets in 1883, which were attributed to the dust from the eruption of Krakatao, and he had wondered whether the sunset of November 13 was sufficiently near to the time of dust scattered by the Leonids, and that of November 26 sufficiently near to the dust which might be scattered by the Andromedes to have any connection with the phenomena to which he had referred.

The President wished to ask Dr. Stoney whether the prospect of being able to photograph the Leonids next year before their striking the earth's atmosphere was better or worse than it was this year. Dr. Roberts had, he understood, made an unsuccessful attempt this year to photograph the Leonids before they struck our atmosphere.

Dr. Downing took it that the present year was the best chance Dr. Roberts had had in that matter, and that it was quite hopeless next year. He, Dr. Roberts, had attempted to take such a photograph on perfectly fine evenings, and had obtained no trace whatever of the Leonids.

Mr. Maunder read a précis of a paper on "Jupiter's Equatorial Current," by M. Comas Solà. The writer said that on examining the results obtained during several years by several astronomers, we could not fail to be surprised by the rapid changes in speed of the equatorial spots as compared to that of spots resting on the surface of Jupiter. In M. Solà's opinion, the cause was certainly outside the planet; but it was a satellite, or perhaps several satellites, invisible or small, very close to the primary, and with an angular velocity a little greater than that of the planet. The action of such satellites would be entirely on the equatorial region, and would be more ineffective on the lower strata of the atmosphere where were the equatorial bands and the great red spot than on the higher.

Mr. C. T. Whitmell read two papers upon kindred subjects, entitled respectively "Tides on Jupiter" and "The Shadows of Jupiter's Satellites." In the first he asked the question, "To what causes are due the remarkable surface changes continually occurring upon Jupiter?" and offered the opinion that the planet's high temperature was probably the main cause. The tidal action of the satellites had, however, also been suggested, and had been specially brought before him by Mr. H. J. Townsend, an able and assiduous planetary observer. In his second paper, Mr. Whitmell referred to some observations, which he previously published concerning a theory of the changes in the shape of the shadows of Jupiter's satellites during transit, and offered some additional observations upon the subject.

Mr. Crommelin said Mr. Whitmell had brought forward a very interesting point with regard to the change in the shape of Jupiter's satellites. He (the speaker) believed Prof. Schaeberle noted something about these changes four or five years ago. It was very curious that they had attracted so little attention. Of course, seen from the sun, the shadow would always be the same shape as the satellite itself. It was only the fact that we saw these shadows at an angle different from that of the line of sight from the sun to the planet that enabled us to see the change at all, and as Mr. Whitmell said that change never exceeded some 12° or so. It was certainly a point that observers might well look out for at the two quadratures of the planet, three months or so before and after opposition. The planet was then a good deal smaller than at opposition, and observation was rather more difficult, owing to the increased distance; but certainly it would be worth while to verify by careful observation these curious changes of shape. With regard to the question of tides referred to in Mr. Solà's paper, it seemed a very big order to require a new satellite—an unseen satellite—for these tides, and he (the speaker) thought Mr. Solà must have forgotten the extreme weakness of the gravitation force, which made it incredible that a satellite utterly invisible to us could produce such a striking effect by its action. The tidal action of an unseen satellite—a satellite too small for us to see—could scarcely be as great, in spite of the small distance, as that of the old four satellites. It would require many thousands of unseen satellites very near the planet. It seemed to him that these changes of rotation of different parts of Jupiter should be taken in conjunction with similar changes in the sun; there was probably a common cause for both. The different rotations at different latitudes of the sun had a very much wider relative range than those of Jupiter; but anyone who studied the different rotations of Jupiter should take the solar phenomena into account as well. He did not know whether Mr. Solà imagined several intramercurial planets to account for the changes on the sun, his theory, at any rate, would seem to require that.

Dr. Johnstone Stoney thought it would be of interest to mention that some 20 or 25 years ago, there was a paper published by the late Charles E. Burton, who was an extremely accurate observer of this phenomenon—of the elongation of the shadows when Jupiter was in or near quadrature, and who came to the conclusion that the mere oblique direction from which we viewed it did not fully account for the phenomenon, but that we must supplement that by some further operating cause, and that which Mr. Burton suggested was that the shadow penetrated obliquely—that is, obliquely as regards our point of view—down through an atmosphere of very great depth. The paper written by that observer formed an estimate of the depth of the atmosphere which would account for the amount of elongation which he observed.

Mr. Teasdale, who said he had made a great many experiments from time to time of the curious effects of photography, showed a slide which, he said, might be taken to represent something like a semi-occultation of the sun by a church steeple. It showed the absolute reversal of the image of the sun, and also somewhat excessive effects of irradiation. The plates used were Ilford ordinary. He regarded the subject as one which should be followed up, and added that the exhibition of this slide might be a suggestion to some who cared to experiment.

The President announced that they had some lantern-slides which had been prepared from photographs which had been taken by Prof. Keeler at the Lick Observatory by means of the 36in. Crossley reflector. This reflector, it would be remembered, was originally made and used by Dr. Common, from whom it had been purchased by Mr. Crossley. After having been erected at Halifax, it was presented by Mr. Crossley to the Lick Observatory, where it had been used for photographing nebulæ and star clusters with most excellent results. Prof. Keeler was, he thought, to be heartily congratulated at the success he had attained. The photographs which were then shown upon the screen and described by Mr. Wesley were as follows: (1) Spiral nebula in Canes Venatici, taken in 1899, May 10, with an exposure of four hours; (2) Spiral nebula in Ursa Major, taken 1899, June 8, exposure four hours; (3) Trifid nebula in Sagittarius, taken 1899, July 6, exposure three hours; (4) Cluster M 13 in Hercules, taken 1899, July 13, exposure two hours; (5) Ring nebula in Lyra, taken 1899, July 14, exposure ten minutes; (6) Dumb-bell nebula in Vulpecula, taken 1899, July 13, exposure three hours; (7) Great nebula in Orion, taken 1898, December 11, exposure one hour.

The President was glad to announce that the Rev. J. M. Bacon and Miss Bacon were present. They were all heartily glad when they received the good news that Mr. and Miss Bacon had finished their adventurous journey without any further mishap than that which befell them. Mr. Bacon had kindly promised to give them an account of that journey, and they would certainly all value his remarks.

The Rev. J. M. Bacon first referred to the exaggerated reports which had been circulated with regard to the injury which he and his daughter sustained in their descent, and then proceeded to describe the journey, which was made on Nov. 16, from Newbury, and which eventually terminated near Neath in South Wales. Incidentally, he said, he took upon himself his full share of blame for what proved to be a risky journey involving them in the unprecedented predicament of being aloft for nearly ten hours in a balloon that would not, and, in fact, could not, come down. They knew for certain the while, that it was travelling hour after hour towards the Atlantic (though they could not get a glimpse of the land over which they were passing), and in the end it came down of its own accord only a mile and a half short of the open sea. When it was arranged that he should make observations of the Leonids on behalf of the *Times*, he consulted their greatest authorities on the subject, Dr. Downing and Dr. Johnstone Stoney, and he was frankly told that if he would fulfil his commission properly he must have a balloon ready to start at any hour of either of the nights of Tuesday or Wednesday. He at once consulted Messrs. Spencer, the well-known aëronauts, who said the thing could certainly be done, but it would require a balloon that should be fitted with a solid or ripping valve—a valve that admitted of no leakage whatever, and no manipulation, so that it might stay in the air for many hours, and which, when once torn open, was torn open for good and all. All things being ready, he and his daughter made the ascent shortly after four o'clock on Thursday morning. At a height of 1,500ft. they entered a canopy of cloud. It was a warm, wet fog, the consequence being that before they could pierce it, the envelope of the balloon, which was a large one, became very heavily charged with condensed moisture. They had to throw out bag after bag to get it to pierce the cloud, and they then got into the cold upper current. This chilled the gas in the balloon, and rendered it less buoyant, and so sent it down again. Time after time they went up a little way, only to find the balloon descending again. They threw out as many as seven bags in twenty minutes, which meant about 3cwt., and then it was that their balloon seemed to have got its level and meant to keep there. There was no more delicate balance in existence than a poised balloon. They were then able to take observations. For the first hour they counted as many as seven meteors, none of them very striking, with one exception. One left a very lasting trail. In the second hour they were more frequent; but those that broke away upwards at that time (5 a.m.) were lost to view from a balloon such as this, for although they saw the radiant, the huge expanse of the balloon above them hid the trails that rose up towards the zenith. The most remarkable of all was the bursting of three or four meteors away from Orion in a manner which he had had never before witnessed. However, there were other things to look for. The most remarkable phenomenon was the colour of the stars. Sirius was seen flashing, not in gleams of red, but in several hues of

blue. Still more remarkable was the colour of the moon. He had seen it the purest white; on this occasion its colour was the dullest copper. There was no lack of definition. The purity of the atmosphere above was most remarkable. More noteworthy still was the dawn. It broke distinctly green at 5.58, and then all in a moment it developed into a great flood of light. He had never seen a sunrise anything like so sudden—not even in India. It had been stated in the papers that he entrapped a great quantity of fiery vapour by a special apparatus. As a matter of fact, he had wanted to carry out a suggestion made by Prof. Ramsay that he should draw a quantity of the air of the upper regions through guncotton to see if it left any special residuum of dust behind, but he had not yet tested his results—in fact, his belief was that there would be and could be no results. There was no possibility of their getting any traces of meteoric dust on that particular day. At dawn they realised that they were fairly caught in a trap. They were at a height at which it was impossible to open the valve. Their balloon had remained poised until then, but it would not poise much longer. The sun began to assert itself. The large amount of condensation on the silk began to dry, and the gas within began to expand with the heat, with the result that the balloon rose rapidly—at the rate, in fact, of 600ft. every quarter of an hour. This went on for two hours or more, until in the end they were nearly two miles high. For the early part of the time they could hear the sounds of earth, but these at last died away, and, while they heard nothing, they could only see the upper surface of the clouds, which, from its extreme whiteness, looked like the purest snow. The speaker then dealt with the nature of the upper currents, and, proceeding, said they came to the conclusion that there was nothing to be done but to let the balloon come down by itself. At about noon they heard the sounds of the pounding of great hammers, and they took it that they were over Bristol. Feeling convinced they were somewhere near possible help, they organised a system of aërial telegraphs, and, having written several copies of the following—"Large balloon overhead, above clouds; cannot descend. Telegraph to sea-coast (coastguards) to be ready to rescue, BACON, SPENCER"—they scattered them in mid-air. Only one of these had been traced, having been picked up on a Welsh mountain; the others doubtless fell into the Bristol Channel. Later they heard the splash of the waves on the shore—a continual sound as of explosion upon explosion; this was unmistakable. For some 20 miles, evidently, they were travelling over the sea. At last the balloon reached its culminating point, and when they next looked it had dropped 2,000ft., owing possibly to some cold current set up by the estuary of the Severn. They thus saw the beginning of the end, but it was two hours more before their monster balloon would at last succumb. As soon as they got through the clouds, the sun being shielded, their descent became rapid; but their aëronaut would throw out no sand until they were near earth. They fell a great distance with extreme velocity. It was the first impact with the earth that fractured his daughter's arm, and the balloon then dragged itself with considerable force over the rough country. It got caught in an old oak of considerable dimensions, carrying away a huge limb.

Mr. Bacon's remarks were illustrated by many excellent lantern slides, one being a photo. of the "Victims" (as he described himself and his daughter), after they had left the balloon. He added that many Welsh friends kindly came to their rescue.

The President expressed the hope that in future ascents Mr. Bacon would come out of his difficulties as well as he had done on the present occasion, and that Miss Bacon would meet with no further mishap.

Mr. Bacon, in making a brief reference to next year's eclipse of the sun, and the arrangements proposed to be made on behalf of the Association in connection therewith, said he had consulted one of the Transatlantic lines, and they assured him that those who wanted to witness the eclipse in America would find it easy enough to get there, but getting home would be the difficult matter, owing to the Paris Exhibition. It was necessary, therefore, that passages should be booked, at any rate, within a week or two from the present time. The voyage should not be very costly—pretty much, in fact, the same as on the *Norse King*, which was about 30s. a day.

The meeting adjourned at 7 p.m.

Drainage: Errata.—In the paragraph under this head on p. 357 some decimal points have been omitted. The error is fortunately evident.

According to the census of 1895, Saxony employs 27½ per cent. of all the textile workers in the German Empire, and upwards of 32 7 per cent. of all the persons employed in Saxon industries are in textiles. In 1895 165,459 persons were employed in the mills, and the power utilised amounted to 81,292H.P.

SCIENTIFIC NEWS.

It appears from the returns that have now been made that some Leonids were observed this year, but not in the quantity expected. Probably the earth was not in the exact position to encounter the full stream, but in 1900 or 1901 it should pass, according to calculations, through the centre of it.

The *Bulletin Mensuel* of the Royal Observatory of Belgium for July has been issued by M. L. Niesten from the Librarie Scientifique of M. L. Lagaert, Brussels. It is especially useful to observers of sunspots.

Mr. E. Walter Maunder, F.R.A.S., has an article in this month's *Knowledge* on Hippalus and its surroundings—a region which "presents a great number of features which are of peculiar value in determining the relative ages of the different types of lunar formation." It is illustrated (by permission) by the reproduction of a plate from the magnificent "Atlas Photographie de la Lune" of MM. Loewy and Puiseux.

It is announced that the Rumford Committee of the American Academy of Arts and Sciences has made a grant of 500dol. to Prof. E. B. Frost, of the Yerkes Observatory towards the construction of a spectrograph especially designed for the measurement of stellar velocities in the line of sight.

The anniversary meeting of the Royal Society was held as usual on November 30, when the reports were read, and the president delivered his address, the medals were presented, and the members of council were elected, the names being the same as those given on p. 290, with one exception, as, a nomination having fallen through, Mr. J. Bryce, M.P., was elected.

The address of the president of the Royal Society (Lord Lister) had reference chiefly to the modern systems of dealing with infectious diseases, by inoculation of "anti-toxins" and "anti-infectives." It was essentially technical, and will be read by experts with interest; but the gist of it may be given in the statement that there seems no reason why cholera, typhoid, diphtheria, &c., should not be stamped out by the modern methods of medical science. Lord Lister said that how long the protection caused by these protective inoculations would last was at present somewhat uncertain. It would, no doubt, differ in its duration in different diseases. In the case of cholera it appeared from Haffkine's results that it continued for upwards of a year. In plague, so far as could be judged hitherto, it would also seem to last for at least a twelvemonth. With typhoid there were not yet materials for forming an estimate.

Applications for a portion of the Government grant of £4,000 to defray the expenses of scientific investigations should be forwarded, upon the printed forms, to the clerk to the Government Grant Committee, Royal Society, Burlington House, W., by Jan. 31, 1900.

Amongst the papers that are in the list for reading after Christmas at the Society of Arts is one by Prof. W. Boyd Dawkins, M.A., F.R.S., on "Coal in South-Eastern England," and the following item of news may be of interest:—"Another thin seam of coal was passed through on Saturday at the boring at Ropersole, between Dover and Canterbury. The seam was 6in. thick, and of excellent quality. This makes the third thin seam passed through at this boring, which had been stopped for many weeks owing to a part of the machinery being lost in the operations. From fossiliferous evidence it is believed that the boring is passing through the upper coal measures. If so, the carboniferous strata must continue to a very great depth in this part of Kent."

At the meeting of the Society of Arts on Dec. 13, Mr. F. G. Aflalo will read a paper on "Sea Angling and Legislation." The concluding lecture of Mr. H. H. Cunynghame ("Art Enamelling upon Metals") will be delivered on Monday, Dec. 11, and will deal with the application of enamel to jewelry and with goldworking and gilding.

It is announced that Sir W. C. McDonald, of Montreal, whose gifts to the McGill University have made him justly celebrated as a benefactor to education in Canada, has placed in the hands of Prof. Robertson, Dominion Agricultural Commissioner, sufficient funds to establish for three years technical schools in various centres throughout the Dominion. The nature of the plan is to take one city or town in each province in which to establish regular classes in some of the ordinary schools on one or two days a week, in which scholars between nine and thirteen years of age shall spend a portion of the day in actual work with tools. This will be supplemented wherever desired by more advanced and special evening classes in manual training and technical instruction.

In a memoir presented to the Paris Academy of Sciences, M. H. Moissan says that the statement that anhydrous hydrofluoric acid does not attack glass is erroneous, as although the glass may retain its polished surface, it loses in weight. Experiments show that glass is invariably attacked by gaseous hydrofluoric acid even when that is thoroughly dried. Perfectly pure fluorine, however, may be kept in sealed glass tubes for some time without the glass being attacked.

At a meeting of the Society of Chemical Industry (Manchester Section), Mr. T. Aspinall read a paper on the oxidation of organic matter by liquid chlorine. He said that for nearly a hundred years chlorine had been used for oxidising colouring matter in cotton and other fibres and organic matter in the air. At the latter end of 1896 he began to carry out a series of experiments with chlorine to see what effect it would have on the oxidation of soluble organic matter in sewage and sewage effluents. The chlorine he used cost 6½d. per pound delivered. He described the experiments in detail, and claimed that they showed conclusively that the oxidising properties of chlorine are very effective. The chairman (Dr. Grossmann) and other members expressed the opinion that the cost of the chlorine would prohibit its use in dealing with large volumes of sewage matter, the chairman stating that for the Manchester sewage the cost would be between £30,000 and £40,000 a year for chlorine alone, to say nothing of the lime process, which *would* be used first. Mr. Aspinall, in reply to this, said there was nothing to hinder the Manchester Corporation from putting down chemical works and generating chlorine as a by-product.

The war is bringing into the newspapers notes which rarely appear in them. Thus it is stated that the Boers blew down the Frere bridge with roburite, which they probably obtained from the Natal coal-mines. It is one of the explosives specially authorised by the Coal-Mines Regulation Act. It was devised as an explosive which should bring down the coal in masses, without giving out any flame to ignite coal-dust or inflammable gas. In order to achieve this result, a mixture of nitrate of ammonium, of nitrobenzol, and chloro-naphthalene is employed in sealed cartridges, which must, according to the Act, be exploded by an electric detonator. The composition is defined in the "license," but the roburite is not a military explosive, and requires a powerful detonator to develop its force. Roburite is flameless, but a committee of the Miners' Federation reported in 1889 that, owing to the necessarily imperfect ventilation of a coal-mine, the health of the miners was injured by the nitric oxide and carbonic oxide gases set up by its explosion.

M. Curie and Mme. Curie have forwarded a note to the Paris Academy of Sciences, in which they state that radio-active chloride of barium possesses the property of converting oxygen into ozone—which is proof that the radiation represents an expenditure of energy.

It is stated that M. de Santos Dumont claims to have made a successful flight round the Eiffel Tower in his steerable balloon. "It is cigar-shaped, with a wicker car and a screw propeller. To drive the aluminium screw, which makes over 1,000 revolutions a minutes, he uses a petroleum motor. The car is constructed of rattan cane and wicker suspended from a steel trapeze by cord. There are two safety-valves made of aluminium. A very light japan silk is used for covering the balloon, a special varnish making the silk impenetrable by air." Why the "steel trapeze" and the safety-valves of aluminium should be introduced is rather puzzling, unless the reporter considered them to be important points in connection with a steerable balloon.

Sir Henry Tate died on Tuesday morning last, aged eighty years. His fortune was made by a machine for cutting or making sugar in cubes—an invention which other sugar refiners had refused to take up.

Mr. William Franklin Durfee, whose contributions to the *American Machinist* we have often quoted, died last month in his sixty-fifth year. He was a native of New Bedford, Mass., and early in life turned his attention to metallurgy and mechanics. In conjunction with William Kelly he produced some ingots of steel, from which, in 1865, the first steel rails rolled in America were made. Soon afterwards he established the first analytical laboratory as an adjunct to a steelworks in the United States. In 1876 he was one of the judges of machine tools for wood, iron, and stone-working machinery at the Philadelphia Centennial Exposition. Later he built the first successful furnaces for refining copper by the use of gaseous fuel. He had a collection of rare and curious books upon mechanical topics, which, it is stated, will go to the American Society of Mechanical Engineers.

The Westinghouse Electric Company are about to build the largest generator yet constructed. They are about to erect extensive works at Manchester, and have secured a unique order from the Manhattan Railway Company. The apparatus covered by the contract consists of eight three-phase alternating current generators, each of 6,650H.P. capacity, with such step-down and converting devices for the railway company's sub-stations as will be necessary to transform the alternating current in the power-house into direct current of 500 volts. These generators will be the largest ever designed or constructed. Their external dimensions will be something over 40ft., while the rotary element has a diameter of 32ft. Each machine and engine complete will weigh nearly a thousand tons. The largest electric generators ever previously constructed were of 5,000H.P. capacity, and these were by the Westinghouse Company.

The tendency to increase the heating surface in locomotives is growing in the practice of modern designers. It is stated that some new locomotives ordered of Stewart and Co., Glasgow, by the amalgamated S.E. and L.C.D.R. Co. are to have 30 per cent. more heating surface than the latest type of express engines placed on the company's lines.

USEFUL AND SCIENTIFIC NOTES.

Tensile Strength of Iron.—The tensile strength of wrought iron or steel appears to be a minimum at about 70° Fahr., and increases as the temperature is changed in either direction, becoming about 20 per cent. greater at about 500° Fahr. and at 60° below zero. There are indications of a brittle region at the temperature of steam at 5lb. to 10lb. pressure. Iron at low temperatures, while increasing in strength, retains its ductility. In the case of cast iron the tensile strength remains constant from 70° Fahr. to 700°, decreasing from that point to zero at 1,240°.

THERE are now three Scherzer bascule bridges across the Chicago River, one being a four-track railway bridge, while the others are highway bridges. Two other bridges of this type are now to be erected, to replace old swing bridges whose centre piers are to be removed in order to give the river the necessary capacity of flow required for the Chicago drainage canal. The bridges will give a clear channel of 120ft. between the guard piles, measured at right angles, and the river will have the required capacity of 300,000c.ft. per minute.

Blocking Out Skies.—Many negatives have what are known as "dirty skies"—that is, the sky of the negative is thin in parts, thus making a muddy or tinted sky in the print. If clouds are required on the print, the sky, of course, must be perfectly white, otherwise they would print in flatly. There are two methods of blocking the skies out on the negatives—painting out and pasting out. The former is the one usually resorted to, and is done as follows:—Obtain a tube of ivory black oil paint, a small sable, and a hog's-hair brush, also some turpentine. Squeeze a little of the paint out, and carefully paint round the edge of the sky against the horizon. Care must be taken that the colour does not overlap any part of the view. Next use the hog's-hair brush, and paint all over the rest of the sky. Every bit must be covered, or it will print patchy. The sky must look perfectly opaque when viewed by transmitted light. The only disadvantage to this method is that the paint takes several days drying. The other method is to do an untoned print of the negative, place on a glass film, side up, and with a sharp penknife carefully cut away the view, leaving the sky intact. Then smear some thin paste all over it, and place on the sky of negative, to register exactly. If carefully done, the sky will print perfectly white.—"O. T.," in *Photographic News.*

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

VARIABLE STAR OBSERVATIONS, NOVEMBER, 1899.

[43090.]—T CASSIOPEIÆ passed a minimum, 11·3 magnitude, September 29. The interval since the previous minimum, 1898, July 31, is 425 days. By the end of November it had risen to about 10 0 magnitude.

S Persei has been slowly declining for the last five months, and was observed 10·0 magnitude, October 25. This was the faintest magnitude of the star since July, 1893. The changes are very slow, and the extreme range during ten years observations is about three magnitudes.

R Ursæ Majoris has gone down about five magnitudes since the maximum on August 12. At the end of November it was 12·5 magnitude, and for the next two or three months will be a very faint and difficult object. The minimum will probably occur about the end of January, 1900.

R Camelopardi has made a rise of about three magnitudes in the last four weeks, and will for the next three months be a conspicuous object. The maximum will probably occur about the middle of January, 1900, when the star will be about 8·0 magnitude.

S Herculis has declined rapidly during November, falling from 8 2 magnitude on the 6th to 9·5 magnitude on the 26th.

S Cygni, after remaining invisible for about 184 days, was first observed on its reappearance Nov. 10, when it was a most minute 13·5 magnitude, and about the limit of vision for this telescope. The magnitude was 12·5 Nov. 26, and it will soon become an easy object.

Instrument in use 6·4in. equatorial refractor. Weather has been very unfavourable, with much dense cloud. Observations were only possible on eight nights. C. E. Peek.

Rousdon Observatory, Lyme Regis.

AMATEUR'S OBSERVATORY.

[43091.]—WITH reference to the friendly remarks and criticisms of Mr. Jenkinson (letter 43050) on the above subject, I should like to remark generally that I have had little or no experience in small telescope houses. This particular house was designed to meet my general requirements, the details being all carried out by my highly intelligent and practical master artificer, who I am pretty certain knew nothing about observatory needs when he started this job. Hence some of the work may not be in accordance with the regular type.

As to rollers, no doubt Mr. Jenkinson is right. Larger ones than those I have would work easier, especially when the iron bars mentioned are used for the rollers to run on. But, as a matter of fact, I do not notice very much friction at present.

As regards the roof, four iron hooks are provided inside building at top, which engage in iron staples on the roof. These effectually hold down the roof, and if that went, the house would have to go with it. It is only a short time back we had a heavy gale, when a vessel was wrecked in Plymouth Sound. The morning after we were pleased to note that no damage whatever had been done to the "house." It was still (nearly) as firm as a rock, and quite dry inside.

I think the idea of the roof divided into two parts an excellent one, as each part must obviously be easier to move, and a portion only can be opened as required. I find a great convenience in my roof is leaving it 18in. or 2ft. "on" at the E. side. I don't usually observe low down in the eastern sky, and that portion of the roof not "off" makes a shelter for books and papers, as well as the observer recording his notes, an aid not to be despised on a cold dewy night.

Then, as to the pulleys: doubtless they are most convenient, provided your runners and roof work perfectly smoothly; but as the pull is limited to only one direction, I can easily imagine a case where a jam would occur, necessitating application of pressure by hand direct on the roof. We thought of pulleys at first, but for some reason or other did not try them. First we had a strong stick or handle with an iron crook and loop, so as to be able to push or pull roof as desired. This was a failure, and was discarded in favour of iron handles. With your back to the wall, and a good grip of the handles, any tendency to jam or sag is easily overcome, and the roof runs off merrily, but not all the way, for the telescope obstructs the movement. Then comes the necessity to step outside and complete the motion by "walking the plank." The whole operation only takes a minute, and the roof can be closed "home" by one motion from the outside. The handles are simply plain pieces of round iron about ½in. diameter, and are secured firmly to the central rib of the roof, from which they project horizontally in three pairs, one on one and one on other side.

In query 97066, "Nemo" asked about an observatory lamp. For years I have used a tin candle lantern, black japanned on the outside. Two arches of tin at top, open at sides, and at right angles to each other, prevent the handle at top fall getting inconveniently warm, the handle itself being triangular with flat side uppermost. The lantern is square in section, the sides being all tin, except one which has a small window inserted say 3in. by 3in. This is glazed, and is used to throw a light on the observer's path to the observatory, which is over somewhat uneven ground. The side opposite the glazed part is hinged to open and shut. A small piece of blackened tin is kept ready for sliding over the window, thus shutting in all light (or nearly all). On recording the observation, the door is opened as required and closed again for next observation, the window being kept closed during the hours of observation. Four circular holes are bored in the floor of the lantern for coolness, the floor being supported on four little points of tin about ½in. high. When using good *hard* candles, I have found the lamp do very well. Just towards the end they do run a little, but the wick lasts until it commences to flutter, when a fresh piece of candle is popped in, the heat of the socket fixing the new piece at once. Occasionally one has to furbish up the whole concern, and clear out any wax that may have accumulated on the floor. This may be all very old-fashioned, and no doubt inferior to the electric light. Still it answers the purpose, and I do not propose to change it. The lantern could be made to order by a tinsmith for 2s. at the outside.

Devonport, Dec. 1. E. E. Markwick, Col.

SODOM DESTROYED BY THE LEONIDS.

[43092.]—THE "F.R.A.S." talks (p. 359) of my "habit of arguing merely for victory," but I should like to know for what he argues. He cannot mention the destruction of Sodom without inserting "mythical." Simply because Christ referred to it (Luke xvii. 28) as equally certain with His own return to judge the world, a Jew cannot mention it but as "mythical." We must even "*remember* Lot's wife," as "Silverplume" says, p. 360, to deride the whole story of her. I never repudiated "Usher's chronology when it conflicts with" my wild assertions, but only when it conflicts with the genuine Bible, and all other good chronology. In fact, Ussher was a painstaking and learned chronologist, and eminently to be believed where he reasoned from genuine records, which means, in all dates subsequent to the birth of Abraham.

That is the very last event wherein the various copies of Genesis agree. Before it they all differ, and indicate plainly how their differences arose. The Jews, or rather their Rabbis, in our first century, altered the numbers in a systematic manner, to reduce the age of the human world, that it might appear the time for the Messiah was still future. But the incorrupt figures in Genesis agreed exactly with the Hindoo chronology, and this agreement, a most remarkable one, is kept entirely out of view. The Hindoos, unlike the Jews, had no religious motives for keeping up false chronology. Their date for the Deluge is, therefore, always kept unaltered, and it agrees with that of the Samaritan Genesis, the only copy moreover, of Chap. xi., where the complete life of each patriarch is given, ending with the phrase "and he died." In our present copy of Genesis xi., we cannot really prove that any of the men named, between Shem and Terah, ever did die. They may each have been translated like Enoch.

Neither Ussher nor your "F.R.A.S." can have ever arranged the lengths of the patriarch's lives in a scale like this—

Had they done this, it would at once have been obvious to "Ussher" or any modern that all those from Adam to Abraham have been carefully doctored, to shorten the whole time. The Greek copy alone keeps all the full numbers. The Samaritans were cunning enough to alter only those of Chap. v., thus leaving the true date of the Deluge; but the Jews altered those of Chap. xi. besides.

Leverrier's story of the Leonids originating in A.D. 126 is utterly disproved. He reckoned from

an estimate of the comet's period, made only from the single appearance in December, 1865, and January, 1866. This estimate, 33·18 years, was a wonderfully good one, perhaps the best that ever was made from a comet's single visit. But the identifying the comet with that of 1366 alters the whole problem utterly. The shortest period really allowable now is 33·295 at least. That exceeds 33·18 by ·115 of a year. We have to go back 52 periods, and that makes the approach to Uranus's orbit six years earlier. It disposes utterly of all Leverrier's reckoning. Indeed, his making any, from such data as he had, was foolish. Even Uranus's period is hardly well enough known. The comet's is now better known than that of Uranus, in the proportion that 499 years exceeded the time since Uranus was first observed, which was in 1690, barely two centuries ago. E. L. Garbett.

IS THE UNIVERSE FINITE?

[43093.]—WE may not be in a position to decide whether the universe is finite or infinite; but in considering the question it is important to get rid of some superficial misconceptions which render many persons blind to the force of argument in favour of finiteness—an argument which is at all events difficult to answer.

As regards the total light or total heat of the sky, it is obviously of no consequence whether we have a single star of the brightness of Arcturus or a million of stars, each giving one-millionth part of the light and heat of the latter. And, again, it is of no consequence in what way this million of stars is distributed over the sky. The light and heat does not become inoperative because it ceases to be separately perceptible even with a fine instrument.

Now the broad fact is, that on the theory of an infinite universe we should expect the general illumination of the sky—the total starlight—to be enormously greater than it is. Enormous distances and consequent extreme faintness are suppositions that answer very well when we are dealing with individual stars; but they entirely fail when we are treating of classes of stars whose individual faintness ought to be more than compensated by their number. The total light and heat of the sky is made up of an aggregate of very small quantities, for the most part separately imperceptible. The remarkable fact is that this aggregate is so far short of what we should expect.

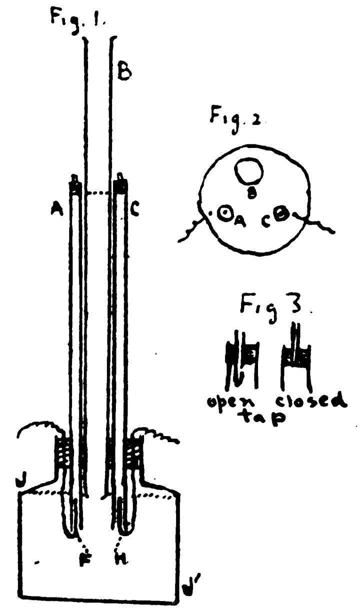
The spurious discs of the stars deceive us as to the portion of the sky that is really covered with them. The surfaces of the stars composing a cluster like that in Perseus or Hercules are probably as bright as the surface of the sun. But how vast is the difference between the brightness of that little grey patch and that of an equal angular extent of the sun's surface? Probably no such patch has $\frac{1}{100}$th of the brightness of an equal angular extent of the moon's illuminated surface, which may be set down as $\frac{1}{500000}$th of the sun's. The inference appears to be that even in these dense clusters the interspaces exceed the genuine star discs in the proportion of 50,000,000 to 1. W. H. S. Monck.

THE MOON AND THE WEATHER.

[43094.]—THE moon has nothing whatever to do with the weather. That is dogmatic, but it is true, because the place of the "weather" must be defined, and then, if the moon is brought in, it will be found that the weather at A is different to that at B, even in these islands; and if the moon has anything to do with it, how account for the variations which, thanks to the telegraph, we know occur? The "terrestrial pulsation" mentioned by Mr. Schucht (p. 361) will not do, for is it a fact, or does anyone suppose, that the weather in London is the same at any given date (allowing ample margin) as it is in, say, California or South Africa? The fact is (so far as is known) that weather is purely local, and, whatever may be the cause, it seems certain that neither the moon nor terrestrial pulsations can have anything to do with it. S. R.

ELECTROLYSIS OF HYDROCHLORIC ACID.

[43095.]—THE failure of this experiment is evidently due to the resistance of the liquid in the quill tubing, as already surmised by "Technicus," letter 43071. A simple and efficient substitute for Hofmann's apparatus is shown in the inclosed sketch, and can easily be constructed out of the material you already have with but little addition. In Fig. 1 S S' is a wide-mouthed jar or bottle, fitted with a bung about 3in. in diameter. A and C are your 2½in. tubes, and B is the 1in. one, all passing through holes bored in the bung. The relative positions of the three tubes are shown in Fig. 2, and in Fig. 1 it may be noticed that the tubes A and C dip further down into the jar than B. The platinum electrode F, and the graphite one H (a short length of ½in. arc-carbon is much better) are suspended in the tubes A and C by means of bent and well-paraffined copper wires, the ends of which project through the bung (which is also well paraffined) for battery connections. The taps of A and C are opened, and acid poured into B until A and C are quite full. The levels of the acid in the jar or in B at this point of the experiment are shown by dotted lines in Fig. 1. Before use, the pure and concentrated acid is saturated with chlorine gas by bubbling it through the acid until it attains a deep-brown colour and gives off chlorine freely at ordinary temperatures. The chlorine prepared by the usual method of acting upon manganese dioxide with warm and concentrated hydrochloric acid may be used. By using this prepared acid I have found



that after a few minutes unequality (perhaps due to occlusion of chlorine in carbon), the gases hydrogen and chlorine come off in almost equal volumes. If the above instrument is carefully-made and mounted upon a wooden stand, it has quite a high-class appearance, and, what is of more importance, works well. An extremely neat and simple tap for tubes A and C, is shown in Fig. 3, and consists of a short piece of glass tubing closed at the lower end, and with a small aperture fitted in its side. The tap is opened and closed by sliding the aperture out and into the cork which is inserted in the ends of A and C, as shown in the figure. As to the second part of your letter, just as in the electrolysis of sulphuric acid and water and nitric acid and water, the water *does* enter into the electrolysis of hydrochloric acid. According to Grothuis's theory, regarding hydrochloric acid for simplicity as H_2Cl_2 and water as H_2O, you have H_2 liberated at the platinum electrode, and the nascent Cl_2 thus liberated seizes hold of the H_2 of the nearest molecule of water forming H_2Cl_2 and O. The nascent O then unites with the H_2 of some more hydrochloric acid forming OH_2 and setting free Cl_2. The action is thus passed on till you have Cl_2 free at the carbon electrode, thus—

$Pt\,(H_2Cl_2)H_2O(H_2Cl_2)\,C$ before electrolysis.

$Pt\,H_2(Cl_2H_2)(OH_2)Cl_2\,C$ after electrolysis.

Chemical.

NATURAL HISTORY STORIES.

[43096.]—IN the winter of '82, I think the winter of the great blizzard, I had the pleasure of company to breakfast a robin for better than three weeks. He made his entry one bitter morning when it was a very hard frost and three inches of snow upon the ground. He tapped at the breakfast-room for admittance; when the window was opened he flew in and mounted the breakfast-table, and seemed quite at home. After breakfast, if the weather was fine or sun out, he would go away, only to return just before sundown. At night I would find him perched upon the corner of the bedroom-door, and we left the door open for him, not liking to disturb him. When I passed he would always greet me. My duties called me up at 5.30 of a morning. He would always greet me; but otherwise did not seem disturbed. Some boisterous heavy snowy days he did not go out. One morning, after breakfast, the snow having disappeared in great patches exposing the ground, being when I made my exit to return to my duties, he gave a chirrup and disappeared with me, and we have not, to our knowledge, seen him since.

We had a large black buck rabbit that used to run about the house tame like a cat. I was residing at Westminster then, and he was a pet with over 200 workmen that used to come to and fro. He used to make his way into St. James's Park, and led the police a nice game: he was a fine fellow, with drop ears. At last the police caught him, and took him to Charles-street Police Station for trespass. I had to go and bail him out and be responsible for his future good behaviour.

Many times, when writing or making sketches for the "E. M.," I have had a canary perched upon my shoulder or on the top of my head, or a large red-and-white Tom cat perched upon my shoulder, combing my whiskers with his long talons, and driving his cold nose in my ear; and if turning or fitting, he would come and mount my shoulders, and hang on like grim death, talking and answering me in his way.

When writing, I have had pet rats, white and piebald, working their way down my neck to get around my breast or lodge themselves in my shirt-sleeves, which was a favourite place with them.

One place where we resided we had a visit three seasons from a family of swallows, who persisted in coming down the chimney to be let out of the bedroom window. My wife persisted that it was the same family every year.

When visiting an elderly person, who was a widow of an old Waterloo veteran, I tapped at the door, when a voice says, "Come in, please; but gently, or you will frighten my poultry." I did as desired, when I saw a sight such as I had never seen before or since. The old lady's window had three panes of glass once; but she had the centre one taken out, and a long board fixed in at the bottom of the entry, thus forming a platform inside and out. When I entered I should say there were over twenty sparrows scrambling over one another, and playing all manner of pranks, and thus afforded this poor, lonely old lady many an hour's amusement in watching them.

However, my business with her was to bring trouble, for the house that she occupied a sky-parlour in was wanted;—it must come down to make room for improvements. I was very sorry for her. I promised to find her a place and see her comfortable; but the old lady grieved very much, as she would lose all her pets, as both she and I thought; but no such thing. Although some considerable distance away in a more confined locality and a first floor instead of third, in a very few days they found her out, and when I visited her I found her with her flock and quite happy.

I see in one of the magazines that a naturalist, and many doubt the statement, that a viper swallows its young when they are in danger. I was an eye-witness of such a performance when making my way from Wood-street to Pitch-place, near Worplesdon, Surrey. It is a thing that very few have a chance to witness.

Jack of All Trades.

"FLYING" CRABS.

[43097.]—CAN any of your readers give some description of what amongst Cornish fishermen are known as "flying crabs"? It appears that recently one of the Port Isaac herring-boats took in its drift nets upwards of 100,000 small "flying" crabs, which by means of two long thin blades or fans at the rear of their bodies are enabled to propel themselves through the water like an ordinary fish, and with much rapidity. The chagrin of the men was great, as many hours of patient toil were required to clear the meshes of these tenacious crustacea, and with a probability of considerable damage to the nets. Another boat was burdened almost to a similar extent. It is thirty years ago since any Port Isaac fishermen had such a peculiar and unprofitable catch. The nets then had to be spread out as far as was practicable in a field, and left there for some days until the crabs were dead.

It would be interesting to learn the size of the mesh of the nets and also of the "flying" crabs, that they are caught in such numbers. Are they sprat nets? Dormus.

POISON IN FISH.

[43098.]—I LATELY received some whiting, as usual, from a smack-owner at Grimsby. As to freshness and general appearance of excellence, they were all that could be desired. They were cooked on the day of arrival, and four persons out of seven who partook of them were seized with sickness, three of them immediately and suddenly, two being members of the family and the others the cook and another servant. The symptoms came on about 15 or 20 minutes after beginning to eat. They were sudden cessation of appetite, nausea, giddiness, fulness of the head, and a strange feeling in the arms; in one case in the legs also, described as a shaking with weakness, but without any actual spasms or movement, except in one case, where there was actual trembling. The two members of the family immediately got rid of the contents of the stomach by vomiting, and the cook vomited four times at intervals of about ten minutes from the invasion of symptoms.

The cook's description of what she felt is as under: "About 20 minutes after beginning dinner, felt something first in the arms, as if there were something rising up in all the sinews of the fingers, as if being drawn; then same feeling went to back of head. No pain; then a curious trembling feeling began in stomach, and worked all the way up until

I was sick; lump in the bottom of my throat; nausea and vomiting in ten minutes."

The second servant who suffered felt nothing till about three hours after eating, when she had what she called a "trembling inside," and not in her arms, which soon passed off.

It is thought that the illness in all the four cases was caused by a single fish, of which the two members of the family took each a little, not more than ten minutes before the symptoms came on, and the cook afterwards took a larger quantity, and the other servant affected only a very little. In two of the cases there was very slight bowel disturbance shortly after. In all the cases except the last there was still some feeling of ailing even next day.

I should be interested to have any probable explanation of this case. What poisons are there which can act in this way with such rapidity? Ptomaines, so far as I have observed, produce no sensible effects for some hours. What else can be reasonably suggested? L. C.

STONEHENGE.

[43099.]—It is from the evidence of the tumuli that I am led to believe that the great monument of Salisbury Plain is of a high antiquity. The contents of these tumuli indicate for *them* the date of the "Bronze Age," so-called. Within these tumuli have been also found pieces of the stone, which has been used in the erection of the circles of Stonehenge. This stone is not found naturally anywhere in the neighbourhood, Salisbury Plain being a chalk formation. Hence probably the stones were erected *before the tumuli were raised*. To attempt to *calculate* the age of Stonehenge from any astronomical data seems to me the height of absurdity; but the general public are easily misled by statements such as "that Prof. So-and-So has determined its age by astronomical calculations." F. B. Allison.

POLISHING AND GRINDING MACHINE FOR GLASS SPECULA.

[43100.]—As promised in my last letter, I now send you a photo. of Mr. Glass's machine for grinding and polishing glass specula. The largest size of mirror worked has been 8in.; but, with slight alterations, it would take a much larger disc. The following figures give the ratio of the various movements:—48 revolutions of driving-handle to 1 of speculum, 19 of ditto to 1 of oval wheel, and 240 of ditto to 1 of tool.

Two tracings, executed by a duplicate of this machine, which was made by a gentleman in the district, appeared in your issue of July 23, 1897.

Dalbeattie, Nov. 18, 1899. Alex. Smith.

DIRECT POSITIVES.

[43101.]—Mr. Dormer (43082, p. 361) states: "The negative image is first developed, then removed by persulphate of ammonia." There is no need to destroy the image by persulphate, for if the plate be removed from the developer directly all necessary detail is out, the negative image formed will be very thin, and another exposure may be made (prior to fixing, and through the film, of course) by gas or other light, and a fairly satisfactory positive obtained. When fixed, provided development has not been allowed to proceed too far in the first place, the negative image can scarcely, if at all, be perceived. By this method, when a plate is much under exposed, a positive may be made, and subsequently a negative obtained, which will be more satisfactory, at any rate as regards density, than would be the case had development been allowed to proceed in the ordinary manner. A better result will be obtained by using rodinol, metol, or other detail giving developers.

Earlsfield, S.W. Silverplume.

DENSITY AND SPECIFIC GRAVITY.

[43102.]—"Technicus" (letter 43037) is puzzled about the meaning of these terms. They are very often used loosely one for the other. In textbooks of physics, "specific gravity" is the term more generally used, the standard of comparison being water in the case of solids and liquids, and air in the cases of gases. In textbooks of chemistry, on the other hand, the term "density" is the more usual. The standard of comparison used is hydrogen, and the density of a substance will thus mean the ratio between the weight of a given volume of the substance in the state of gas compared with the weight of the same volume of hydrogen, the pressure and temperature being the same in the two cases.

Density is also used in a more limited sense, as the ratio between the amount of matter in a body and the space it occupies; thus, taking the foot and the pound as our units, a body has unit density when one cubic foot of it weighs one pound. According to this standard, the density of water is $62\frac{1}{2}$. Avogadro's law is all right. Molecules are supposed to be all of the same size, but of different weight; and therefore equal volumes of gases, though equally compact in so far as they contain the same number of molecules, will not have the same weight. A molecule of carbonic acid is 22 times as heavy as a molecule of hydrogen, and therefore a million molecules of carbonic acid will weigh 22 times as much as a million molecules of hydrogen. Density.

THE ORIGINAL STATE OF CARBON IN NATURE.

[43103.]—When in the company of a friend the other day, we had occasion to discuss the original state of carbon—i.e., before any organic structures existed to bring it into circulation in the economy of nature as we now see it.

We all know the existence of animal and plant life would be an impossibility without carbon in some form or other; hence, from the very dawn of all organic life, the original, natural store, whatever and wherever that may have been, of this element must have been drawn upon to maintain the necessary chemical changes which always accompany manifestations of life on our plane. As a consequence of this, there is but a very limited quantity of carbon, it seems to us, which has not at some time or other in the earth's history been used by, and formed part of, animal and plant structures. As far as we can see, excepting the carbon dioxide in our atmosphere, the only large store of carbon we have is contained in the coal-measures, and in the limestone rocks as a carbonate; but these cannot have been its original states, since both of these, according to the teachings of geology, are petrified plant and animal remains.

The question arises: Where and in what form did carbon exist originally? In the air as carbonic acid or in the earth in combination with metals and minerals?

According to textbooks of chemistry, there is some carbon in combination with inorganic substances in nature, such as in sea-salt, barium, ironstone, &c., as well as in a nearly pure state in the diamond. But the quantity from all these sources combined would only be infinitesimal as compared with that which has been, and is, in circulation for the use of organic life—i.e., in the coal, in the limestone rocks, in the structure of plants and animals, and in the atmosphere.

Carbon is a most interesting element in many respects. It has not been, so far, produced as a liquid or a gas, and it has the curious property, in a higher degree than any other element, of "uniting with itself." But what renders it still more interesting to the student, is the fact of its inseparable connection with the very existence of all forms and manifestations of terrestrial life.

Lower Brynamman. D. J.

THE DIALYTE.

[43104.]—Replying to the kind letter by "H." (No. 42983, p. 276), I would say the old Gregorian gives me every satisfaction that could be expected from an instrument of its limited aperture ($2\frac{1}{2}$in.)

Lunar views by it are magnificent, and its extreme sharpness of definition is always a matter of surprise and satisfaction. I may mention in passing that its focus is so sharply defined that, when correctly adjusted, a movement of the small mirror of one-fiftieth of an inch either forward or backward is quite sufficient to confuse the view, which seems to me to prove that the figure of mirrors is very accurate. But it is a very small mirror telescope after all, and its powers are quite limited. I have been unable so far to see the companion to the Pole-star with it, but hope to do so on some very clear moonless night. I think perhaps its most striking effects are when used upon terrestrial objects at eight or ten miles distance, the amount of detail shown and the clear definition of small objects being very surprising in an instrument of its size.

I wish also to express my thanks to "H." for furnishing the address of Mr. Ingall; but I do not think it will be necessary to write him at present owing to the results I have reached in experimenting with the dialyte.

I have received several letters from American readers of the "E. M." since you published my inquiry, all giving me advice on the subject, most of which was to the effect that the dialyte was useless, and one of them kindly gave me several references to back numbers of "E.M.," among them being one at p. 61, Vol. LVI. Having looked up all of these references in a public library, I find this particular one to be the only one of interest, and note that the writer speaks of a strong display of colour in the borders of the field of view, although

the centre was achromatic and satisfactory. Now, although this writer's instrument was a dialyte of the crudest possible construction, yet this statement, taken in connection with all I had received from other sources, was very disquieting, and I determined to find out some facts for myself without delay.

I had already finished the mountings of the corrector lenses, and on November 16th I proceeded to mount everything on the wooden bar that I had used originally, and fix it so that it could be directed to the Pole-star, and rigidly held in position. I selected the Pole-star, as it has practically no motion, and so I would not have to follow it; the instrument once fixed in position could remain so while I changed its details and adjusted its parts. Again, I thought the small companion to this star would prove a good object to test the definition of the margin of the field of view in comparison with its centre. I provided enough movement to the eye end of the instrument to enable me to get the star into any portion of the field I might select for trial.

Having all ready, and the night proving fairly clear, the process of adjustment began, and you may readily believe I found out a great deal about the dialyte. Not to weary you with details, I will merely say I found that the position of the corrector lenses had to be materially changed from that which I gave in my first letter, and which was found from terrestrial observation alone. The lenses remain in the same relative positions—viz., crown lens nearest o.g., with convex side towards o.g., flint lens nearest eyepiece, with concave side towards e.p.; but the distance from o.g. to first surface was reduced to 25¼in., and the lenses of corrector require a separation of very nearly ⅛in. The focal length of the combination is now 56in., and it is perfectly achromatic, while there is no difference perceptible in the definition at any part of the field of view. The Pole-star and its small companion are both satisfactory in this instrument, the small star showing beautifully distinct to the extreme edge of the field of view, with a power of 65.

I am now satisfied that the telescope will prove a very good one, and shall proceed to finish it up on these lines, and will try to give you particulars of its performance when finished. I will also send you some sketches of the details after a time, if you think they would prove acceptable, for I have introduced some novelties into the corrector mounting and the eyepiece end, designed to give rigidity, and provide for ease of adjustment.

I thoroughly agree with "H." regarding the poor workmanship in many telescopes, even by professional makers. A friend of mine has a very good 3in. achromatic by a well-known American maker, and the straight adapter fitting into the bushing of draw-tube at one end, and carrying the eyepieces at the other, having been lost, he came to me to get a new one made. I found that the bushing of the draw-tube was neither round nor straight; nor was the screw by which it was held true with any part of the crooked-bar.

Yet this was supposed to be "good enough" for a telescope. A steam-engine built with as little regard for truth would never be expected to give satisfaction; but a telescope is supposed to be all right any way, and the amateur constructor calmly sets his lenses in paper tubes, and squints at the heavens and then remarks that the lenses are not quite perfect; but, on the whole, they are pretty good.

I wish "H." or some other competent authority would give me a rule for finding the proper diameter of diaphragm opening, and its position in relation to the lenses for the Huyghenian form of eyepiece, as I intend to purchase the lenses and make my own eyepieces, and can find no rule for the diaphragm. E. P. Clark.

245, West 18th-street, New York.

ON THE ANGLES OF THE EDGES OF SLIDE-REST TOOLS.

[43105.]—Having been busily engaged away from home, I did not see my English Mechanics until after the publication of "D. H. G.'s" two articles in your issues of Nov. 17 and 24. Being familiar with the numerous contributions of "D. H. G." in back volumes, I should not have made any observations on the recent articles but for the fact that he has made statements of mine the occasion of rehabilitating Prof. Willis's theory of the possible value of double-cutting edges—a theory, by the way, which the Professor only expounded "in the hope that someone with the proper opportunities will be induced to make experiments upon the best form and edges of tools for different materials."

The fact on which I take my stand and justify what I have written on the subject is, that for all practical purposes, and in probably nine cases out of ten, the angle, as given in my diagrams mentioned by "D. H. G."—that is, the angle included between the top and front faces of a tool—is taken as the "cutting angle" in all machine-shops. The top rake, and the clearance, and the tool angle included between them are measured along the middle plane of the tool. And in this sense, nine tools out of ten, doing good work, will be found to be single-edged tools.

As regards the Smith and Coventry tool-points, "D. H. G.'s" remarks on p. 307 exaggerate what occurs. He speaks of the metal engaging the edge of the elliptical cutter where its decrease of acuteness may amount to 70° or 80°, or even more. Well, it may amount to 70° in a very heavy cut, but who would think of forcing a cutter nearly half its section into metal? Besides, the cutting angles would not be 70°, 80°, or 90°, because of the angular setting of the tool-point in the holder.

As regards this tool-holder, I knew it a dozen years ago, and believe that it is used by engineers more than any other type which has been ever invented; and as to Prof. Smith's remark that the cutter is apt to slip, I never noticed such slip to occur, for the grip is too powerful. The only thing is, and that is common to all tool-holders without exception, the tool-point becomes heated on heavy duty.

If the principle of double edges, so ably enunciated by Prof. Willis, had possessed any real practical advantage over the single-cutting angle, would it not have survived in the stress of keen competition? Even Prof. Willis admitted that it is convenient to consider only the angle which the upper plane of the tool makes with the line of the front angle. It is curious, too, that Prof. Willis advocated a pointed-tool in preference to a round-nosed one. Yet modern practice uses the latter in preference to the former, and the heaviest slogging is done with such tools.

The main point raised by "D. H. G." is that in the one-cutting-edge system the edge contains only a single point in which the cutting angle remains constant. That, though obvious enough, is not a matter of so much importance. For if there is one lesson more than another which machinists learn, it is that the angles of tools may vary considerably, without seriously affecting results. When a turner sets his round-pointed tool diagonally towards the work, he takes off great curling chips with ease, notwithstanding that the angles of the tool vary round the cutting section.

"D. H. G." quotes Prof. Smith, to the effect that it is not only the front edge, but the side of the edge of a tool that cuts. But the Professor, nevertheless, does not advocate the double-edged system; his work is based on the single-cutting-angle types of tools. Of the double-edged type he says distinctly: "There does not appear to be any advantage in this form," and much more to the same effect, which I need not quote (p. 159, "Cutting Tools.")

The advantage in double-edged tools, as pointed out by Prof. Willis, is, that one edge cuts the main shaving, while the other severs it cleanly. This is a point of value in hand turning. But with slide-rest tools and ample lubrication in wrought metals, the engineer roughs out more expeditiously with a round pointed tool, and smooths with a broad faced tool, the latter taking off a mere scrape. In each case he is troubled with but one cutting angle, and that is the single-cutting angle which we have in the chisel, the plane, the gouge, the axe, and myriads of other tools.

As an old reader of the "E. M." I was once familiar with "D. H. G.'s" and "O. J. L.'s" contributions on the subject of tool edges. All the same, I do not accept that system as of much practical value. I doubt not it is an extremely worthy basis on which to fashion hand tools, and tools for the lighter classes of slide-rest turning. But I do not think it has any advantages over the system based simply on the angles of front and top faces, while for heavy cutting I should deem it much inferior.

A word about myself. "D. H. G." warns the novice to distrust such books as take the "cutting angle" for the standard by which to estimate angles, and seems to class me with the writers of books who should be distrusted. It is rather inconsistent in "G. H. G." to throw mud at "books," and then give as his authorities book writers, neither one of whom was ever under the necessity of earning by the manipulation of tools, and whose knowledge, therefore, was of an academic character. In writing on tool angles, I may say, in self-justification, I have not followed books slavishly, though I know probably all that are worth knowing; but I have given with confidence angles which I have myself measured from tools which I have known to be doing good work. What I know I have learned in thirty years of work in the practice of engineering as a means of living, and I have therefore acquired the habit of bringing statements in books always to the test of shop experience. And, therefore, because I knew that the single cutting-angle is at the basis of nearly all tool formulation in the shops, I pin my my faith to it, and have illustrated it in my writings. J. H.

An electric railway line, the current for which is generated by gas-engines, is in use in Huntingdon, L.I., in the United States. The gas costs 90 cents per 1,000c.ft., and the cost of working the line comes out at 13 cents per car mile.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96864.]—**Knocking in Gas-Engine.**—Many thanks to "Jack of All Trades" for his kind reply, but I am afraid the pen-steel bush will not answer in my case, for not only is the hole in rod worn oblong, but the pin is also worn. What I want to know is, how large can I make the hole, with safety, and the best way to do it. Will not swing in lathe. I shall fit with a gunmetal bush, and make a new pin. Gunmetal will not wear the pin, and a new bush can be fitted in a few minutes. Crackpot.

[96922.]—**Stylographic Ink.**—Will anyone kindly explain the reply on p. 280? Are all the ingredients to be mixed together, or do they belong to separate recipes? At any rate, please explain the order of proceeding? Are the gum, the sulphuric acid, and the gallnuts boiled together? If so, in what kind of a vessel, and how long should the boiling be continued? I think the querist is asking for what he will not get; but it may be that the reply given on p. 280 is just the thing, only unfortunately it is not quite definite. Perhaps some reader will help to elucidate? Q N.

[96930.]—**Sound.**—If this querist will say what sort of an instrument he refers to, he may obtain an answer. Is there to be any mechanical connection between two instruments, or what? I find it quite possible to "hear through a glass window or a wooden door" without any instrument at all. In fact, the sound comes rather too easily. W. H.

[96943.]—**Diving.**—This question can be answered only indefinitely; but there is information in back volumes. The actual distance to be seen through under the sea depends on the character of the water (some holds more matter in suspension than other samples), on the diver's eyesight and the state of his health, which is affected by the pressure under which he is working. For the sake of a datum, say a mile. T. L.

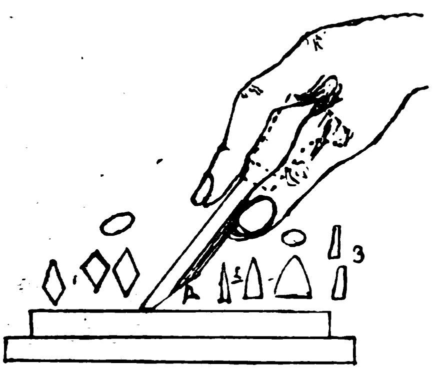
[96946.]—**Navy.**—I do not know exactly what an "assistant probationary engineer for permanent service in the Royal Navy" may mean; but it is certain that no one can be an engineer in the Navy without going through the schools and passing the examinations. The querist seems to have confused the Board of Trade exams. with the Royal Navy. There is a great difference. Essar.

[96960.]—**Carbide.**—I think, but I am not sure, that as much as 5lb. of calcium carbide can be kept within the Metropolitan District; but outside the Board of Trade regulations, which can, of course, be ascertained on application at headquarters, there are local by-laws to be noted, and they, equally of course, can be ascertained from the authorities of the respective districts. M. T.

[96985.]—**Condenser.**—Your best plan will be to get a square or round tank, and put a series of coils in it, and, taking a good size into the tank on the top just below the water-line, and from the bottom out back just above your screw, and the sea-water will circulate amongst your coils, which must be led into a tank to feed from. Of course, I do not know how you are situated, and what tools you have got; but to fit up a surface condenser proper needs money and tools, as well as a good workman to put them together. The castings for tube-plates, flanges for barrel covers, and tubes want finding, and patterns want making, and plenty of work cut out, when you may get coils fitting one inside the other to fit barrel or bore; or there are hot-water tanks all sizes to hand here that would suit your purpose. The scheme will answer, because it was patented by an old friend of mine many years ago, and is still in use on steamboats and barges. Jack of All Trades.

[97023.]—**Engraving Tools.**—The accompanying sketch will give you an idea how to sharpen them at an angle of 45° for general use. But old practical hands do not sharpen them square upon the face, but at angle right and left for right and left-handed cutting. But for your work square face, these tools are made stiff, and therefore, unless they are ground away at the long angle, A, it would require a considerable amount of exertion to sharpen them. Never touch your tool-face to wipe off burrs or the wire edge, or you will come to grief in more ways than one. When taken off the stone, job them into a piece of hard wood, to remove the wire edge. There are a few sections of tools—the diamond or lozenge shape and square are called gravers, the others (2) spitsticks; the oval sections, of which there are several, bullsticks, the chisel or square ones. (3) Scrapers. You can get any of these from Bucks, Fenns, Smith, St. John's-square, Clerkenwell, and I daresay at Melhuish, Sons, and Co., ready for use—that is, as hard as they will go. In some instances they want lowering to a very pale straw. It is very doubtful whether you would be able to make them to work

with properly, on account of getting the face up true. You can get them any section almost for parting, and all sorts of work; but if you must try your hand at making them, make them of the best steel. Heat them in a pan of charcoal-dust and salt to a cherry-red heat, and slack them right out



in some cold lard or tallow, with about 5 per cent. resin melted up with it. Let the material be clean, and keep it for hardening small tools.

JACK OF ALL TRADES.

[97100.]—**Lyddite.**—The query asks whether there is any ferrocyanide of potassium or other cyanide in lyddite, and the reply must be that its composition is kept secret. It is known, however, to be practically identical with mélinite, écrasite, and crésilite, which is probably the substance referred to as "crelinite" on p 64. M. Turpin took out a patent in this country (15089, '85) for the employment of picric acid as an explosive. It is believed to be the base of mélinite and other powerful explosives, though in its ordinary state (such as used by dyers) it is not an explosive, but burns away readily in an unconfined space without exploding; but mere contact with certain metallic oxides or salts renders it very explosive—so violently so that a small quantity will act as a detonator to any quantity of the picric acid, wet or dry, which is within reach of the detonating influence. Probably that fact is the origin of the query. It may be mentioned here that several works on high explosives have been published; but I suspect they do not contain full particulars of the substances actually used. However, there is the patent list, and much may be learned from the specifications.

S. R.

[97100.]—**Lyddite.**—The noxious gases set free on explosion of the above are not due to the presence of any cyanogen compound, but consist mainly of the poisonous carbon monoxide. T. J. LENEY.

[97101.]—**Acetylene Lamp.**—Best to unscrew if able, and soak in some such a softener as petroleum, and then rub off, if able; but it may possibly be difficult. Carbon, as a rule, being insoluble in water, acids, or alkalis.

REGENT'S PARK.

[97113.]—**Bermatine Bread.**—You can, I apprehend, work in small quantities on old lines. What do you say to aërated bread made thus:—Divide 3lb. flour into two portions; mix up the first with water, holding in solution 2oz. bicarbonate of soda; then mix the second portion with water, to which 1oz. of muriatic acid has been added. Knead each mass of dough thoroughly. When this is done, mix both portions together as rapidly as possible, form loaves, bake immediately. Bread contains no yeast, and is very wholesome. You can, if you prefer, use a baking-powder as follows:—Powdered cream tartar 30oz., bicarbonate soda 15oz., flour 6oz., all well dried, mix thoroughly, keep dry. Berme is Low German for barm or yeast, so I imagine bermaline bread means yeast bread.

REGENT'S PARK.

[97128.]—**Rate of Interest.**—It is impossible to obtain by any direct process the rate of interest yielded by a terminable security. The desired result can, however, be arrived at, to any desired degree of accuracy, by a method of successive approximation. I make the rate, taking the data exactly as given in the question (although, in all probability, the interest is payable more than once a year), to be between 3¼ and 3⅛ per cent.—more nearly 3·203 per cent. As £1 10s. has accrued for interest, a period of ⅜ of a year must have elapsed since the last interest payment was made, and, therefore, the next will fall due ⅝ of a year hence. Let i be the rate of interest *per unit* actually yielded; then the present value of 1 due a year hence is $\frac{1}{1+i} = v$ (say), and of 1 due n years hence $= v^n$; and the present value of an annuity certain of 1 per annum for n years is—

$$\frac{1 - v^n}{i} = A_{\overline{n}|} \text{ (say).}$$

(These results need not be proved here, I imagine.) Now, the price paid for the security is 108, and this has purchased the following benefits (the accrued interest of £1 10s. not being payable till the end of the current year)—viz., (1) one year's interest of £4, due ⅝ of a year hence; (2) an annuity of £4 per annum for 9 years, deferred ⅝ of a year; and (3) the redemption money (£100), due 9⅝ years hence. Therefore—

$$108 = 4v^{\frac{5}{8}} + 4v^{\frac{5}{8}} A_{\overline{9}|} + 100\, v^{9\frac{5}{8}}$$

$$27 = v^{\frac{5}{8}} [1 + A_{\overline{9}|} + 25 v^9].$$

This must now be worked out at several trial rates of interest, a simple process if a complete book of interest tables—such as Oakes'—be available. For example, try 3¼ per cent.—i.e., $i = \cdot 0325$; then the right-hand side of the equation is—

$$\begin{aligned} & \cdot 98021\,[1 + 7\,6961 + 25 \times \cdot 749876] \\ = & \cdot 98021\,[8\,6961 + 18\,7469] \\ = & \cdot 98021 \times 27\,4430 = 26{,}900, \end{aligned}$$

which shows that 3¼ per cent. is just a little too high. Similarly, 3⅛ per cent. will bring out a result of 27·166, which is a little too low. Hence the true rate is between these two rates, but a little nearer to 3¼ per cent. Interpolating between the two, we get 3·203 per cent. as approximately correct. The above equation cannot possibly be solved by any known method; but the process here adopted is by no means troublesome if interest tables can be used. A. J. H.

[97128.]—**Rate of Interest.**—

Gross price......	=	£108 0
Accrued interest..	=	1 5
Net price........	=	106 5

106·5 : 4 : : 100 : 3·7558685. This is the rate if the security could be sold for 106·5 at the end of ten years; but the querist tells us it is redeemed at par. Let us, therefore, calculate the amount of 106 5 in ten years at 3 75 per cent —

$$\begin{aligned} \log. 1\,037558 \ldots &= 0\,016012667 \\ \log. R^n &= 0\,16012667 \\ \log. 106\cdot 5 &= 2\cdot 02734961 \\ \log. M &= 2\cdot 18747628 \\ \text{Amount} &= 153\,98424 \\ \text{Less} &\quad 6\cdot 5 \\ & \quad 147\,48424 \end{aligned}$$

Now, the question is, at what rate will 106 5 amount to 147·48424 in ten years?

$$\begin{aligned} \log. 147\,48424 &= 2\cdot 1687455 \\ \log. 106\,5 &= 2\,0273496 \\ \log. R^n &= 0\cdot 1413960 \\ \log. R &= 0\cdot 0141396 \\ &= 1\cdot 033093 \\ \text{Rate} &= 3\cdot 3093 \text{ per cent.} \end{aligned}$$

—GARSDALE.

[97131.]—**Metal Polish.**—I should have thought that anyone hailing from "Owdham" would not have signed "Constant Reader" to a query which has been answered hundreds, if not thousands, of times. There is a technical difference between "polishing" and "cleaning," and there are many recipes. One favourite is the mixture of rottenstone and oil, and one for cleaning brass is "spirits of ammonia and vinegar," finishing with blotting-paper soaked in spirits of wine. Prepared chalk is useful, but to clean brass use oxalic acid, and for silver-plated instruments use jeweller's rouge, as it is not desired to remove the coat of silver. The recipes are copied from book to book, and often appear in the columns of newspapers from the pens of writers who probably never tried any experiments with them. Jeweller's rouge is not quite so low-priced as Bath-brick, but I think it is cheap. Here, then, is the recipe: Wash the articles thoroughly so as to remove all grease; hold them in a hand covered with a clean glove, and then apply jeweller's rouge (a very little) with a soft brush or very soft leather. S. R.

[97131.]—**Metal Polish.**—White vaseline 14, levigated flint 13, well-dried whiting 3, oleic acid 1. Melt vaseline with about 4oz. of lard, add the oleic acid, and stir in flint and whiting. Petroleum jelly 14, paraffin wax 2, levigated flint 11, oleic acid 1. Melt the jelly and paraffin wax, add acid, and stir in flint. Tripoli powder 28, petroleum jelly 7, oleic acid 28, paraffin wax 7, oxide of iron 7, myrobane ½. Melt the jelly and paraffin wax, add the acid, then stir in the oxide of iron and Tripoli powder, and add the myrbane, and many others.

REGENT'S PARK.

[97132.]—**Dry Inhaler.**—Menthol is dissolved by alcohol. REGENT'S PARK.

[97134.]—**Vox Humana.**—The Vox Humana in the American organ is generally a fan—that is, a stick or rod with a bit of cardboard stuck in each side—say 15in. by 1½in. broad. A wire is inserted firmly in one end of the rod, and passes into the motor-box, which is simply a box of thin wood containing a wheel of tinplate or wood. That is fixed on the windchest over a hole, and it has a valve in the top which is actuated by the stop. When the stop is pulled out, the air rushes past the wheel to the bellows, and the wheel being attached to the cardboard fan, causes that to revolve rapidly—thus producing a wavy atmosphere in the inside of the case, and therefore wavy sounds from the reeds. It will be understood that the bearings of this little affair must be "nice," to prevent any rattle. ORGANON.

[97135.]—**Expansion Rate of Metals.**—Aluminium: Centigrade 0000231, Fahr. 0000130, co-efficient of linear expansion Austen Roberts. Chaney gives for 1° Fahr. 0 00001234, for 1° Centigrade 0·00002221. See book issued by Pittsburgh, Reduction Co. on "Aluminium and Alloys, &c.," 1898, second edition. As to iron expansion, between 32° (0 Centigrade) and 202 (100 Centigrade 0 001220 to 0 001235.

REGENT'S PARK.

[97137.]—**Grammaphone.**—In reply to "T. M. C.," I have counted the teeth in wheels and pinions as accurately as I can, and the following is the result:—Large wheel (Fig. 33, p. 256), 150 teeth; pinion underneath ditto, 28; second largest wheel (C, Fig. 31, p. 255), 63; pinion above ditto, 20; smallest wheel (B, Fig. 31), 58; pinion beneath ditto, 18; spring wheel (D, Fig. 32, p. 255), 65; ratchet attached to ditto, 10; flywheel pinion (P, Fig. 26, p. 254), 19. I hope this will give him the information that he requires.

R. A. R. BENNETT.

[97138.]—**Polishing Specula.**—Spend no more time in polishing, but return at once to the fine grinding. The roughness you can distinguish through the magnifying glass has been left by the coarser emery, and you have proceeded to polish before sufficiently fining with elutriated emery. Contrary to the opinion expressed in your query, rapid polishing must produce heat, and will inevitable destroy the curve left by the fine emery grinding. I much prefer polishing by prepared pitch polisher; but, on the other hand, Dr. Blacklock, a late former correspondent to this journal, rather favoured paper polishing. Work with your finer emeries until the mirror seems on the point of transparency, and the task of polishing with pitch, instead of being a labour, will then be a work of skill and scientific interest.

Northants. FRANK H. WRIGHT.

[97140.]—**Dynamo.**—For so small a power the most suitable dynamo would certainly be a little overtype Siemens H armature dynamo. Diameter of armature, which should be laminated, 2in.; length 2in. Massive pole-pieces, with F.M. cores 2in. by ¾in. in section and about 2in. wiring space. If the armature be wound with No. 20, and the field-magnets with No. 22, shunt connected, you will have an efficient machine, well under control of your engine. S. BOTTONE.

[97141.]—**Glass-Blowing.**—The best book on the subject for amateurs is by T. Bolas, "Glass-Blowing," price 2s. 6d., published by Dawbarn and Ward. It gives full instructions for tube-joining, thermometer making, and fancy work in glass.

West Didsbury. M. COLE.

[97142.]—**Telescope.**—The following is an easy and very fair method of finding whether the object-glass of a refracting telescope is square with the axis of the tube:—The correcting (flint) lens of the o.g. is a double-concave, and therefore the surface nearer the eye-tube will throw back an image of a light if held at a certain point distant from it as close as possible to the observer's right eye. In a dark room lay the telescope level at a convenient height. Keep the cover over your object-glass, and remove the eyepiece tube. Hold the candle as already directed, and presently the observer will find a position in which the inner concavity of the o.g. will be illuminated all over. This is the focal point, and if your eye is central to the axis of the tube the glass is correctly placed. If, on the other hand, no such reflection appears, the observer may take it for granted that his o.g. is not square with the axis of the tube, and he should take steps to remedy it. In answer to the second part of his query, "Algol" can probably refer back to last year's volume of the "E.M." to find a description of what is called "The Sirius" telescopic stand—a simple and inexpensive arrangement that might probably suit him.

Northants. FRANK H. WRIGHT.

[97143.]—**Induction Coil.**—TO MR. BOTTONE.—Wire resistances for shocking coils are eminently unsuitable, because so much is wanted. One square inch of your skin presents a resistance of about 4,000 ohms. So, if you feel a severe shock from the coil without a resistance, you would have to insert a resistance of 4,000 ohms to halve its intensity, and in the case of No. 42 platinoid this would mean about ¼lb. Where could you stow it? The plan is altogether bad. You should have wound your secondary in 16 separate sections, and brought out the ends to the studs, thus: ⌒⌒⌒⌒ &c. If the

iron core is good and the primary well wound, it does not require a specially delicate spring on the contact-breaker to work with even one dry cell. Water regulators are excellent for secondary coils, if properly made. S. Bottone.

[97145.]—**Ampmeter.**—Make a sucking solenoid about 2in. long, wound with two layers No. 14 d.c.c. copper wire. Connect the ends of this wire to the terminals. Arrange a thin piece of soft sheet-iron, pointed at one end, and about ½in. wide at the other, so that it can swing in the inside of solenoid, without touching the sides. This must be suspended by pivoted arm from a bracket. A prolongation of this arm carries a light pointer, which travels over a cardboard or metal quadrant, on which the ampères are marked. The instrument can then be graded, either by being put in circuit with another ammeter, or with a battery giving a known current. See my book "Electrical Instrument-Making for Amateurs" for fuller instructions, under the heading "Solenoidal Ammeter." S. Bottone.

[97149.] — **Manchester Dynamo.** — To Mr. Bottone.—In going through your data, it strikes me that either your figures have been given wrongly, or else that you have about twice as much wire on the armature as needed. 5lb. No. 17 wire would be about 180 yards, of which nearly 90 would be active. This is greatly in excess of the requirements, and, besides, throws the iron core so far away from the fields. In our armatures of this size we put on about 2lb. No. 20 = 160 yards, and get 50v. 8a. quite easily. It is quite possible that you may have a false coil on the armature. The amount of wire on the field-magnets, 22lb, though not disproportionate in a large machine made of very soft iron, may be too much in your case. Try the effect of putting the F.M. wires in parallel, and report results before proceeding to rewind the armature. S. Bottone.

[97150.] — **Wireless Te'ephony.** — Erect two equilateral triangles of insulated wire, each 70ft. in the sides; one at the receiving, and one at the sending station. At the apex of the latter place a microphone in connection with a coil and battery. At the apex of the former, connect the telephone. S. Bottone.

[97151.] —**Bone Bearings.**— In reference to answers to above my experiences may be useful. I acted on the suggestions of our old and respected correspondent "Jack of All Trades," who wrote about bone bearings some time ago in the "E. M." I purchased a leg-of-beef bone, and turned a collar for my 6in. centre foot-lathe, as I had previous difficulty with steel collar. After giving the bone collar a fair trial, I had to discard it, and replace steel collar in lathe; the result of bone bearing was that, in spite of large amount of lubricating oil, my lathe-spindle got exceedingly hot; lathe also ran very heavy. I ran lathe at about 1,200 to 1,800 revolutions a minute. I think our old correspondent was in error in the following manner. It is a well known fact that steel a few years ago was of a far different nature than the steel is at the present time, being made under a different process; and probably the lathe that our friend had to repair, the spindle was of a good-quality steel, and run well in a bone bearing. I have had some experience in paying for lathe repairs, and I may state that there is a difficulty in getting a lathe-collar or spindle properly hardened. I had my lathe fitted with best steel bearings, and hardened the collar, back-centre, and spindle myself. Result: lathe has been running nine hours a day for the last two years by foot, without any cost for repairs, for turning bone. Ordinary wood-turning tools would do if of a good quality, about ½in. ground bevel. For burnishing, try a piece of leather, rubbing quickly, or running as a buff. I must apologise to our respected friend "Jack of All Trades" for answering query addressed to him, for I feel sure he has answered to the best of his abilities, and trust that he may be long spared to answer any of "ours" in "E. M." Hardwood Turner.

[97151.]—**Oil-Engine.**—The foundation suitable for a ½ oil-engine is best made of bricks built up with cement, and the middle part filled in with concrete. The holding-down bolts should be bedded in holes cut in the brickwork, and filled in with liquid cement. Leave it to set about two days before running engine. The size would be about 58in. by 30in. It would be advisable to make dynamo-bed in the same manner as engine, bedding the belt-tightening rails in liquid cement. A 1in. leather belt is quite strong enough for dynamo, but should be flexible, and the joint well made, so as to pass easily round the dynamo pulley; otherwise, the voltage will jump each time the joint passes round the pulley. Ignition Tube.

[97152.]—**Coherer.**—Such a coherer will work, though it is not of the best form. (See my many letters on this subject in back numbers.) One-eighth of an inch will be ample between the ends of the wires. Do not jam the filings between the points; let them lie loosely. A 6in. spark-coil would transmit for nearly 10 miles. You may either screw up contact-breaker tight, or leave it in its usual position; but in either case you must use a tapping-key. My book will not be out till January; but there is Kerr's and Oliver Lodge's. S. Bottone.

[97154.]—**Bone Bearings.**—In the "seventies" I laid out a deal of money, intending to make this one of my specialities in supplying of these for various purposes; but being haunted by a demon-possessed individual, until human nature could stand it no longer—the same had haunted me for years—I found that if I did not make tracks, that it must either end in lunatic asylum or on a rope around my neck, so I made tracks. A month after I made my appearance again, to find matters worse, and upon looking things up again worse still, for the demon had made away with materials that I had prepared, and many things that were intrusted to me for repairs, for about one-fortieth of the cost, for the sake of drink, the whereabouts of which I never could find out. A party whom I had assisted in more than one way robbed me of my tools, and that broke my back. 1. No, it is not likely to cut a ring around the centre of bush, and a hole into it. 2. Any good sound bones, as marrow-bones, sheep, oxen, horse, and elephants', and any of the sound bone-shanks or marrow. Two of the shanks are flat, and two round; any that look like ivory. The one that I saw, and believe could have been traced for 200 years, was running in the knuckle of a ham-bone. 3. I should think that they would do very well in a wet place. I should not hesitate to use them. 4. The cohesion of African oak being 17·200lb. per square inch, bone would at least double that. 5. Yes, if lubricated properly, I have not the least doubt but that they stand any speed; why not? Boxwood steps have been in use in silk and cotton mills to advantage. 6. There is no reason why they should not be fit for gas, oil, or steam-engines, or rotary engines, and all dynamos and electric motors, connecting-rods, and slides, as well as gland-packing. The cause of their being everlasting is their more pliable, tough, elastic composition, as witness your own carcase. Good bone was no more porous than ivory. Bone does not wear down if the bearings, or rathermore journals, are turned true and burnished. 8. No, bone is not self-lubricating. 9. What do you want to burnish bone for? There is no reason for doing so, and it is not very likely. Just think for a moment what would be the result. The oil would decidedly render it loose and laminated. If you mean what is used to polish bone or ivory: whiting, well washed, and methylated spirit. 9. A species of gravers are the best tools, the faces of which are ground up true and polished to a face. The front may be ground any angle from 80° to 45°. Bone, like Babbitt's metal, should be put into a shell, or the recess made in the article, and the bone bush built in as shown at Fig. 3, query 97696, p. 343, Nov. 24, 1899. Jack of All Trades.

[97155.]—**Catch Question.** — "Damon" can sell five apples for 2d. only when he takes three from the cheap lot, and puts them with two from the dear lot. This he can do only ten times, for then he will have used up all the cheap apples, but will still have 10 of the dear ones, which, of course, he cannot sell at the rate of five for 2d. Arithmos.

[97155.]—**Catch Question.**—Three for a penny = $\frac{1}{3}$ of a penny each; two for a penny = $\frac{1}{2}$ of a penny each. Adding together $\frac{1}{3}$ and $\frac{1}{2}$, we get $\frac{5}{6}$ of a penny as the value of two articles. Now, five articles for 2d. = $\frac{2}{5}$ of a penny each, or $\frac{4}{5}$ of a penny for two. We now compare $\frac{5}{6}$ or $\frac{25}{30}$ with $\frac{4}{5}$ or $\frac{24}{30}$, and find things are not what they seem. Quite a nice little catch. Almost as good as the hen and a half that laid the egg and a half. T. J. Leney.

[97155.]—**Catch Question.**—If you take equal numbers of an article at one halfpenny and one-third of a penny each, the average price is twenty-five sixtieths of a penny. At five for twopence, the price is twenty-four sixtieths. R. B.

[97155.]—**Catch Question.**—The reason is that in the question as put the numbers 3, 2, and 5 are the denominators of fractions, and must not be added together. If we put half a crown instead of one penny in the question, and then reduce to lowest terms, this becomes instantly apparent.
Oystermouth. Scorpia.

[97155.] — **Catch Question.** — The reason is twofold; (1) As to the value of the articles. Because 30 articles at three a penny are worth 10d., and 30 at two a penny are worth 15d., total 25d., or 2s. 1d., whilst 60 articles at 5 for twopence, or 2½ for a penny, are worth only 2s. Thus: 3)30(10, and 2)30(15 = 25, or 2s. 1d., 2½)60(24, 2s. exactly. (2) As to the numbers themselves, irrespective of values, $30 \div 3 + 30 \div 2 = 25$, while $60 \div \frac{5}{2} = 24$; evidently not the same. S. Bottone.

[97155.]—**Catch Question.**—There are three ways of looking at this old catch; but probably the following will reveal the precise source of its "catchiness" best. Suppose the 60 articles to be arranged in 12 twopenny groups where each rate of sale alike produces two shillings. There will then be 36 articles included in the three-a-penny lots and 24 in the two-a-penny. The question, however, stipulates that 30 only shall be sold at each of these rates. Hence six of the three-a-penny articles, which produce 2d., must be transferred to the two-a-penny lots, which produce 3d., or a gain of one penny. Again, we may equalise the prices thus—

$$\left.\begin{array}{l} 30 \text{ at } \tfrac{1}{3}\text{d.} = 10 \text{ at 1d.} \\ 30 \text{ at } \tfrac{1}{2}\text{d.} = 15 \text{ at 1d.} \end{array}\right\} = 25 \text{ at 1d.}$$
$$60 \text{ at } \tfrac{2}{5}\text{d.} = 12 \text{ at 2d.} \quad = 24 \text{ at 1d.}$$

Hence there is an additional 1d. article sold by the first arrangement. Lastly, we may express each article at fixed rates—

$$\left.\begin{array}{l} 3 \text{ a penny} = 1 \text{ at } \tfrac{1}{3}\text{d.} \\ 2 \quad \text{do.} \quad = 1 \text{ at } \tfrac{1}{2}\text{d.} \end{array}\right\} = 2 \text{ at } (\tfrac{1}{3}\text{d.} + \tfrac{1}{2}\text{d.})$$
$$= 2 \text{ at } \tfrac{5}{6}\text{d.} = 1 \text{ at } \tfrac{5}{12}\text{d. or } \tfrac{25}{60}\text{d.}$$
$$5 \text{ for twopence} = 1 \text{ for } \tfrac{2}{5} = 1 \text{ for } \tfrac{24}{60}\text{d.}$$

Thus the second rate is $\frac{1}{60}$d. cheaper than the first, and therefore produces 1d. less.
West Norwood. Henry T. Burgess.

[97158.]—**Bichloride Mercury Disinfectant.**—Should say there was no fear of injury in its use. Regent's Park.

[97165.]—**Drill Makeshift.**—The best thing for "Impatient" to do, will be to buy a breast drill. I use one by the Millers Falls Co., and a few twist drills size of holes required. He will find this to suit small jobs, if he does not want to go in for a bench drilling machine, which would come in rather expensive. J. A. C.

[97165.]—**Drill Makeshift.**—Drill is probably soft; see that drill is well hardened, and cutting-edges are properly sharpened, and see that drill is a good fit in brace or spindle. Hardwood Turner.

[97166.]—**Chromic Battery without Acid.**—Pure chromic acid contains no sulphuric acid; some commercial samples do; but even these, not in sufficient quantity to render them of any use in a battery without the addition of a considerable quantity of sulphuric acid. Your only way to prevent the rapid consumption of the zinc in a Fuller cell is to dry the porous pot thoroughly, and then to paint it all over, except one narrow strip, ½in. wide up one side, with hot melted paraffin wax. S. Bottone.

[97170.]—**Grammaphone Records.**—Will not the article on p. 321 of the last volume (LXIX.) give you the information you want? R. A. R. Bennett.

[97172.]—**Holtz Machine.**—To Mr. Bottone. (1) About 3in. (2) Yes, and very uncertain in action. (3) Yes, by taking one electrode from the Wimshurst to one of the "windows" of the Holtz. (4) No. See my book on "Radiography" for description of the best type of machine for this purpose. S. Bottone.

[97173.]—**Pigeon Post Photos.**—I made some of those for a bazaar by the ordinary dry-plate process. First make a negative, then a good positive transparency as for a lantern slide. Soak in acid and water till the film floats off. Then float it over a plate slightly smeared with vaseline, to prevent it sticking. Strengthen when dry with a coat of collodion, then pull off and wipe off any vaseline that may come with it.
West Didsbury. M. Cole.

[97176.]—**Cement for Vulcanite.**—This universal cement may be worth trial. Boiled linseed oil 20, gelatine size 20, slaked lime 15, crude turps 5, alum 5, acetic acid 5. Melt size in acetic acid. Add alum, then slaked lime, then turps and boiled oil. Mix thoroughly, and keep in well-stoppered bottles. Good for wood, glass, cardboard, porcelain, &c. Regent's Park.

[97178.]—**Joint and Piston Packing.**—The joint for cylinder covers is made by cutting an asbestos millboard ring the same size as flange on cylinder end, making small holes for the bolts to come through, and screwing up tight. I suppose the cylinder and cover to have faced joints. You will find soapstone and asbestos packing as good as anything for packing piston-rods. J. A. C.

[97179.]—**Explosives.**—The safest way would be to use the small paper caps used with toy pistols. You could use two or three to get noise enough.
West Didsbury. M. Cole.

[97181.]—**Giddiness.**—This may be due to a variety of causes, amongst them cerebral, cardiac, or aural trouble; aural trouble is generally accompanied with deafness. Overwork of the brain is also a cause, so also is a deranged stomach. The querist had better see a reliable medical practitioner whom he knows by repute to be fairly straightforward as the world goes nowadays, and get him to find out the cause—that is, if he can. It is hardly possible that anyone in these columns could suggest a remedy likely to be of any use without knowing the cause. T. J. Leney.

[97183.]—**Painting on Silk or Satin.**—In oils:—Tightly stretch material, and thin colours with turpentine, but not so to make them run. Use

only enough colour to hide material underneath, and blend the lights into dark shadows with help of a dry brush. If when first coat is dry material shows through, apply a second, worked in like first, then bring out stamens of flowers and markings of leaves sharply; throw up well by working in deep shadows behind or near them, but attempt no great amount of shading. Dark flowers require a good deal of working up, light do not, and therefore preferable in this kind of work. Use wooden rest to keep hand from touching wet paint while work in progress. Take a bar of wood 2in. wide, raised at its extremities by feet 2in. high, length variable, according to size of painting, which it should just clear. Place it across, and steady the hand by resting upon it while working. When painting is quite dry (four or five days) varnish with white spirit varnish, if it dries dead and colourless, but if bright omit this last. In water colours: Stretch evenly, then take 1oz. Nelson's gelatine, melt in tall gallipot just covered with cold; leave for one hour, pour off cold water, add pint of boiling water; stir, dissolve quickly, run through coarse muslin to strain, and whilst hot apply to silk. Take sponge, well clean face, dip into hot gelatine, thoroughly wash over surface, not too wet; rub mixture well in, leave no place untouched. Rub with piece of soft silk and leave stretched till perfectly dry, then rearrange it if it requires restretching. Same mixture can be applied to satin, but as every mark shows great care is required. Arrange design. Draw this out on a sheet of paper; if a fan, be careful that the largest flowers, &c., are not stretched in so that they come on ribs of fan mount, &c. Trace outline of the design on to silk or satin. Use tracing paper, red carbonised paper, and a fine knitting-needle; clean carbon paper before use. Do not press on it, as all marks show. Painting done in two ways. Easiest is by mixing Chinese white with other colours to turn into body colours; second is by simple water-colour, working up colours patiently, last tints and higher lights added in body colour, but chief painting in ordinary moists. To paint with body colour:—Materials: Chinese white in bottles, ordinary moist colours, ox gall, veloutine, red sable brushes, palette; distilled water, to which a little sugar is added; spare pieces, to try effect of colours. Always put colour on palette before mixing it with white or other colours, and keep that left in pans perfectly clean, or shades become dirty. Be careful that Chinese white is not too dry, as it cakes and rubs off. Add veloutine to it before use; rub well up with palette-knife. Commence by laying coat of C. white mixed with V. over whole design; lay on rather fully, without streakiness. Thin with turpentine if too thick, and whilst wet colour required tints into it. Lay colours over white ground as even tints; do not attempt to shade. Do not apply to design a shade not tested on spare silk or satin. Body colour on satin allows of less shading than on silk. White satin requires no ground of Chinese white. These data are not all in book—viz., B. C. Saward on "Decorative Painting," published by L. Upcott Gill. That gives on various textiles, pottery and porcelain; paper, vellum, and leather; glass and wood; stone, metal, &c.
REGENT'S PARK.

[97185.]—**Bookbinding.**—You can never get these equal to new again, but a great deal can be done with a hot burnisher, as used by bootmakers for polishing the soles of boots. A little white of egg as a dressing will help.
West Didsbury. M. COLE.

IT is said that only about one-seventh of the glass used in this country for ordinary purposes is of British manufacture.

TELEPHONIC communication between St. Petersburg and Moscow is obtained by a line 412 miles long. It is said to be the longest single line in Europe.

A Gigantic Megaphone.—An enormous megaphone has been erected at Faulkner's Island, Conn., on the Government lighthouse reservation, for testing a new system of fog signals. The megaphone is 17ft. long, and 7ft. diameter at the mouth. Attached to it is a 1½in. steam siren. The whole contrivance is mounted on a circular platform 28ft. in diameter, so that it can be revolved to any point of the compass. Different signals may be made for each point of the compass. The object of the invention is to throw the sound-waves in a certain direction to the exclusion of any other direction, so that any vessel approaching the signalling-station in a fog shall hear only the sound which is given when the megaphone is pointed directly at it. That is to say, if the signal means north, the fog-signal must be due north of the vessel, or those on the latter could not hear that particular signal. The instrument has been tested, and it was found that the sound could be heard 10 miles away when the observer was standing in a line with the axis of the megaphone; but nothing could be heard of the sounds sent to other points of the compass when at a distance of a mile or more from the instrument.—*Scientific American.*

UNANSWERED QUERIES.

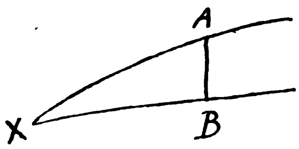
The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

96727. Elementary Optics, p. 168.
96731. Power of Boiler, 168.
96740. Efficiency of Small Gas-Engine, 168.
96747. Retouching Negatives, 168.
96748. Boilers for Motor-Cars, 168.
96751. Diving, 168.
96752. Motor-Carriage, 168.
96760. Model Loco, 168.
96765. Bagatelle, 168.
96766. New Lawson Biunial Saturator, 168.
96769. Search-Light, 169.
96775. Boiler for Marine Engine, 169.

96919. Floating Body in the Air, p. 258.
96926. Velocity of Centre of Gravity, 258.
96929. Electric Ignition, 258.
96931. Dry Batteries, 258.
96934. Motor Tricycles, 258.
96936. Locus, 258.
96939. Ebbing Well and Burning Cliff, 258.
96949. Mutoscope Pictures, p. 259.
96950. Slade Micrometer, 259.
96951. Inflammation of the Parotid Glands, 259.
96958. Negatives on Celluloid, 259.

QUERIES.

[97187.]—**Calculation of Sun's True Bearing and Altitude.**—I should be obliged for explanation of these calculations, latitude and sun's declination being known. The solutions of both quantities are got, I



presume, from a spherical triangle, in which X B is the line of the horizon and X A the path of the sun on any given day across the sky. The point X will be the intersection of horizon and sun's path, and the side X A will be got from the hour angle. Particulars of calculating this hour angle will be very acceptable, as it involves that of time of sunrise. Having got X A, the angle at X is got from sun's altitude at noon, I suppose, and, of course, B is a right angle. Are these the two quantities used for the complete solution of the triangle and determination of azimuth B X and altitude B A at any given time?—FLEUR-DE-LYS.

[97188.]—**Asbestos Packing for Incubator.**—I am making an incubator on Hearson's principle, and wish to pack that part of the flue which is in the lamp-box with asbestos for heat-retaining purposes. Will asbestos powder answer my requirements as efficiently as the usual asbestos packing, since I find it can be purchased at about one-fifth the price of the latter? An answer will much oblige.—A. DICKENSON.

[97189.]—**Razor Sharpening.**—Will someone tell me the proper way to work a dull razor up to shave easy? Also state what kind of grindstone, oil-stone, and strop for getting up full hollow-ground and half hollow-ground razors.—SHAVER.

[97190.]—**Launch Boiler.**—I have a small vertical launch boiler, with 19 vertical tubes. Up to a few months ago it made steam very well; but now I cannot raise above 5lb. or 10lb. If I do manage to get 50lb. or so it works down very quickly. What is likely to be the cause? No alterations have been made.—W. J. R. BELL.

[97191.]—**Disinfectant.**—A firm of chemists of repute advertise as a disinfectant pellets of nitrate of lead to be dissolved in water which is to be added to other water in which common salt is dissolved. In what way does this mixture act as a disinfectant? Is it by the evolution of chlorine from the salt (chloride of sodium)?—ROTOS.

[97192.]—**Dynamo.**—I have a dynamo made by Spagnoletti and Crookes giving 10 ampères at 100 volts, speed 1,650. I wish to rewind this to give 10 volts and 40 ampères. The size of armature over the wire now on is 5¼in. and the length 5½in.; the commutator is 3in. diam., and has 30 sections in it. Will some of your readers tell me the size of wire required for both the armature and field, and number of turns? Also, what speed would it require to run? It can be arranged for any speed suitable, the slower the better.—E. JONES.

[97193.]—**The Colouring of Lantern Slides.**—In the "E.M." of Nov. 24 appeared an extract from the *British Journal of Photography* under above heading. Will some of "ours" who have had experience with aniline colours give their experience and say if they can be used on the print-out lantern plates, such as Paget's? And also give details of articles required for a person beginning, and who has had only little experience. A reference to a good work or articles in back numbers of the "E.M." would greatly oblige.—J. F. H.

[97194.]—**To Mr. Bottone.**—Is the Carsak cell you described in last week's "E.M." non-polarising, or how long will it last, taking the full current from it?—ELECTRO.

[97195.]—**Sizes of Wire.**—Will Mr. Bottone kindly tell me if No. 14 wire for the primary and No. 24 for the secondary will answer the same purpose as No. 24 primary and No. 36 secondary in shocking coil, as directions in your book?—F. J. BUXTON.

[97196.]—**Science and Art Department Certificates.**—I am desirous of obtaining the elementary and advanced certificates of the Science and Art Department for knowledge in astronomy, chemistry, and electricity. Can any reader of "Ours" tell me how best to proceed? Where could I get examined? I do not attend any evening science class, as I cannot be absent from home, but I teach myself from book and experiments. Any information bearing on this will oblige.—LUX.

[97197.]—**Change-wheels.**—Could any reader tell me how to get sizes of a set of change-wheels? I have got a screw-cutting lathe, but no wheels. How must I measure to get the wheels right?—W. J. ROGERS.

[97198.]—**Screw Gear-Wheels.**—Will "Jack of All Trades," or some other able reader, say if screw gear-wheels for gas-engines 10 and 20 teeth can be cut in a lathe with a milling cutter thus: by fixing vertical slide on the top slide and set the top slide at a sufficient angle, then by having a bearing on the vertical slide with a spindle through it, with a pattern wheel at one end and a blank wheel to be cut at the other, and a fixed tooth on the saddle, so that when the top slide is fed up by hand would it give the proper swerve needed? I am afraid the screw-cutting wheel would not stand the strain to cut such a quick thread as would be needed in the 10-teeth wheel, which would be (?) diameter and 1½in. across the face, of course. Place the milling cutter on mandrel between lathe-centres. Also, would more than one cutter be needed?—J. A. C.

[97199.]—**To Mr. Bottone.**—1. Is it necessary for iron rods to be continued down pole, or about 10ft. from top, and lead in with leading-in wire? 2. How is the transmitting coil prevented from effecting the home coherer as well as the distant one? 3. How are the waves directed to one station alone from a central station which can communicate with two others, so that both shall not be affected at once?—E. H. K.

[97200.]—**Feed-Pumps of Steam Launch.**—I have a small steam launch driven by a compound condensing-engine. The air and feed-pumps are driven by gut bands off the main shaft. As these are constantly breaking, I shall be glad if anyone will please tell me if it will be best to drive the pumps by a chain or by an eccentric off the main shaft. At present the pumps work at half the speed of the engine, so that if I drive by the means of an eccentric the pumps will have to work at the same speed as the engines, but to get over this will have to work at half their stroke. Will this be correct? At the same time, I shall be glad to know if a chain can be got that will work without noise, and what chain?—E. J. C.

[97201.]—**Dross from Type Metal.**—I have a large quantity that I wish to get back into bar metal. Would any reader inform me the best way to do this, and kind of furnace required? I have steam-power, so could easily get a blast.—DROSS.

[97202.]—**Gas-Engine Piston-Rings.**—I should be very much obliged if any of your readers would be kind enough to illustrate and explain how a gas-engine piston-ring is turned, as I have seen one turned in rather a funny style, and find that the engine blows a fairly good quantity of exploded gas through or between the piston and the cylinder, and causes no very pleasant smell.—POOCHO.

[97203.]—**Ivory Dust.**—I have a quantity of ivory dust, and I would like to use it if possible. Could any reader give me particulars of any process of moulding it into small objects to be as hard as possible?—T. V.

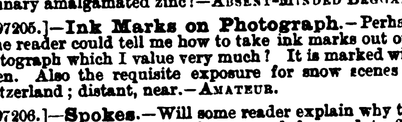
[97204.]—**Daniell Battery.**—(1) Is a gravity Daniell battery suitable for lighting a photographic Ruby lamp of about 2½c.p.? (2) What is the voltage of each of these cells, and (3) internal resistance? (4) How is an alloy of zinc and mercury made, as it is recommended in place of ordinary amalgamated zinc?—ABSENT-MINDED BEGGAR.

[97205.]—**Ink Marks on Photograph.**—Perhaps some reader could tell me how to take ink marks out of a photograph which I value very much? It is marked with a pen. Also the requisite exposure for snow scenes in Switzerland; distant, near.—AMATEUR.

[97206.]—**Spokes.**—Will some reader explain why the spokes of some wheels, which are used for road traffic, and especially those of coal, rubbish, and such carts, are dished in—i.e., the rim and spokes are not in one plane? Is there any scientific reason for this?—H. N. N.

[97207.]—**Multiple-Plate Wimshurst.**—I would feel greatly obliged if Mr. Wimshurst or Mr. Bottone would kindly state if a 12-plate Wimshurst with glass plates 28in. diameter would act satisfactorily if the trunnions were made of steel tubes instead of wood (as in the 36in. plate machine made by Messrs. Watson, of London)? Would the presence of so much metal so near the plates affect the efficiency of the machine?—T. M. C.

[97208.]—**Voltage.**—I charged my 8-volt accumulator from works electric light circuit, which runs at 80 volts, and connected as per diagram; but I cannot understand



the following. I shall be glad if someone will explain. Why should the voltmeter B only register 10·5 volts when voltmeter A registers 80 volts. I switched current off; then B registered 10 volts, which I can understand. The ammeter registered 0·7 amp.—VOLTAGE.

[97209.]—**Incandescence.**—I want to heat a platinum wire of 1 millimètre diameter and 1ft. long to white heat, near fusion point, for about half an hour at a time. Wire is coiled into shape of a spiral. No dynamo available. What kind and size of battery would be most suitable? How is the problem to be calculated? Also

for other metal wires? Would Mr. Bottone or other specialist oblige?—A. S.

[97210.]—**Steel-Facing Copper Plates.**—Would Mr. Bottone or other kind reader advise me on the following subjects? I want to steel-face copper printing-plates (size 20in. and under). I have available for the purpose a Gramme dynamo (series wound) capable of giving a current of 20 amps. at 50 volts when making 900 revolutions per minute. Should be glad of answers to the following questions:—1. What is the best voltage for this work, and how can I obtain this with my machine, using one depositing vat only? 2. How to control the intensity of current with varying surface of copper in depositing vat? If this has to be done with a variable resistance, please give particulars how to construct same, and sketch showing connections. 3. What is the best solution to be employed? In preliminary experiments I have found great difficulty in depositing a film of sufficient thickness of white metal, the plates after a while becoming covered with a yellow or black film respectively, when one or the other of two solutions was employed. Is this due to the solution, or the intensity of the current employed? If to the latter, please state what amount of current should be used, and the best and simplest means to adopt for measuring same?—TRINACRIA.

[97211.]—**Cockroaches.**—I have a kitchen infested with cockroaches. I am building a new one. Can I set the range with any particular cement or poison therein to prevent this nuisance?—CHESTER.

[97212.]—**Molybdenite.**—I should esteem it a great favour if any of your well-informed metallurgists would kindly tell me the value of this mineral in the market, and also the best market for it. I understand it is becoming extensively used in the arts and sciences. I am told by a friend that molybdenum constitutes one of the metals forming some of the valuable alloys on the market whose composition is for the present kept secret. If any of "ours" should choose to enter into correspondence with me touching it—as I am part owner of a deposit of it—my address may be found in the "Address" Column of this journal.—THIRTY YEARS' SUBSCRIBER.

[97213.]—**Chaff Cutting.**—Can any reader kindly give me the required information? I have a chaff-cutter which I desire to be worked by power. It is in a loft 40 yards from 8H.P. steam-engine. Is it possible to work the chaff-cutter by this engine to advantage, notwithstanding the distance between the two? If so, how? Perhaps it would be cheaper to buy a small oil or gas engine to drive it. The chaff-cutter must be kept where it is.—REDBUN.

[97214.]—**Softening Brass.**—Where can information be obtained as to the methods of softening and hardening brass, both sheet and wire? There is plenty of information to be got as regards softening and tempering iron and steel; but if brass cannot be tempered, how are brass springs made? I have consulted Holtzapffel and many other books in vain on these points; but the principal reason for my question is that some time ago I found much difficulty in fastening some thin brass sectors on to Wimshurst machine I was making, owing to the softness of the metal, while some samples I obtained from the manufacturers being hard and springy, and perfectly flat, could be easily attached without rising here and there, as my own did. Any hints or information on these points will be welcome?—A. C. T.

[97215.]—**Hektograph Stains.**—Can anyone tell me what will remove hektograph inkstains from a mahogany table. I have tried hot water, but cannot get the stain out. Also, white stains caused by leaving glasses with hot water on the table?—JACK.

[97216.]—**Grammaphone.**—What is the largest size of the records to be had? Those I have seen are about 7in. across.—GRAMMY.

[97217.]—**Gravitation Problem.**—I have been informed that there are cases on record of a balloon descending so rapidly as to pass the ballast thrown from itself. Will any scientific reader kindly inform whether this is a fact, and, if so, what is the reason for it? I thought that gravity affected all falling bodies equally. —NEWTON.

[97218.]—**Potash Making.**—Will any reader of this paper kindly inform me what is the nature of vessels used in potash-making, and which is the best practical book adapted for the same?—AN OLD GREEK READER.

[97219.]—**Rope Drive.**—To get a silent drive from an electric motor, I use a rope 1¼in. circumference running on a pair of pulleys with five grooves each and a guide-pulley, the single turn of rope 28ft. long running round the five grooves and over the guide-pulley. As the motor-pulley is only about 3½in. diameter, the rope has to be very flexible, so I use collars, but this gives much trouble from continual stretching. Can anyone recommend a flexible rope or cord that can be spliced or joined, and that will not go on stretching continually? Gut-band seems rather stiff, and the hook-and-eye joint is liable to come off. There is rather a heavy pull on the rope.—J. BROWN, Belfast.

[97220.]—**To Mr. Bottone.**—Will you kindly inform me of a book that will assist in calculating the sizes of cables, wires, and fuses to carry current for from one to any number of lamps?—A LEARNER.

[97221.]—**Telectroscope.**—As there seems to be some doubt whether Szczepanik has invented a machine for "seeing by wire" or not, will someone who knows for certain kindly say where a description can be seen? Or, if patented in England, what number is it, as I am certain there are scores beside myself who would be glad to see such a much-sought-for machine?—R. W. S.

[97222.]—**Eros.**—The elements of the orbit of this planet, recently calculated by Hans Osten from over 200 observations, make the planet's period and distance a little less. Has any amended value of its eccentricity (0·23) of a year ago been given?—GARSDALE.

[97223.]—**Staining Deal Cabinet.**—I have a deal cabinet stained walnut and varnished. I wish to restain and polish it. What would be the best method of removing the old varnish, and would you recommend a good polish?—W. H. COX.

[97224.]—**Curb Chain.**—Could some reader in the jewelry trade inform me how to make the links of a curb pattern chain (gold)? If a special tool is required, a short description would greatly oblige.—B. CARLISLE.

[97225.]—**Acetylene Burners.**—I am making an acetylene gas plant for my lantern (4in. condensers). (1) How can I obtain suitable burners? (2) How many should I require? (3) What should be their relative positions?—FISHTAIL.

[97226.]—**Condenser.**—Will Mr. Bottone kindly say about how many square inches of tinfoil it takes to make a condenser of one micro-farrad capacity? Also, what size wire, two layers, to magnetise an iron wire core 15in. long by 1½in. diameter, battery to be used with same 8 volts 25 amp. hours?—A. F. G.

[97227.]—**Wimshurst.**—I have read with interest the replies of "J. W." to various correspondents on Wimshurst machines, and also the letters he has contributed on the same subject. I am thinking of constructing a fairly large machine with about ten 32in. plates, and should be glad of information on a few points. (1) Is glass equal in any way (except, of course, its liability to breakage) to ebonite? (2) Would it be advantageous to have the driven pulleys made of ebonite instead of wood? (3) What material is best for the neutralising brushes, excepting palladium-iridium alloy? (4) Is tinfoil as good for sectors as brass or copper, with a slight projection pressed in? (5) What is about the most suitable thickness of tinfoil for sectors? (6) What material is best to form the insulating supports for collectors? (7) What precautions are necessary to prevent reversal? (8) With regard to sectorless machines, what is "J. W.'s" opinion of them as compared with the ordinary form? (9) Are condensers of small capacity of any advantage for X-ray work with a machine of the above size? (10) Is a journal published in England on X-ray work? (11) Could you give me the address of the secretary of the Röntgen Society? Would it be asking too much of "J. W." to give a short description, with some of the principal dimensions and any novel features, of the large machine exhibited by Mr. Wimshurst at the conversazione of the Royal Society in 1887?—W. G. C.

[97228.]—**Blue Printing.**—Would one of our readers be kind enough to give particulars of chemicals used for blue printing, as engineers use for copying drawings, &c.? —JOHN POLMEAR.

[97229.]—**Voltmeter.**—Will Mr. Bottone, or some other reader, tell me how to make a small voltmeter to read from 1 to 10 volts? Also a small ammeter to read from ·2 to 5amp.?—R. S. V. C.

[97230.]—**The Blue Eye.**—"Helmholtz has irreverently disclosed the fact that a blue eye is simply a turbid medium."—Tyndall, "Lectures on Light," p. 155. Will any reader of "E.M." kindly help me to Helmholtz's words *re* the blue eye?—F. H. E.

[97231.]—**Moving Hearthrug.**—I was recently staying with some friends in London, and, always noticing the hearthrug riding up and over the curb, I remonstrated. I was met with the remark that unless it was fastened to the floor it would resume its position. To test this matter, the last thing before retiring for the night on two occasions I moved the rug 8in. from the curb to find in the morning it had travelled back again. There is about 3ft. space between the floor-joists and foundations. Floor covered with cedar felt, over which is a Saxony velvet square, and upon this the hearthrug, I think technically called or described as "town-made." Will some of "ours" tell me the reason or cause of this (to me) peculiarity?—R. J. NEWCOMB.

[97232.]—**Maxim Guns.**—Can any reader give me a description of the Maxim guns mentioned in this paragraph from *Fielden's Magazine*?—"The Boer army is equipped, in addition to Schneider, Krupp, and other ordnance, with several batteries of the 37-millimètre Maxim automatic gun firing shells, and now used for the first time in civilised warfare. These guns were supplied several years ago with the full knowledge of the Home Authorities. Whereas the ordinary Maxim fires only rifle bullets, the 37-millimètre piece fires a shell weighing about 1½lb. at the rate of 300 shells a minute, with an effective range of 2½ miles. That is to say, it will throw 375lb. of explosive projectile a minute among the enemy at the range mentioned. The gun with its mounting weighs about a quarter of a ton, and can be worked by one man only."—R. V.

THE total output of coal from mines in the United Kingdom last year was 202,042,243 tons, and from open quarries 12,273 tons, making a gross total of 202,054,516 tons, a decrease of 75,415 tons compared with 1897.

THE production of sulphur in Sicily amounted to 3,000,000 tons in 1897, which grew to 3,200,000 tons in 1898. In 1898 the principal buyers were the United States, 142,553 tons; France, 95,000 tons; Continental Italy, 60,919 tons; Germany, about 27,000 tons; and Great Britain, with Malta, only 26,487 tons.

Retouching Desk.—Presumably no house is without a mirror, neither is any amateur photographer without a printing-frame. It does not interfere with the usefulness of the latter for printing if made to serve an additional purpose. By screwing a pair of wooden supports fairly fast to the sides of the frame, it can be made to stand at any desired angle with the back of the frame towards you. (The backboard is laid aside for the time being.) A mirror is laid face up on the table, and near to the window; the printing-frame converted to a retouching-frame is placed over it. The window-blind may be lowered to the required extent, and so protect the operator from conflicting lights. Sometimes a book may be laid behind the mirror to prevent any sliding or shifting. Retouching and blocking-out may be done as carefully as in the most expensive retouching desks.—THE PHOTOGRAPHIC TINKER, in *Photographic News.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 6, and unacknowledged elsewhere:—

SECULARIST.—Manx Visitor.—Anxious.—Westminster.—A. B. McDowall.—Student.—Jack of All Trades.—J. Matthewson.—G. Bousfield.—Richard Hudson.—S. Reynolds.—Le Vilcoq.—Theodore Brown.—F. H. Ewers.

A STUDENT (Oldham).—We can send you the book, post free, for 8s.

J. M.—The articles on Oil-Engines, by Mr. Taylor, commenced in No. 1601, and concluded in No. 1606.

J. K. A.—Probably the apparatus for filtering rain-water, illustrated on p. 187, is what is meant.

D. P. W.—Do not know of any work giving instructions as to the method of working a patent; but as to taking out a patent, please see the advertisements on front page.

A. HARSTON.—Thanks. As you point out, the decimal point has been omitted.

J. D.—In Manchester you can see the works and form your own opinion as to their suitability to your requirements. "The Marine Steam-Engine," by Sennett and Oram, published by Longmans, price 21s., is a standard work.

STEN.—In our opinion there is no other really *good* system. For private memoranda the best way is to use a cipher code. Many volumes back we gave all the space we can or could spare for the discussion of merits of various systems of shorthand. Lewis's (now nearly obsolete) and Gurney's are the only two other systems we have practical acquaintance with. They had each good points, but were inferior to Pitman's.

T. G. ROBB.—Full particulars can be obtained from the Programmes and Prospectuses published by the Institutions or Societies, which are sold by all booksellers. The "Directory" of the Science and Art Department is published by the Queen's Printers, price 6d., and that will answer the other question about the Whitworth Scholarships, and the City and Guilds Institute, for which last, however, apply to Gresham College, Basinghall-street, E.C.; the programme costs 3d. Full particulars can be obtained on application at any of the science classes.

NEMO.—Of what is the stand composed? The bits of "cement" seem to be composed of pitch and cinder-ash or fine mould. That can be moulded into all sorts of shapes very easily, and be touched with greenish paint to give the appearance of moss.

R. M., Leith.—The book referred to does treat the subject fully, and so do several others. It has also been fully described in back volumes (amongst the L.'s) and in many others. Several manuals have been published on electric-bell fitting and wiring for electric light. "The Internal Wiring of Buildings," by H. M. Leaf, published by Archibald Constable and Co., is a good work.

DYNAMO.—Such information can be found in many of the books which are available in the free libraries of your city. The usual plan to "take up" a career in any branch of engineering is to become either an articled pupil or an apprentice.

IN TIME.—We shall probably stop the sale of our 'Best Books" soon after the end of the year, so that you had better order before Christmas to make sure of getting a set.

PUZZLED.—Such problems are not worth their space.

W. P. THORP.—We suppose plenty of other poisons are taken daily in drugs! We should not swallow kerosene ourselves, but the small quantity mentioned by the correspondent would not, we fancy, result in a coroner's inquest. We believe the earliest use of the petroleum oils was medicinal, internally and externally. There is nothing that the average man will not swallow, one time or another, as a drug!

H.—We do not know a book. Batsford, 94, High Holborn, W.C., may.

F. C. LAMBERT.—Look through the "Sixpenny Sale Column." Mr. Allsop's book is as good as any.

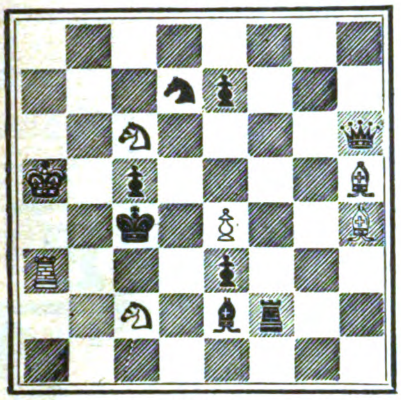
THERE are 20 carbide manufactories in France, most of them obtaining their current by means of water power.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1704.—By C. A. Gilberg.

Black. [8 pieces.



White. [7 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Dec.* 18.)

Solution of Problem No. 1702.—By L. Hawkins.

Key-move, Kt-Q5.

NOTICES TO CORRESPONDENTS.

Problem No. 1702.—Correct solution has been received from Frank Gowing, A. Tupman, T. Clark, Richard Inwards. This problem, unfortunately, has a second solution by Kt-R5, as pointed out by J. E. Gore, C. R. Baxter (Dundee), and F. B. (Oldham), S. Woollen.

Rev. Dr. Quilter.—Can you supply the continuation after Q-QB8?

P. Hutton.—We commend your pluck, although again unsuccessful.

Experiments have been carried out in America with wireless telegraphy, in which a telephone receiver was substituted for a coherer, and is said to have responded to the electric waves, even when the diaphragm was of rubber and the coil removed. The law deduced is that the air in proximity to the conductors conveying big-frequency waves acquires a pulsatory motion, which it may transmit to a diaphragm. The rigid chamber behind the diaphragm should be connected to two terminals in contact with media at different potentials, which media may be the air or the earth.

The Marine Department of the Board of Trade have issued the report for the live-saving apparatus for the year ended June 30 last. During the twelve months 223 lives were saved on 37 occasions by means of the apparatus, this being 92 more than the number saved by the same means during the previous year, and 59 less than the average for the previous ten years. The total number of lives saved by the live-saving apparatus since 1870 is 7,241. During the past year three new stations have been established. The total number of live-saving stations now under the control of the Board of Trade is 313—viz., 297 rocket apparatus stations, eight cliff ladder stations, and eight heaving-line stations. There are also 354 stations supplied with belts, or belts and lines, for life-saving purposes.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent One Month before expiration, in order to give them time to forward fresh remittance before subscription expires.

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

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£3 0s.	£2 15s.	£2 10s.	£2 5s.	£2 0s. each.

	1	6	13	26	52 insertions.
	£ s.	£ s.	£ s.	£ s.	£ s.
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Half-page	4 10	3 15	3 10	3 0	2 10 ,,
Quarter-page	2 10	2 5	2 0	1 15	1 10 ,,

Back Page, £10 10s. A few dates open during 1899.

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	£ s.
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Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the English Mechanic Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to The Strand Newspaper Company, Limited, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

Special Notice. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

Printing Press and Type, outfit complete, value 50s. Offers, cash or exchange.—Apply Adams Bros., Daventry.

Wanted, a **Treadle Lathe**, by good maker. Give Pedigree Mastiff Bitch, value £10; or Mastiff Dog (prize winner), value £15.—Beanland, Odiham, Hants.

Calver Reflecting T lescope, 8½in. mirror. Exchange for good, light, back-geared Lathe.—Banks, Corporation-street, Bolton.

6½in. **Equatorial Reflector** (Calver), heavy iron stand, slow motion, fine instrument; exchange refractor, or sell. Seen by appointment.—C., 16, Sunningfields-crescent, Hendon, N.W.

Pair Pneumatic-Tired Wheels, secondhand; small Lathe, 2 cast steel headstock mandrels. Exchange Camera, or Musical Instrument. Letters only.—Cripps, 13, Henrietta-street, Deptford.

Wanted, Berliner's Gramophone, Diaphragm; exchange 25-string Triumph Auto Harp or new Silver Lever Watch, value, 20 each.—James Sharp, High-street, Sanquhar, Dumfriesshire.

"**Jamieson's Celestial Atlas**," 30 plates, figured constellations, descriptive and explanatory, published 25s. Exchange for good Field-Glass, or Cash offer.—Desmond, 50, Woodchester-street, W.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of Screws, Bolts, and Nuts for model work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—Morris Cohen, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—Clegg, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—Jarratt, Queen-street, Leicester.

Eyesight.—All whose sight is in any way defective should send to Horne and Thornthwaite, 416, Strand, for—

"**Hints on Spectacles**" (Why the Eyes want Help), by Overstall, F.S.M.C. (with distinction), post free.—Above.

Rubber Outer Covers, 3s. 6d. Prepared Canvas, 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—Pemberton.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—Pemberton.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—Pemberton.

Detachable Outer Covers (Licensed), 12s. 6d. each; all cycle accessories and cycle rubber goods stocked.—Pemberton and Co., 1, Cardwell-place, Blackburn.

Nuts and Bolts for Model Work. Illustrated List, 2,800 varieties, 3d.—Butler Bros., Haggerston, London.

Screws, Screw-plates, Taps, round and hexagon special steel brass and iron rods. See list.—Butler.

Rubber Outer Covers, average 16oz., Para rubber 5s. each.—Franklands.

Rubber Outer Covers, 3s. 6d. each, 36s. per dozen.—Franklands.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—Franklands.

Air Tubes, best quality rubber, 2s. 9d. each. Fitted with Dunlop valve, 3s. 9d.—Franklands.

Air Tube, Para rubber. Marvellous value. Large stock to clear. Perfectly air-tight., 2s. each.; 21s. per dozen.—Franklands.

Cycle Capes, 3s. 6d., 4s. 6d., 5s. 6d. Also a few cycle Capes, guaranteed waterproof, 2s. 6d. each.—Franklands.

Detachable Outer Covers, licensed, 12s. 6d. each.—Franklands.

Saddles.—A clearing line in ladies' and gents' saddles, 2s. 6d. each, 24s. per dozen.—Franklands.

Inflators, 18in., 1s. 6d. each, 15s. dozen.—Franklands.

Bells.—Special line, double gong, usual price, 12s. dozen, will clear 5s. per dozen.—Franklands.

Prepared Canvas, 90 by 9, 1s. 3d. each, 12s. per dozen.—Franklands.

Pedal Rubbers, 6d. per set of four, 4s. 6d. per dozen sets; no rubbish.—Franklands.

Spanners, nickel, usual price, 13s. per dozen. Will clear a few dozen at 7s. 6d. per dozen.—Franklands.

Cycle Accessories and Cycle Rubber Goods. We hold the largest stock in the North.—Franklands, Astley Gate Blackburn.

Brass and Gunmetal Castings of finest quality. Prices on application.—Daniel Young, Witney, Oxfordshire.

Mail Cart Wheels and Perambulator Furniture.—Walker Bros., Primo Wheel Works, Sheepscar, Leeds.

"**Spesco" Belting Syrup** prevents slipping, and keeps belts in good condition; 1lb. sample tin, post free, one shilling.—Spesco Ltd., Suffolk-place, Bermondsey, London.

Gas-Engine Oil, 1s. 6d. gallon. Cheaper grade, 1s. Cotton Waste, Tallow, Packing, &c. Correspondence invited.—Under.

Polishes, Varnishes, Paints.—Large or small quantities, by rail or post. Benzoline, Gasoline, Mechanical Rubber Goods.

Why Burn Dangerous Oils? We have Safety Kerosene in barrels or drums. Refined quality only.—Under.

Lamps and Stoves Repaired. Wicks and Glasses of every kind. Low prices.—Jones Company, Bethnal Green.

"**Electricity**" is a bright, chatty, and practical journal, which everybody interested in the science should read. Fridays 1d. Of all bookstalls and newsagents.

"**B" Oil-Engine Castings and Forgings.** Easy to make; no complicated parts; very reliable.—Barkers, Leyton.

"**B" Oil and Gas-Engines** are fitted with silent gears, sensitive governors, adjustable bearings.—Barkers, Leyton.

Original Testimonials can be seen at any time, together with English and Colonial Press opinions.—Barker.

"**B" Gas and Oil-Engines.** Supplied the word over. Particulars stamp.—A. and S. Barker, Engineers, Leyton, E.

Launch Oil Engines a Speciality. New designs. High speed. Very reliable.—A. and S. Barker, Engineers, Leyton, E.

Money Saved is Money Earned.—The cheapest house for electric bells, telephones, light material, &c.—Write for catalogues, post free 3d., to C. W. Treacher and Co., 165, Queen Victoria-street, London.

"**Acetylene: its Characteristics, Generation, and Use**," with Descriptive Catalogue of "Incanto" Apparatus; just published, 2d. post free.—Thorn and Hoddle 1 Tothill-street, Westminster, S.W.

Gas and Oil Engines.
Steam Engines.
Dynamos.
New Designs. New Patterns.
Latest Improvements.
Send at once for Latest Catalogue.
H. Warsop, Launder-street Works, Nottingham.

Simplex Typewriter, 14s. 6d., delivered. Thousands in use. Illustrated particulars free.—Atkinson and Co., Harehills-avenue, Leeds.

Model Boiler Fittings and Material, seamless copper tubes, 5-32in., 3-16in., ¼in. up to 8in. diam.—Below.

Steam Gauges from 1in. dial, 60lb., 6s. Warranted ¼in. Wheel Valves, 3s. 11d.; Water Gauges, &c.—Below.

Injectors, Cylinder Lubricators, Lever Safety Valves, Copper Rivets and Sheet Brass and Steel Rods, &c.—Below.

Illustrated Catalogue of above high-class gunmetal fittings, 2 stamps.—Bert Garside, Golborne-street, Warrington.

Brass Casting Made Easy by using Wells' specially prepared Moulding Loam. Brass casting a pleasure.—Below.

Sold in 5lb. canisters, 2s. 3d.; 10lb., 3s. 9d.; 20lb. 6s., carriage paid, with instructions.—Below.

Plumbago Crucibles, with instructions for melting brass, sixpence each post free.—Geo. Wells, Needham Marke Suffolk.

Phonographs, new Gem, take standard records, and are fully licensed, £2 2s.—Below.

Phonograph Records, Bands, Songs, Instrumental Speeches, 2s. 6d. each, post free 2s. 9d.—Below.

Phonograph Accessories, &c.—T. G. Woods and Sons, 51, Spencer-street, Clerkenwell, E.C.

A Perfect Portable Home Turkish Bath, folds into 3in. space, weighs 7lb.—Gem Supplies Co.

The Folding Quaker Bath Cabinet. Cleanses and invigorates, cures diseases without nauseous drugs.—Gem Supplies Co.

A Turkish Bath for a Penny. "E.M" pamphlet free.—Gem Supplies Co., 6, Bishop's-court, Chancery-lane, London.

"Perfect" Pocket Oiler, emits one drop at a time, never leaks, 1s. each.—Gem Supplies Co.

"Perfect" Pocket Oiler.—Best oiler for bicycles, typewriters, or sewing-machines, 1s. each—Gem Supplies Co.

"Perfect" Pocket Oiler, 1s. each. Trade terms on application.—Gem Supplies Co, 6, Bishop's-court, Chancery-lane, London.

Watchmakers, Amateurs, Collectors.—Good watch movements, verge, cylinder, lever, from 1s. 6d.—Below.

Antique Watches, movements, specimens of work for the last 200 years.—Willis.

Boxes of Parts, for repairs, 1s. 6d.—Willis, 19, River-street, London, E.C.

Magnificent Model **Vertical Engine,** tubular boiler, glass gauge, whistle, double-action slide-valve cylinder, bronzed stand, exhibition model, silver-plated, high speed, and guaranteed perfect. Worth 42s.; accept 12s. 6d. free. Photograph 1d.—Manager, Hassall's Chemical Works, Stratford, E.

Motor Cycle Castings, rough or finished, from "E. M.," list 1d.—Homer, 93, Hurst-street, Birmingham.

100 Billheads, Memos., or Cards, post free 1s. 3d.—Young, 57, Leyton Park-road, Leyton.

Watches, Clocks, Jewelry, Musical Boxes, Novelties. Dealers supplied at rockbottom trade prices for cash. Cheapest house in England. Lists on application. Gentleman's crystal face keyless nickel silver, 2s. 9d.; not less than three will be sent.—Woolredge and Co., 90, 91, Queen-street, London, E.C. Agents wanted. Mention paper.

Reliable, efficient **Dynamos, Motors.** New catalogue, stamp.—Webster Michelson Co., Electrical Engineers, Eve-hill Works, Dudley.

Engineers', Cycle-makers', Gasfitters' **Stocks** and Dies, also Taps, all sizes, price list gratis.—Metz, Edgbaston-street, Birmingham.

"The Model Engineer" for November contains:—"My Model Electric Tram-Car" (Illustrated); "Useful Additions to a Screw-cutting Lathe" (Illustrated); "The A. B. C. of Dynamo Design" (Illustrated); "Britain's Latest Battleship"; "Brazing"; "Model Railways" (Illustrated); "The Wehenelt Electrolytic Interruptor for X-ray Work"; "Melting Metals in the Amateur's Workshop" (Illustrated); "Model Yachting Notes"; "Steam Raising in Model Locomotives" (Illustrated); and many other interesting articles. Post free 3d.—Address below.

"The Model Engineer" for December contains:—"Making Cardboard Model Locomotives" (Illustrated); "½H.P. Avery-Lahmeyer Dynamo" (Illustrated); "Liquid Fuel for Model Boilers" (Illustrated); "Model Railways" (Illustrated); "Ringing Two Electric Bells in Series" (Illustrated); "How a Battery Works"; "The Society of Model Engineers' Conversazione"; "Model Yacht Measurement" (Illustrated); "Boilers for Model Torpedo Boats" (Illustrated); "A Cheap Speedometer" (Illustrated); "How to Demagnetise a Watch"; &c., &c. Post free 3d.—Address Publisher, 6, Farringdon-avenue, London, E.C.

Calver's Complete Equatorial, best ever designed, revolving eye-end, set any latitude by screw and vernier at once. Second-hand Telescopes, perfect order. "Hints on Reflectors," 13 stamps.—G. Calver, F.R.A.S., Chelmsford.

Cycle Motor Castings to drawings in Mechanic, most complete. — Everett and Co., 32, Charterhouse - square, London, E.C.

Electric Lighting Plant.—4 nominal horse-power Stockport Engine, 150v. 30a. dynamo, and 50 E.P.S. storage cells, £95. Engine only £40.—Palmer, 6, Upper Tulse Hill, S.W.

30c.p. **Dynamo** (Butler's), charging and lighting amps, holders, wires, new, £4 15s.—4, Dixon-terrace, Darlington.

"Screw-cutting," both simple and compound, explained, with list of wheels, post free, seven stamps.

"Cycle Brazing," four stamps. If you require a good book to learn from, send for this.

"Guide to Soldering," three stamps, which shows how to solder gold, silver, copper, brass, tin, &c.

The Three Books post free for One Shilling Postal Order.—Geo. Harrison, 6, Manning-street, Nottingham, E.

Complete Catalogues.—Electrical supplies, Steam Models, Magic Lanterns, Fretwork materials, and Air-Rifles. Free three stamps.—Greaves and Co., 230, East India-road, Poplar, E.

Films for Tracing Lantern Slides, 4½d. per doz., 1s. three doz.—Photo, 11, Bothwell-street, Glasgow.

Genuine B.S.A. Cycles, from £8 10s. Up-to-date Machines, £4 8s. 6d. Frames, 37s. 6d. Wheels, 12s. pair. New Outer covers, all sizes, 9s. each. Inner tubes, 2s. 6d. Send for lists and testimonials. — Kirkdale Cycle Works, 41, Kirkdale - road, Liverpool.

Pair 5in. back-geared **Lathe Heads,** complete, well made, quite new, 50s. Also pair 5in. single-geared, 30s.; bargains. —Walmsley, 17, Calton-street, Keighley.

Gas, Oil, and Steam Engines, Lathes, Dynamos, &c., all soft metal. List three stamps.—Reynolds Bros., Barnsley.

36 volumes **"English Mechanic,"** 1870–1888, strongly and neatly cloth bound, two vols. in one, excellent condition, £3 12s. the lot. Exceptional opportunity.—Percy Lund, Godwin-street, Bradford.

Motor-Bicycle, double cylinder, with spare wheel, magneto ignition. Has run well, but wants overhauling. Very little used. £10. A bargain. Write for evening appointment to view in North London.—H. C. C., 204, Amhurst-road, Hackney, N.E.

Large Nicol Prism, 1in. diameter, for the study of both ordinary and extraordinary polarisation phenomena, specially made by Hilger, £10 10s.—As below.

Pritchard's Wedge, by Grubb, with extra revolving glasses; cost £9 9s., price £6 6s.—As below.

10in. Reflecting Telescope, with eyepieces &c, by Calver, £60.—C. Baker, 244, High Holborn, London.

Cassell's "Science for All," complete, in 60 seven-penny parts, clean, 12s.—Morrell, Springcliffe, Manningham, Yorks.

50,000 Choicest Microscopical Objects, New and Second-hand Microscopes, Cabinets, Mounting Materials.—Suter, 10, Highweek-road, Tottenham.

Ornamental Design, Hay, published 42s., take 10s. Two Mummied Cats' Heads, 7s. 6d.—Walker, Church-lane, Liverpool.

Shells.—Large quantity British and Foreign, named, 40s. Iron Pump, 6s. Exchange.—Walker, Church-lane, Liverpool.

Whiteley Exerciser, new, 9s. Quaint old Microscope and objectives, 20s. Exchange tools.—Walker, Church-lane, Liverpool.

Bench Lathe, 3½in. centre, driving wheel, £1. Gas-Engine, 12s. 6d.—Grumble, St. Nicholas street, Leicester.

Vertical, double-cylinder, **Scale Model Marine Engine,** 1in. by 1in. cylinder, reversing gear, £2.—H. Bolsover, Yarm.

Lathes, Drilling, Planing, Milling, Shaping Machines. Britannia Co., Bonâ-fide Makers to the British Government.

Iron Castings, various, good working quality. Prompt execution of orders.—Britannia Foundry, Colchester.

Britannia Co. Heavy Department make Tools, &c., up to 20 tons. They also continue the Light Tool Department.—Write Britannia Works, Colchester.

Britannia Co., having erected large foundry, fitted with electric light and crane, are open to supply light or heavy castings.—Britannia Works, Colchester.

Fancy Ornamental Lathes, by Holtzappfel, Evans, and various first-class m·kers, and various appliances on sale. —London Machinery Agency, 100, Houndsditch.

Special Tools, as designed for eminent firms, for any special work; interchangable.—Britannia, Colchester.

"Gem" Gas-Engines. ⅛B.H.P., Otto Cycle, well made, best and cheapest offered.—Crewe, below.

"Gem" Gas-Engine Castings Supplied. Most easily fitted. Complete sets partly machined.—Crewe, below.

Gas-Engine, second-hand, Crossley, 2-man power, cheap.—Crewe, 78, Queen Victoria-street, London, E.C.

Horizontal **Gas-Engine,** 3½in. bore, 6in. stroke, tube ignition, two flywheels, good as new, £7 10s., on rail.—Brown, 9, Henry-street, Lytham, Lancs.

Second-hand.—Linesman's **Galvanometer and** Telegraph Instrument. Price and particulars — Hargrave, 4, Fowett-terrace, Morley, Leeds.

Books. — Spon's "Workshop Receipts," Spon's "Mechanic's Own Book," "Machinery and Millwork," "Turning Lathes," Work Handbooks. Quantity other books; all cheap.—Angell, London-road, Boxmoor.

Siemens **Dynamo,** shunt wound, 40 to 50 volts, 16 to 20 ampères, about 1600 revolutions. Complete order £10.—Tuer, 13, Park-road, Bellevue, Southampton.

Model Boiler, 13in. tubular, nearly new, tested 50lb., brass mountings, 17s.—51, Winchester-road, Romsey.

Complete Sets **Water Motor Castings,** ½-horse. 20s.; ½, 30s.; ¾, 40s.; 1-horse, 50s. Satisfaction guaranteed.—P. Pitman, Halifax.

Water Motor Castings.—The Superintending Engineer, L. & N.W.Rly., says:—"I fitted up the water motor from your excellent sets of castings and fittings, and it runs beautifully, and is now driving my 3in. centre screwcutting lathe."—P. Pitman, Halifax.

Water Motors, Turbines, Water Pressure Engines, Dynamos, Castings. Illustrated lists, 3d.—Pitman, 64, Stanley-road, Halifax.

Marvellous Value!—All Shopkeepers should send for one of our wholesale cases well assorted Fancy goods, Toys, Household Requisites, Special Lines, £1, £3, £5, £10, carriage paid.—Barnes, 41, Kirkdale-road, Liverpool.

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But you will save more than that by smoking the *Weekly Times and Echo* Cigar which only costs *twopence*, and is equal, if not superior, to any other cigar which costs three or four times the price. We are selling (and tobacconists all over the country can supply you if they like) this cigar as a gigantic advertisement, because we know that wherever the cigar goes the marvellous value we are giving smokers will be a matter of universal comment and astonishment. See that every cigar has the *Weekly Times and Echo* band round it, and is sold from a box similarly labelled and branded: otherwise you will not be sure of getting for twopence a cigar which would otherwise cost from three to four times the price.

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"Designing and Drawing," No. 1 of The Useful Arts and Handicrafts Series of Books is ready.

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"Decorated Woodwork," by carving, colouring, and wire inlaying. No. 5 of The Useful Arts and Handicrafts Series, ready December 21st.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, DECEMBER 15, 1899.

INLAYING.—X.

ANOTHER plan is to prepare the bed in cement first, and when dry flatten down with a piece of pumice-stone, and centre or deepest tints, and blending off by gradually using the lighter until the bright lights are gained.

To help as much as possible, it will be found that if a water-coloured drawing is made, and you work upon that, the selecting of the different tints and shades will be more quickly accomplished.

As it is impossible to get that softness that the pencil or paint-brush will give, it behoves one then to use as small squares as it is possible to prepare, and the cement used to

Another plan with cement mosaic is to prepare a stout piece of board, size it, and give it two coats of varnish. The first must dry hard, the second coat can be wet for our purposes, but not of too great a body—in plain words, thinly laid on. Having your specimen ready and hard dry, level the surplus projections of cement that may remain after assembling, and then rough the surface with coarse grit or sand. The assembled or mosaic surface is intended to be attached to the wet varnish. When all is perfectly dry,

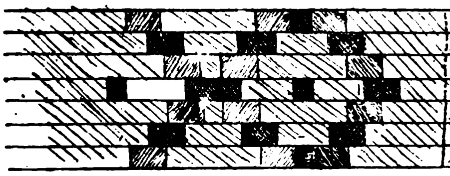


Fig 157

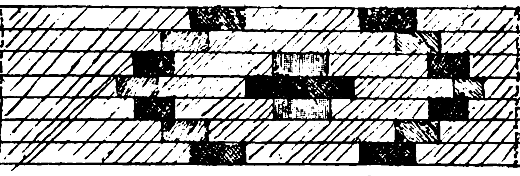


Fig 158

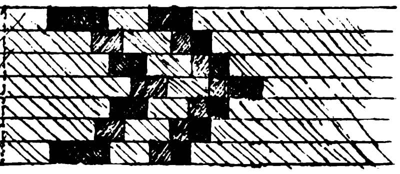


Fig 159

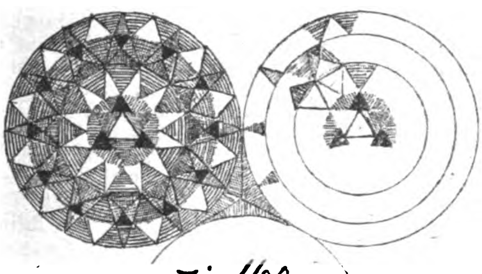


Fig 160

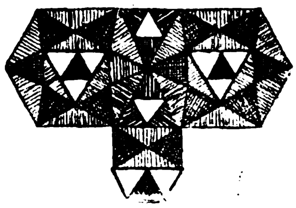


Fig 161

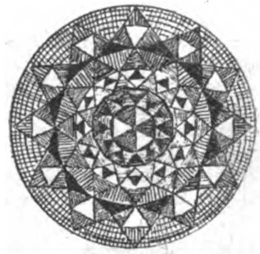


Fig 162

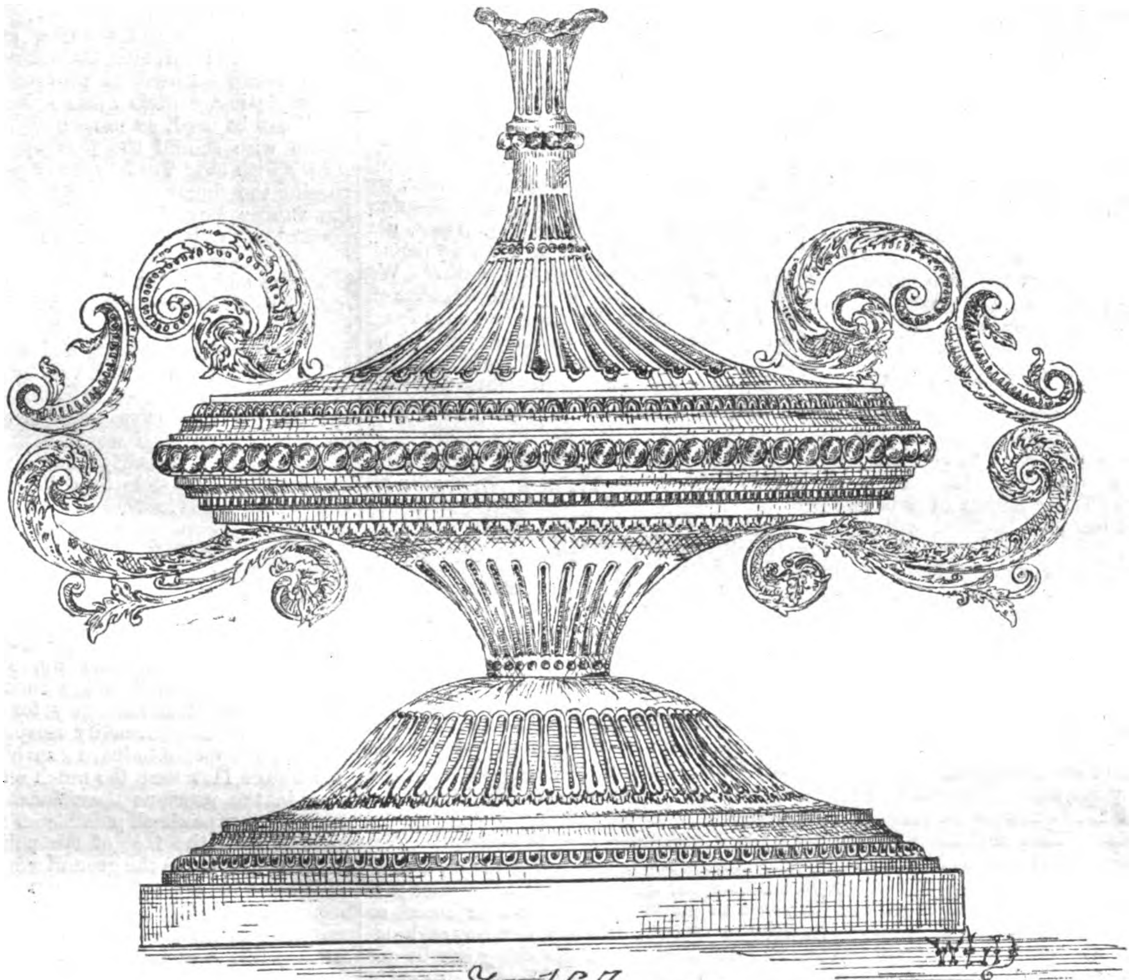


Fig 163

mark the outline on it and proceed to build together the small square on the outlines first, then fill in the body. The shading can easily be got by working up the different tints, using a dark tint for the attach them together must be fairly thin or fluid. Under any circumstances the drying must be gradual. If hastily dried there will be but little chance of shifting over if found necessary in assembling or putting together. the bed above alluded to can be cut down with coarse sand, but no more than is necessary to get a level surface, although that surface may contain some hundreds of pieces; it will now show any defects of

assembling if due care has not been bestowed in the preliminary stage. The after-process is simply to get the coarse marks out with finer grit, finally polishing with snake stone.

The wood process is very similar in many respects, only in lieu of fluid cement we prepare our drawing-paper by coating it with two fairly thin coats of glue or gelatine. The coating must be done after the drawing is traced in, and it is for that purpose we use clear glue in preference to the ordinary Scotch. Do not wet in more than, say, about 1in., and while assembling the wood square, the outer face can have a little rubbed in to help it in remaining intact. If by chance the wood mosaic should curl up, it will be best to desist, and gently flatten out. If not done, there will be trouble in assembling the adjoining portions.

The cutting of the strips can either be done with a fine circular saw, or the gauge of the cabinet-maker. It will be necessary to have all the strips well taut (close together), and the tooth of the gauge should be very sharp, in fact the keen edge should be got up on the oilstone. In cutting, the tooth of the gauge should incline over, like a paring-knife, for the simple reason that if the tooth of cutter is too upright, it is just possible your cutter will send the small pieces all over the place. It will be found necessary to have a weight of some sort to keep all the strips down, and the edge of the same, if square, should be brought up as close to the cutting end as possible, yet not foul the gauge holding the cutter. When all is together a piece of paper should be glued over all the surface and allowed to dry.

Up to now the work has been to unite together a number of small pieces to represent the whole, whether it be cement or wood. With the former there need be but little fear of its curling up; with wood it is vastly different, and it is for that reason we deem it advisable to comment further. As above stated, it is possibly curled or somewhat buckled; if so, we must proceed to warm a piece of wood (caul), and at first simply lay it on and let its own weight regain flatness, and that must be repeated perhaps three or four times; but in no wise must force be used until such times as the face is flat or nearly so; then pressure can be brought to bear upon it. Should the caul be overheated, it should be just sufficiently let cool to keep the glue as nearly approaching a fluid state as possible.

The veneering has been explained in the part allotted to "Buhl-work," and the same amount of care is necessary to prepare the face when the veneering is hard and thoroughly dry. The addition of a border or frieze around the mosaic panel will conclude this part.

Figs. 157 to 162 give specimens of Indian ivory and metal-work. Fig. 163 is what can be done in wood, metal, or mosaic work and engraved. In either material the work can well be enlarged three to four times, and, if well done, should look handsome.

French Polishing.

The ground of the wood will be treated first. We speak of wood generally as being "dead"; it is quite the contrary—it is the *life* in the wood that answers so readily to climatic changes. That shrinking in hot weather and contracting in cold is continually going on. What does that suggest? Simply this: We employ a grain-filler that may or may not act in unison with the wood we desire to polish, and we get a surface like marble or like sponge! What, then, is wanted is a filler that must lend itself to the natural action of the grain of the wood it fills. Plaster of Paris, brickdust, ground resin and shellac have each and all been found wanting, although much is now done with the first-mentioned. There is not a particle of elasticity in either three.

Having had a set of dining-table tops to polish, we could not help remarking upon the excellence of the colour, the evenness of the texture, or face of the tops, and the apparently marble-like appearance of the tops themselves. We polished them, and were greatly surprised with their appearance, and the small quantity of polish required to gain a truly beautiful surface. Inquiry elicited the fact that the tops had been in the family a number of years, and were touched up with linseed oil and turpentine, drying up all surplus, or superfluous grease, with waxed rags.

The above facts induced us to experiment. We found that resin, with and without shellac, tended to a rounded form, and so did brickdust. That the finer they were ground the more globular they became, but with pumice-stone we certainly found the conditions different. Instead of tending to a globular form, its particles presented always the porous nature of sponge, even when ground to a very fine state. We next sought the liquid best to use in conjunction. Oil itself was out of the question, and only with plaster of Paris was it a partial success, whereupon we added the everyday turpentine, and, so far, satisfactorily; but how to eliminate the partial greasiness of the turpentine, and that quickly? We found it next to impossible. Knowing that boiled oil had a tendency to harden quicker than ordinary oil, we made up a filler of pumice-stone and boiled oil made fairly hot, and just a trace of common wax to aid, as we thought, the tendency to dry or set hard. We were successful, and where time has permitted we have ever resorted to its use. We have found that the atmosphere acts but slightly either to soften or harden it after the polishing is done.

For the guidance of the reader, we may say the drying-up process after the above filler has been rubbed in, and while in a warm state, is greatly helped with finely-sifted plaster of Paris.

Ere we proceed to the polishing proper, we think it advisable to discuss the "cleaning up." There are grades of *glass-paper*, not sand-paper as is often advised, from "flour" to what is known as "gravel-walk." We have only to do with the Middle 2, Fine 2, and No. 1½. After the work has been freed of all glue and paper, the work should be *toothed down* with a tool or plane, with the cutting-tool set nearly upright, the iron itself having a number of fine cuts upon its face exactly like a fine file "single cut." If we grind the reverse side or face upon an angle similar to any ordinary plane-iron, we shall have a number of fine teeth or points according to the face cut of the iron. It should project just enough to *lightly* cut or mark the face of our work. If it projects too far, it is liable to drag out some of the finer cutting, or the little squares of the mosaic inlay. Having levelled the work no more than is necessary, it must be scraped with a steel scraper, then papered with middle or fine 2, finishing with No. 1½. In papering up work, a flat piece of cork or wood (pine) should be used. Some cabinet-makers glue a thin layer of about ¼in. of cork on to the pine, and when dry flatten the cork on a coarse sheet of glass-paper, which should lie on a flat bed of either iron or glass.

The work now being ready for polishing, the filling in, as above, is now done; if allowed to stand for twenty-four hours, so much the better. After a few hours, however, the first stage of polishing can be got on with. With some wadding a rubber is made that can be held between the index finger and thumb. Some use two, others three fingers in conjunction with the thumb. Over the rubber is stretched some clean, old white calico, and twisted round the top of the rubber, and held with it. The rubber should approach the form of a cat's foot. It can even be pointed a trifle, with the index finger lying exactly in the centre of the projecting portion of the rubber.

It may be advisable to oil-in the surface. With this exception light woods should not be oiled, as it is desired, of course, to retain their whiteness as perfect as possible. All white, or light-coloured grounds should have either transparent or white polish used in conjunction.

Having the work ready, pour a little polish on the wadding, covering it with the rag as explained. No perceptible difference will be found after three or four rubbers of polish have been spread over the surface, and it is as well, as soon as a slight shining appearance has been gained, to set the work aside, for two reasons:—Firstly, we have used oil in dark work, and it would be best to let the work stand ere we use any more oil; secondly, we are compelled to use a little oil to assist the rubber. For this reason the shellac solution cannot set hard enough in working to prevent the future coats adhering in mounds or hills, which would tend to spoil the work, irrespective of trouble in gaining an even body, which must exist to receive the *finishing* that all polished or bodied work has to undergo. After the first coating is hard the surface is again levelled down slightly, not only to level or cut down the excess polish, but likewise to lower the projecting edges of the cavities that tend to swell and rise. It may be here stated that the first coatings of polish answer a twofold purpose, they not only help to fill up what grain may be open after the filling in, and also act in the same manner as size with the painter, or rather painted work.

Having levelled the surface down with the worn out No. 1½ glass paper, the same filling of rubber and working as before is gone through; but, after the second rubber, a little oil can be used to prevent the polish accumulating, a little more liberal addition of oil can be used, as more polish is applied. In no wise should the face appearance be glossy with oil. That is easily perceived by passing the finger over the face lightly: if the rubber mark is still existent, and is not marked with the finger, then more oil (a drop or two here and there sprinkled on) can safely be added; but if there is a decidedly greasy smear across the polish, then the oil supply must be stopped. As the body of polish begins to thicken, and if the smear left by the polish in the rubber is not too dense, then the process of bodying or building up the successive coats of polish will eventually give good work, both as regards soundness and equality; but if the polish rubber seems to slide over the work, then less oil is used in the succeeding rubbers of polish necessary to obtain a body for finishing.

The defects of the above process will be palpable after the work has stood aside for at lease twelve hours, and are as follows:—If the circular rings of polish are fixed—that is to say, cannot be rubbed up, and the oil smear is very thin, then the work will be as near right as it is necessary for finishing; but if the oil smear readily escapes from the polish, yet appears to leave a surplus behind, it is a sure fact that too much oil had been used in the previous operations. Now endeavour to wipe all oil possible off the polish, so as to leave the face of the polish bright. If the polish leaves the ground when pressure or friction is used, then the use of oil had been resorted to at too early a stage, and may lead to serious results. Again, if too much polish is worked on the face, or even if the rubber is over-charged, then the surface polish that is being laid on has not hardened as it should do. The remedy then is to level all down to the groundwork, and begin again, noting well that if the polish rubber seems to bite or grip the underlying polish then all is well, even though we use oil to lighten our labour.

The work should now stand aside to

harden, because the *spiriting-off*, as it is termed, will give better results than if finished off on semi-soft polish.

It greatly enhances the quality of the finished polishing if two or more bodies of polish are applied, especially if the surface is just levelled a trifle. The safest method of levelling is done as follows: Have ready a strip of felt about 1½in. wide, and long enough to make a round wheel-like form. Insure having one face flat—the other does not matter. When wound tightly, the end of the last coil can be sewn to the body. To prepare the leveller, soak it in boiled oil for a day and night, then expose it to gentle heat or to the air. The latter is the best if time is not an object. Assuming the circular rubber is so far hardened as to bear grinding down on coarse glass-paper, it can be used on the work, which should be oiled over, and extra fine-ground pumice-stone dusted over it. The pumice-stone powder should be held in a rubber made of two or three thicknesses of fine muslin. When the work looks equally dull and yet retains a polished surface, even and free from nibs when held up to reflected light, it may be assumed to be satisfactory.

It is advisable to level down finally with the round felt-rubber and pumice-stone. The cutting should be as light as possible. It is not necessary to flood the work with oil; a touch here and there will be found all that is necessary. When all inequalities are levelled down, the work is wiped quite clean, free from oil and grit. We shall require a special rubber, with an interior pad of worsted, with three or four coverings of good clean old flannel. Clean old calico rag will do for all coverings, and they should be washed in soda water (hot) to free them from grease. To commence, pour a little polish and spirit on to the rubber, ever aiming at covering the rubber equally so as not to have one part more moist than another.

The first rubbers having now become exhausted, it will be necessary to apply more; but more spirit must be used, which consequently lessens the polish, and that system is pursued until the final replenishings are without polish entirely and less in quantity. To free the surface entirely from grease, the last two or three rubbings may be simply damping the face of the rubber. The *drier* the polished surface becomes—that is to say, freed from oil—the quicker will the evaporation take place, and the more transparent will the smear become, until finally there will be no smear whatever left.

With many polishers it is customary to have three rubbers—one for bodying-in, another for bodying-up, and the first few rubbers in spiriting off, and the flannel rubber, as above explained. We must caution the reader against overflowing the rubber towards the last stage. In fact, if a drop or two is placed in the palm of the left hand and taken up by the rubber, there will be no fear of marking the surface. If all is well, he spiriting off should be clear and bright tas glass, and, not least, should be durable. If any oil remains it must be dried up, otherwise the brightness will not be lasting. The second qualification is that it should stand a moderate heat—above the heat of the hottest day in summer.

The more solid the foundation the surer will the fabric be that is built upon it. More we need not say than that in varnishing the interior cuts of fretwork must be as clean as possible, and that the work must not be drenched with varnish, or it will require double time to get in order.

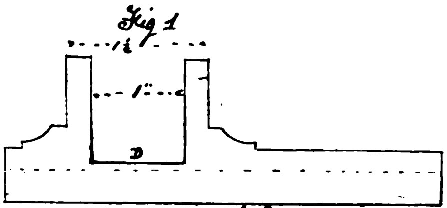
THE END.

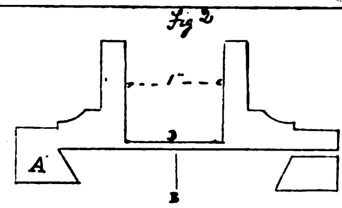
The quantity of coal mined in New South Wales last year was 4,706,251 tons, or 322,660 tons in excess of 1897. The Sydney Harbour Collieries Company are carrying on sinking vigorously at Balmain. It will be some time yet before the coal is reached, which lies some 3,000ft. from the surface.

ORNAMENTAL TURNING.—XXXII.

By J. H. EVANS.

HAVING in my last reached that part of the construction of the spherical slide-rest which constituted the third slide, as attached to its permanent place, although fixed in one sense, it will, of course, be easily recognised that it can be at once removed for any particular purpose that may so require it during the progress of fitting-up the succeeding slide, which works upon it and carries the fourth slide. At the same time, I may point out that the removal of it should be conducted with caution, and as seldom as possible,





as the continued removal of it from the worm-wheel naturally causes the screws to become more or less free in the fitting, and it is desirable that this should be avoided, as it will to some extent influence their holding powers. This will, I think, be so readily seen and acknowledged that it will need no more comment now.

We pass on now to the gunmetal plate which moves upon the slide we have just referred to, and as this has to carry the fourth and final slide, it is provided with a vertical socket, which admits of the tool-box being turned to any angle or position that it is in anyway likely to be required in.

By reference to Fig. 1, a section of the plate and socket, it will be clearly seen how this is constructed. In the first place, a good pattern must be made of the dimensions given, and the casting must then be treated as all the others—that is, planed up and surfaced. By Fig. 2 it will be noticed that in like manner to the preceding slides of a similar character, one angle is cast in the solid with the plate, *vide* A, Fig. 2. Now, there are several points in getting up this socket that will require very careful attention. In the first place, it is absolutely necessary that the centre of the socket should be identical with that of the worm-wheel, which means also the

FIG. 8.

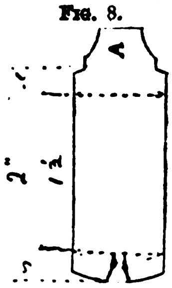
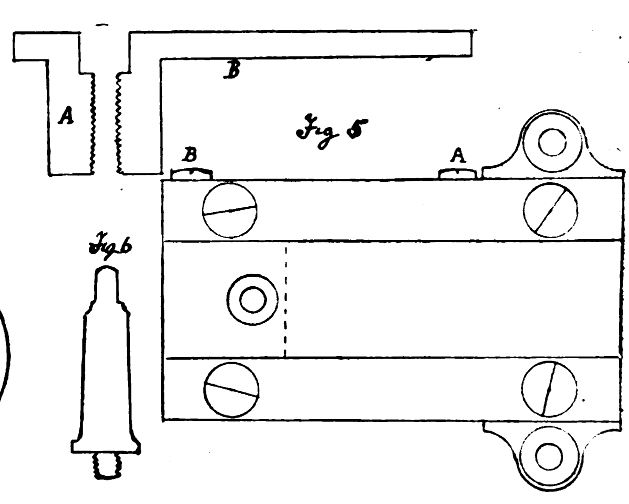
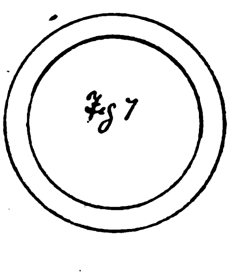


FIG. 4.





centre of the slide, which is presumably correctly attached to the wheel. This will entail the planning of the angle as follows: We will take, which it really represents, the line B as the centre of the socket. Now, to get this correctly, the distances must be set out with care, and the lines adhered to with equal care.

This, we will take it, has been executed to our satisfaction; but we must remember that when this is so far done, and the slide finished, with the loose strip and set-screws in their places, we still have to bore the hole, and this is another point which must claim our entire attention and thought. We have, of course, the finished surface of the slide as the basis upon which to rely when chucking the plate for the purpose of boring or turning out the hole. There are several ways of chucking or holding such a piece of work for the purpose. It can be held to a surface chuck by clamps and screws; but I think I cannot do better than explain the manner we

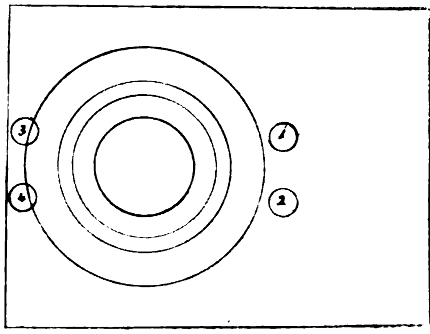


FIG. 3.

have always found the most satisfactory, and, for that matter, the least trouble.

Reference to Fig. 2, the line D, will show the approximate depth to which the fitting should be bored. It may become a question with many, Why not carry the hole through? The fact is, the base thus left forms an important feature for future developments. But at the precise centre a small hole, rather less than 1/16 diameter, must be drilled, and this has two purposes to serve: First, I may say it is impossible to fit the stem required to work in it without a free passage for the air to pass out; secondly, this same hole forms a means of chucking the plate with the desired accuracy. The readiest way to chuck or hold it firmly is upon a metal chuck, the diameter of the face to pass the angle A, and at the centre a small pin is turned to fit the hole, which certifies the centrality. The plate is then carefully soldered to the chuck, when not only can the hole be turned out, but the exterior also turned and finished.

The plate extending on one side of the centre, as it does, when the extension is reached, care must be exercised in the movement of the slide-rest, for the reason that, although perfectly secure for all practical purposes, any sudden jar, caused by a catch of the tool, might tend to alter the position of the work upon the chuck; I say might, because such a thing would probably happen and no harm occur; while at the same time the undesirable alteration is likely to occur.

The external fitting is turned to 1½ diameter, and, as in other similar instances, it is an advantage to have it slightly taper, and it assists in the fitting of the ring which has to be

ultimately fitted to it. The hollow and surface are both, as I have already stated, turned at the same time.

The reason why the socket is made at the end of the plate is that it enables the tool-box which works in it to be brought in closer contact with the work in hand when the slide-rest is in use. I have, I hope, now given a pretty clear insight as to the preparing of this part of the work for the reception of that to follow. Before leaving it, I will explain the meaning of the four holes shown in the plan Fig. 3, marked 1, 2, 3, 4. These, then, are for the purpose of holding the nut in which the main screw of the slide works. We will take 1 and 2 as the position that is most generally used; but at times it is required to create a longer range of movement, and when this is so, the nut is moved forward, so that it may be held to the slide by the holes Nos. 3 and 4, to which the same two screws are transferred. This, it will be seen, will allow the slide, and consequently the tool, to recede quite 2in. or more, which may at times be of great service.

We pass on still further, and this brings us to the steel plate, Fig. 4, upon which the tool-box slides. This plate, it will be noticed in Fig. 4, is provided with a stem in the solid, *vide* A, Fig. 4. The plate must first be carefully surfaced on the top, and by this it is chucked to a true surface chuck, and held by clamps, while the stem A is carefully fitted to the hole or socket. Here again we come to an important fitting; inasmuch as it is necessary that this plate be elevated or depressed according to circumstances, therefore it must not only be well fitted, but must be perfectly cylindrical, so that in whatever position it is placed it will fit equally well. The under surface B must, of course, be turned while the plate is thus held, making one job of it.

We will now return for a moment to explain the reason why the aperture in the metal plate (Figs. 1 and 2) is not bored or turned right through. By referring to D (Figs. 1 and 2) it will be seen that the bottom of the hole is left about $\frac{1}{16}$in. thick, rather more than less. The object is this. By referring to Fig. 4 the section will clearly show that a screw passes through the centre of the stem, the upper part being countersunk or recessed to allow the head to pass freely up and down within its diameter, and at the same time to go well below the surface of the plate in order that the slide or toolbox may not be impeded in its passage over it. It will be obvious that when it is required to make any alteration in the elevation or depression of the height of centre, the said slide must be withdrawn just beyond the recess, so that the key may pass freely into it; this is shown in the dotted line on the plan of plate (Fig. 5). I may mention that the alteration in this respect is a matter so seldom required that very little trouble will be experienced in the adjustment.

The top and final slide is precisely similar to the toolbox made to the ordinary ornamental turning slide-rest, the double-chamfer steel bars being fixed to the plate, as shown in Fig. 5, by two steel screws, the heads of which should be as large as possible, so that the bars are held firmly to the plate. The bar on the right-hand side has the holes slightly elongated to admit of the pressure created by the two set-screws A and B (Fig. 5), moving it forward when adjusting the slide.

The plate, as seen, has, at the end opposite the stem, a projection on each side, which projections are for the purpose of receiving the pillars upon which the lever which actuates the slide rests. The pillars are made similar to Fig. 6, the elongated slot in the lever passing over the top of the pillar. Here again we have exactly the same movement as in the ornamental slide-rest. The base of the pillar should be in diameter just below the curve of the projection; but this is entirely a matter of taste, and may be safely left to the one who is making the slide-rest. Having said that the toolbox not only resembles, but is exactly like that in the ordinary rest, I need say no more on this point. So far, then, we have before us—I hope clearly defined—the manner of fitting up this, the final slide connected with this, I may in all fairness say, complicated tool, or, rather, piece of machinery. We have still another small, although important, matter to look to—viz., we have deliberated upon the fitting of the stem of plate A, Fig. 4, to the socket shown in Figs. 1 and 2; but we have yet to show how this, when fitted, is fixed in the required position. To effect this holding, a steel ring, as illustrated by Figs. 7 and 8, is fitted to the outside of the socket. This again requires considerable care, and the forging should be made of cast steel. When thus fitted and turned to the required width, which will be to correspond with the depth of the socket, it is scarcely possible to give the exact dimensions of this particular part, because it may vary slightly, according to the thickness of the many preceding parts. The diameter of the external fitting is given as $1\frac{1}{4}$in., therefore that of the ring should be about 2in., as shown in Fig. 8.

The ring is centred between the boss A, Fig. 8, and the opposite side, where, it will be seen, it is countersunk to receive a small screw which passes into the socket, to retain it in the necessary position. When the hole in the boss is tapped, and the mouth countersunk, we have it ready to turn, and this forms the next proceeding. The boss should be shaped as shown for preference; but if the taste desire it otherwise, any shape, I need scarcely say, will answer the purpose quite as well.

We must now chuck the ring by the inside, and carefully turn each side down to a slight curve, and perfectly equal. This not only affords a means of obtaining the desired shape, but it also removes a deal of superfluous material, and at the same time gives the distance to guide the file, for it is by this means that it has to be finally shaped. This is a piece of work that will test the abilities of a workman as to his efficiency as a viceman. However, with care it is not a job that should cause any trouble, and if we have effectually reached such a stage, the experience derived will be a great help. When the ring is filled and the screw at the opposite end is in its place, the side of the socket must be marked from the inside of the hole in which the fixing-screw is filled. This done, it must be carefully bored through and a metal plug well filled, but sufficiently free to allow the pressure from the binding screw when tightened to press it forward. The interior of this plug must be made precisely to coincide with the curve of the fitting so that it will bear all round the stem when so clamped. It will be obvious that it would not do to allow the point of the steel screw to bear against the stem; it would become indented and consequently immovable.

We have, now that all else is practically finished, to look to those parts on which it is necessary to have divisions. The steel ring last referred to should be divided into degrees externally, and a steel reader fixed to the underside of the steel plate, the object of this being to enable the tool to be inclined to any definite angle to the right or left of the slide below it, and when so adjusted it is secured by the binding-screw through the ring.

It will be found a great convenience to divide each of the slides into a scale of tenths, and this must be done from the screw; at least, it is preferable to do so. By referring to Fig. 6, Oct. 13, p. 179, it will be clearly seen to which divisions I refer. The readiest and most certain way to divide the slide correctly is to make a cranked tool to fit into the tool-box for the top slide, and to fix a tool of similar character to each of the preceding slides. The starting-point determined, the zero on micrometer must be adjusted, and at each successive turn of the screw the line is marked. The slide may have a steel index fitted, or the division may be read from the edge of the plate. It will be easily recognised that unless these lines are correctly marked, we are better off without them.

It will be a pity, having gone so far, not to have the slide-rest as perfect as it is possible to make it. Therefore, I strongly recommend that each slide is fitted with a pair of fluting stops, which may be made in a similar way to those employed on the ornamental slide-rest. They will be found invaluable in many ways, and form a definite stop, which is so often required in work of a complex character. We have, of course, the means of deciding the length of any traverse by the division I have already explained, but, when once determined and the stop adjusted, much time is saved by the presence of the fluting stop, which is absolute.

I have now completed, as far as possible, the entire details of this, as I have before stated, complicated piece of work; but I feel so certain that all those who have summoned the resolution —and the communications I have received relative to it show that they are not a few—to undertake the task will, in the end, afford a vast deal of interest, amusement, and satisfaction, and I hope all so interested will take advantage of my desire to help in all ways by asking for any further information that may be required. For my next I propose to continue with the necessary tools and manipulation of the slide-rest.

THROUGH A SMALL TELESCOPE.—I.

By NORMAN LATTEY.

REPORTS of observations, comparisons of drawings, and critical examinations of celestial objects, both conspicuous and faint, are constantly being contributed to these columns. To see some of the exquisite sketches that are occasionally sent in by skilled observers, armed with 6in., 8in., 10in., and 12in. reflectors and refractors, is almost enough to make the possessor of a small instrument despair. But he need not. Much valuable work has been, and is being, done with apertures down to 2in. Needless to say, atmospheric conditions and the quality of the

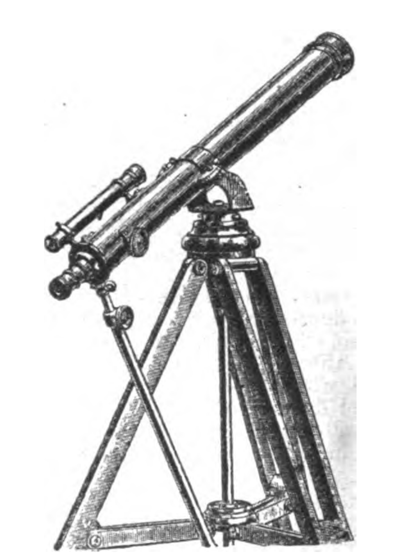


FIG. 1.—Three-Inch Telescope, with Finder, on Tripod Stand, Altazimuth Mount.

lenses, as well as the observer's eye, must all be tolerably good. The writer knows of a refractor but 2in. in aperture, which gives views of the moon in sharper detail than prints of the finest photographs taken at the Lick Observatory; although, of course, the pictures will not bear much enlargement.

It is the purpose of these papers to show what can be done with a small instrument, and by making a systematic survey of the skies with its aid, examine not only the sun and moon at convenient seasons, but also each planet, star, and nebula as it comes into favourable position with the advance of the season. In this wise will the beginner obtain such a general knowledge of the marvels of astronomy as will serve him usefully by way of introduction to more important work later on. Moreover, a few simple directions how, when, and where to look, and what to look for, will enable the student to see more with his humble 3in. than many a casual uninstructed star-gazer boasting superior optical appliances.

Assuming, then, the possession of a telescope of some description together with at least three eyepieces, the only other adjuncts needful as a commencement are:—

(*a*) A star atlas, for the purpose of locating celestial bodies in the same manner as towns and places on the earth are located—viz., by their celestial latitude and longitude, termed in astronomy Right Ascension and Declination.

(*b*) A revolving planisphere, showing at a glance which stars and constellations are above the horizon at any hour of the day or night throughout the year.

(*c*) An elementary work on astronomy, in order to gain a clear conception of the scheme of the universe, and the movements of the heavenly bodies.

(*d*) An astronomical almanac. Klein's Star Atlas, published by the Society for Promoting Christian Knowledge, Northumberland-avenue, W.C., at 7s. 6d., is all that is required to supply the first want, and will invariably be referred to throughout this series. It contains eighteen maps, and charts stars down to $6\frac{1}{2}$ magnitude; besides

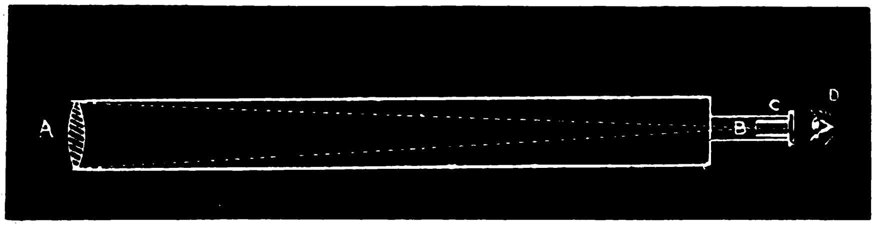


FIG. 2.—Section of a Refracting Telescope showing the Cone of Rays formed by the object-glass.

marking the principal clusters and nebulæ, it also has an extensive explanatory catalogue and several beautiful photographic plates. Messrs. Longmans, however, publish a smaller atlas by the late Mr. R. A. Proctor, at 5s.

By means of the revolving cardboard planisphere, not only are the constellations visible at any particular hour clearly exhibited, but their times of rising, southing, and setting approximately indicated. The publishers, Messrs. Geo. Philip and Son, of 32, Fleet-street, London, send it post free for 2s. 3d. They also issue for 6d. extra an edition printed on tough transparent paper, and fitted with a portable compartment holding a candle, which renders all the stars visible while in use in the open air in the dark.

Sir Norman Lockyer's book "Elementary Lessons in Astronomy," published by Messrs. Macmillan and Co., at 5s. 6d., will suffice the beginner until prepared for more critical works, such as Mee's "Observational Astronomy," Chambers's "Handbook of Astronomy," and Webb's "Celestial Objects," besides various specialised publications of the class of Neison's and Elger's "Moon," &c.

Lastly, *Whitaker's Almanack*, price 1s., *The Companion to the Observatory*, 1s. 6d., and Mee's "Heavens at a Glance," on card, price 6d., will each of them be found extremely useful for the information they give regarding astronomical phenomena generally.

Obviously, the first thing to do is to master the general principles of the telescope, and, by applying this knowledge to your own, see that all the parts are in such accurate adjustment and relation to each other as to insure the instrument performing to its utmost capability.

The main duty of the object-glass (hereafter referred to as the o.g.) is obviously to gather together all the rays of light that fall upon its outer surface at A (in Fig. 2), and to converge them to the point B, where they are received and magnified by the eyepiece (hereafter shortly termed the e.p.) at C, whence they are conveyed in a pencil of light to the observer's eye at D. The enlargement of the bright image so produced will, of course, depend on the power of the e.p., the rules for finding which are given further on.

The accurate "squaring" of the o.g. in relation to the optical axis of the telescope tube is an important matter. It is absolutely necessary that the point of the cone of rays B should strike the exact centre of the larger or field-lens of the e.p., for if there is the slightest tilt the image becomes distorted. The simplest method of ascertaining what the condition of things is in your instrument is to fit in an e.p. of moderate power, and examine a fairly bright star, sharply focussed—the middle star in Orion's belt is as good as any—on a dark, still night. If your o.g. is truly squared, the tiny disc of the star will appear surrounded by flickering hair-like circles of light, called diffraction rings, arranged perfectly concentrically round a well-defined brilliant centre, as at *a*, Fig. 3. If this margin of rings is at all one-sided, as at *b*, or fan-shaped, as at *c*, you should immediately communicate with the maker, or take the o.g. to an optician, for these two last appearances betray some extent of mal-adjustment, and render delicate observation impossible.

A still more certain test, and one which should be tried before all faith in the glass is utterly abandoned, is a similar process to the foregoing, but with the star image *well out of focus*. The diffraction rings will now appear much enlarged and close together, and, if all be well, the illuminated area will be of tolerably equal brightness. If, however, the star's light spreads out into a more or less pear-shaped luminosity instead of into a round patch of mottled and circular-ribbed gold, it means that the edge of the o.g. corresponding to the smaller and brighter side is nearer the e.p. than the opposite one. This happens equally whether the view be within or without the focal point. Should your o.g. be provided with adjusting screws, you can easily correct the obliquity yourself; otherwise the maker or an optician is the safer person to doctor it.

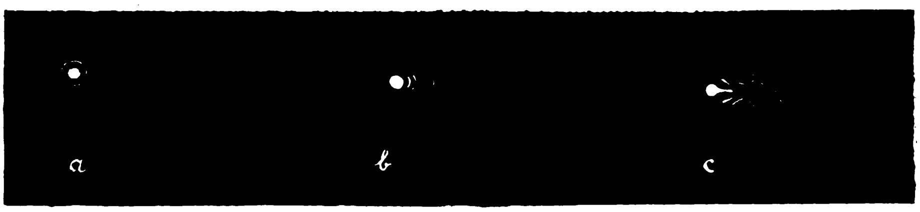


FIG. 3.—Appearances of a Star in Focus when the object-glass is correctly and incorrectly adjusted.

We will now deal with the eyepieces. These should all be of the Huyghenian achromatic type, although a Kellner e.p. of low power gives exquisite map-like views of comparatively large areas. The theoretical limit of magnifying power in a first-class instrument is commonly laid down as 100 diameters for every inch of clear aperture—i.e., a good 3in. should, under perfect atmospheric conditions, be capable of standing a power of 300 on stellar objects, though perhaps rather less on planets. In practice, however, it will be found that 200 on the former and 150 on the latter will be the highest of any real use. This is chiefly owing to varying air currents, aqueous moisture, irregularities in the glass, and other causes unnecessary to go into here. Generally speaking, if with 250 a sharp steady image of a star is given surrounded by neat diffraction rings, you can be perfectly satisfied with your possession.

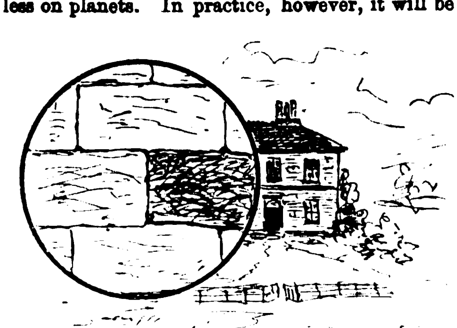


FIG. 4.—The Brick-Wall Method of Determining the Magnifying Power of an Eyepiece.

There are many ways of ascertaining the magnifying power of an eyepiece. The simplest method is to turn the instrument on to a distant brickwall in full daylight. Looking with both eyes wide open, notice with your disengaged eye what height of wall the thickness of a single brick in the telescopic view (which you will see simultaneously with the other eye) covers. Then with the aid of the telescope, count carefully the number of brick courses superposed by the magnified brick, and you will obtain a tolerably accurate notion of how many diameters your e.p. magnifies. A reference to Fig. 4 will make clear the *modus operandi*. It will be observed that the width of the shaded brick in the circular field of view of the telescope extends over the entire height of the wall of the distant cottage—from the ground to the eaves. If, now, this piece of wall is found to actually contain 150 brick courses, that figure may be taken to represent your magnifying power.

You may, however, not have a convenient brick wall at your disposal, in which case adopt another plan. Point the telescope at the sunlit sky, and withdraw a foot or so; you will then see a bright disc just within the e.p. Accurately measure the diameter of this disc with a graduated scale, and divide it into the diameter of the o.g., of which the tiny disc is really an image. The result will be somewhere near the magnifying power of that e.p.; but if you wish to be absolutely exact, the

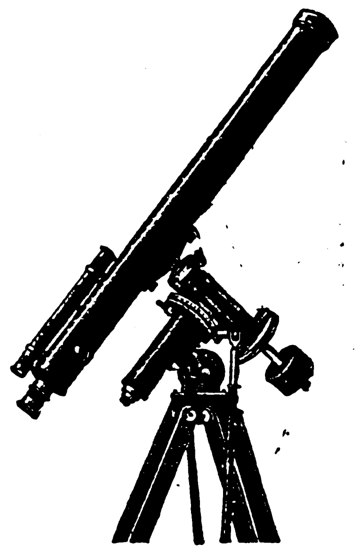


FIG. 5.—Three-Inch Telescope, with Finder, on Tripod Stand, Equatorially Mounted.

following is the usual rule. *The focal length of the o.g. divided by the focal length of the e.p., or the equivalent focus of a compound e p.* (such as a Huyghenian), *yields the magnifying power.* To make the matter quite clear, it may be mentioned that the focal length of the o.g. is the distance from it to the point of sharp focus without an e.p., and the equivalent focus of a compound e.p. is found by dividing twice the product of the focal lengths of the eye- and field-lenses by their sum. For instance, supposing the focus of the larger or field-lens to be 3in., and the eye-lens 1in., then twice 3×1 divided by $3 + 1 = 1\frac{1}{2}$in., the equivalent focus. This, if divided into an o g. of, say, 48in. focal length, would yield a power of 32 diameters.

A word may here be said in regard to the mounting. If you have an equatorial head so much the better, provided, having once found the proper angle and direction of the polar and declination axes, you can always replace the stand in exactly the same position. Full particulars of how to adjust an equatorial have frequently been given in the Correspondence columns. But the labour and patience required is so great, that unless the stand is immovable, or iron shoes for the reception of the legs of the tripod can be fixed permanently in the ground to enable work to be immediately begun without being compelled to occupy several hours on each occasion in re-adjustments, an ordinary altazimuth mount will be found the most handy. Such a one can also be freely moved about when it becomes necessary to dodge an obstructing chimney or tree.

When commencing observations, choose as much of a south aspect as possible, with a fairly open east and west. This will give you command of that belt of sky known as the Ecliptic, within which the sun, moon, and planets restrict their apparently erratic wanderings. Leave your instrument out for half an hour ere settling down to work. A little time is required for the temperature of the lenses and the surrounding air to become equalised. This improves definition and

prevents dewing, that bugbear of all astronomers, professional or amateur. Notice that your finder, if you have one, is accurately set, so that you can pick up the smallest visible object without losing time "sweeping" for it. If you have no finder, look along the top of the tube. With a little practice you will get quite expert, especially if you use a low-power eyepiece to begin with. When the object is found you can, of course, exchange the e.p. for a higher one; but it must be done rapidly, else the star will pass out of your field of view, and may not be so easily caught again.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—IX.

THE battle of Sedan ended in a torrential downpour of rain, and there are those who suggest that it was the concussion of the air produced by the firing of cannons and muskets that caused the atmosphere to yield up its stores of moisture. An enthusiastic researcher once examined the records giving full accounts of important battles, for the purpose of discovering the kind of weather that followed these engagements, and, by tabulating the number of instances that were followed by heavy rain, he was able to develop a theory, and prove to his own satisfaction, that rain could be brought from the skies by concussion. He was, moreover, able to procure a grant from his Government for the purpose of making experiments in this direction, so that his researches were not in vain. Rainmakers do not flourish so conspicuouly in this country as in many of the American States; but, even here, there are certain theorists who every now and then point out supposed methods by which mankind could gain control of the rain-showers, and so deprive the weather prophets of their occupation. The authority mentioned above, who made his researches in a scientific spirit, and is not to be confounded with the ordinary type of rain-maker, states that during the whole of one celebrated campaign unusual rains, and in many cases unseasonable thunderstorms, followed every battle, and the facts thus collected have given encouragement to the belief that rain could be shaken down, as it were, by the help of detonating shells, or by violent discharges of electricity. Accordingly, few Governments have escaped demands for pecuniary assistance from those who believe that they know best how the thing should be done. Hitherto those in authority have not been eager to place the national armaments at the disposal of the rain-makers, and this notwithstanding that the cost of producing a shower of rain has been estimated at only £10,000—a charge which is not unduly high when the commercial value of, say, ·25in. of rain in times of drought is taken into the account.

It has been suggested that obsolete and abandoned guns might be employed in these rain-making bombardments of the atmosphere, since they are useless for any purpose save that of making a noise and producing rain. There is, however, always the danger that the rain-making might be overdone, and it is on record that certain rain-makers only ceased to claim credit for producing heavy rain and hail-showers when they were threatened with actions at law by those who sought to recover compensation for damage incurred by the unduly excessive rain-making. In passing, it may be remarked that the rain-makers are discredited when it is observed that they are most active when rain is about due, or when it has been forecast by the Weather Office of the country, the rain on these occasions being of course instanced as proof of their skill. It is, moreover, impossible to get rain-makers to agree to any one system of testing their methods, and it need hardly be said that they are adepts at changing their ground when suggestions are made for checking and comparing their records. The advocates of atmospheric concussion as a means of making rain have just now a melancholy opportunity of observing whether explosions of Lyddite shells and other detonating missiles will have any effect in shaking rain from the comparatively dry atmosphere of South Africa, and so provide modern instances of rain out of due season occurring as the result of prolonged bombardments and fusiladings. It is to be feared, however, that war correspondents do not always record these meteorological incidents, and the records, moreover, do not always state the hour when the heavy firing commences, for, in checking the theories of the rain-makers, a note of the time when rain commenced is important. The path of the rain-maker is, therefore, beset with difficulties, and, even if his theory be correct, that prolonged battles and violent concussions and explosions produce unexpected atmospheric disturbances, he has not yet succeeded in persuading the bulk of meteorologists to believe it.

The amount of moisture condensed out of the air either by natural or artificial means is, of course, measured by a rain-gauge, and it is with the records thus obtained that all theories concerning rainfall need to be compared. The work entailed in making rainfall observations as compared with other meteorological investigations, is not difficult, and, since most people appear to be more concerned about rainy days than any other kind of weather, it is not surprising that the rain-gauge is the most popular of meteorological instruments. To obtain a record of the daily amount of rainfall, it is only necessary to visit the gauge once a day, so that when it is fixed in position only a very little experience is required to make the required measurements. It is, however, by no means an easy matter to select a suitable site for a rain-gauge, and since the whole value of the record depends upon this factor, it is worth while to pay a little attention to this part of the subject. Most people are aware that a rain-gauge should be placed on the ground, and in a position where the surface is level, and not shut in by high walls, fences, trees, or buildings. It should also be firmly fixed, so that it cannot be blown down, and, except in those localities where deep snow is frequent, it should be 1ft. above the ground. Any increase in this height will reduce the amount of rain collected, the loss being principally due to the action of the wind which deflects the rain, so that it does not fall directly into the gauge. Were it not for the wind, it is probable that a moderate height above the ground would make no difference to the record. Owing, however, to the fact of the angle at which the wind blows increasing with the height above the ground the roof of a house is considered to be an unsuitable place for a rain-gauge, the records obtained in such situations being further vitiated by the currents and eddies which develop among chimney-pots, and drive the rain in all directions. Undesirable, however, as is a site on a roof, it is sometimes to be preferred to a situation in a small garden surrounded by buildings and overhanging trees.

Further, the use to which the rain-gauge is put necessarily renders it very liable to be deteriorated by rust, and although many gauges are made of galvanised iron, it is wise to increase the pecuniary outlay, and obtain an instrument made of copper. Now during the prevalence of strong winds, the rain-drops bounce and jump about with an increased activity, and many that have no business there find their way into the gauge. To diminish this insplashing the rim of the gauge is made circular and ground to a knife-edge, and this latter not only stops the drops from bouncing into the gauge, but it also splits them with precision, and sends one half inside and ejects the other. The rim is made circular, because it is less likely to lose its shape than if made square; and this rim is about 6in. deep, and is placed around the collecting funnel, the effect of this arrangement being to prevent snow from being blown out when once it has been collected. From the protected funnel the rain or melted snow runs into a storage can, and is subsequently measured in a graduated measuring-glass. As regards this latter, it is not advisable to use it to store the daily rain, for during times of frost it is liable to be broken if water chance to freeze therein. Commonly, most observers find 8 a.m. or 9 a.m. a convenient hour at which to visit their gauge, and since it is probable that most of the collected rain fell during the sixteen hours preceding the previous midnight, it is customary to refer the amount measured to the previous day, the amount measured at 9 a.m. on the 12th, for instance, being entered to the 11th. Experiments show that there is no difference between the indications of a gauge 2in. in diameter and one of 20in., so that the diameter does not matter. The most common diameters in use, however, are 5in. and 8in., and, on the ground of economy, the former size perhaps finds most favour. Seeing that any alteration in the shape of the gauge diminishes the collecting area, it follows that care is necessary to prevent it from damage, a dent in the rim being a thing to avoid. Care as regards the exposure and regularity in respect of the hour of observation are therefore the main considerations in observing rainfall, and if precautions be taken to secure the continuity of the record, the figures obtained may be made to answer many interesting questions.

No part of the world where systematic observations of rainfall have been made have been found to be absolutely rainless, and a rain-gauge erected in even the most arid region succeeds in catching at least an inch of rain during the year. Such areas as the Saharah Desert and certain parts of Arabia are sometimes considered quite rainless; but could a rain-gauge be satisfactorily maintained in these inhospitable regions, it is probable that they also would be found to receive some sort of aqueous precipitation. The term "rain" to the meteorologist, it should be said, includes all kinds of atmospheric moisture that may be collected in a gauge, and in the daily, monthly, or yearly totals of rainfall are counted amounts derived from dew, hoar-frost, fog, mist, snow, and hail. These condensations of moisture, equally with rain, have their effects on soil and vegetation, and no attempt is therefore made to separate them in the gauge. Even therefore supposing rain itself does not actually fall, it is more than likely that the forces of radiation which cool the surface of the earth bring down moisture in other forms, and such localities where this happens are not therefore described as rainless. On examining the rainfall records for any given area, it is seen that the values for stations, only a short distance apart differ considerably from one another; and even for so small an area as a square mile several stations would be required if the average rainfall for the whole area is to be accurately determined. Such an examination also indicates that local geographical conditions are the chief agents in producing diversities in rainfall amounts—conditions which the most expert rain-maker will always find beyond his control, and so pronounced are these effects that in some localities the regimen of the rainfall would only be discovered by a series of gauges separated by distances not exceeding a quarter of a mile.

Now there are, of course, many forces which produce rain; but the greatest effects are to be ascribed to the reduction in temperature brought about by ascending or convection currents of air. The most obvious illustration of this action is to be observed in those onward-moving currents of vapour-laden air which are given a vertical component when they strike against a range of hills or mountains. The convection currents, which are the chief feature in the mechanism of cyclonic storms, are also to be reckoned among the most active rain producers, and in the temperate latitudes nearly all the rainfall may be described as cyclonic. A similar source of rain is to be found in the reduction in atmospheric temperature which occurs during thunderstorms. Another effective cause of rain occurs during the movement of masses of air from the Equator to the Poles, this change of position as regards the sun's rays resulting in an increased radiation from the upper portions of the air, so that clouds are formed and speedy condensation of rain follows. Other prime producers of rain are the moist currents of air which flow in from the sea over the land, and radiate their heat to this cooler area, and in this way lower the temperature of the air to its dew-point, and so bring rain. Now a consideration of these general principles indicates that those who desire to produce rain by artificial means must in some way or other set these convection currents going, and what is required is that the atmosphere should, as the term is, be overturned. Concussion and bombardment of the air have not, as already hinted, been very effective agents in this respect, and a far better motive force would be developed by kindling great fires of an extended area, and thus establish the necessary overturning of the air currents which leads to the condensation of rain. But this method of rain-making is something like Charles Lamb's account of burning a house whenever it was desired to procure roast pig, and has similar economical drawbacks. There would seem, therefore, nothing to be done at present but to continue setting up rain-gauges after the methods mentioned above, and abandon all attempts to tamper with the sources of the rain until more is known of the conditions under which it is produced.

Experiments are being conducted at South Bethlehem, U.S.A., with a plant for producing from hollow ingots seamless steel pipes of large diameter. Pipes of 20in. diameter and ⅜in. thick are said to have already been turned out.

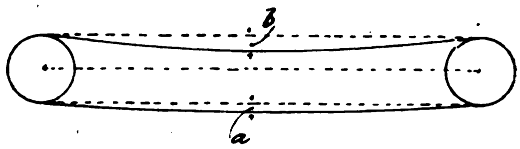


FIG. 125.

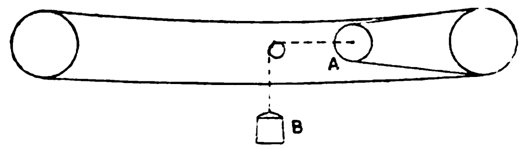


FIG. 126.

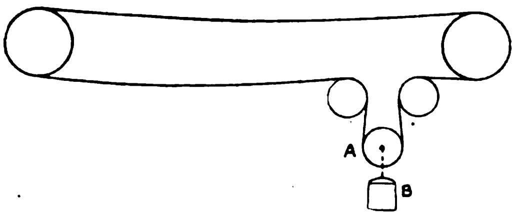


FIG. 127.

MILLWRIGHT'S WORK.—XX.

THE most favourable conditions for the life of a rope are, after those already named, those in which it always bends in one direction, and in which the pulleys are situated a good distance apart. To return a rope round binder pulleys or round tension pulleys shortens its life by about one-fourth. This is clear, since bending a piece of material in opposite directions alternately stresses it more severely than bending it, and straightening it alternately in one direction only. The farther the sheaves are apart also, the less is the rope strained, because its fibres are bent less frequently; therefore, as with leather, so with ropes, the most favourable and economical method of driving is that in which the pulleys are a

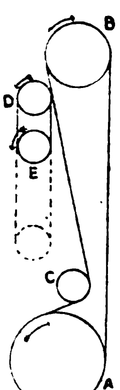


FIG. 128.

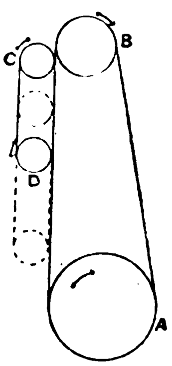


FIG. 129.

reasonable distance apart and the ropes horizontal, with the bottom part of the rope driving, as in Fig. 125. In this figure, *a* shows the sag of the rope on the driving side, and *b* that on the slack side. The amount of these sags, as mentioned in the last article, varies with distance between pulleys, and with speeds. *a* is constant for all speeds at the same centres, *b* varies with speeds at the same centres. Ropes perform best when the sag on both sides approximates to fixed dimensions, which are understood in practice. On long drives the sag amounts to several feet.

There are two ways of using ropes. In one, termed the "multiple" system, a number of separate and independent ropes are employed side by side, each running in its separate groove: in the other, the "tension" system, a single rope is passed round a succession of grooves. The latter is the American, or Dodge system. But though now known as the American, it really originated at Belfast in 1878. The device, however, has not been adopted much here, and in cases where it has been fitted in England, it has been done chiefly, if not wholly, by American firms.

In the tension system, the rope is reeved over the first groove of the first sheave to the first groove of the second sheave, back to the second groove of the first sheeve, and so on until the grooves are all occupied. Thence the rope passes from the last groove of the first sheave to and over the tension sheave. The rope is endless, with but one splice, and the tension allowance for stretch varies with the number of sheaves and their distance apart, and the nature of the atmospheric changes which are likely to occur; ropes exposed to weather requiring a greater range than those which are not. Lengths of from 15ft., to 30ft., or 40ft. in extreme cases, are, therefore, required with varying conditions.

The difference between the two systems of rope driving is very great and important, and each has some advantages over the other.

In the English system, the ropes all being independent have this advantage—that when any single rope requires resplicing or renewal, it can be removed, leaving the remaining ones to do the work, without involving more than a few minutes' stopping of the machinery. On the other hand, there is no such thing as uniformity of tension in all the ropes, for, though they may all commence work alike, in respect of tension, differences become apparent after some amount of service has been accomplished. But, as a set-off, since the ropes run one way, with no return movements, they are in the most favourable condition for durability.

The American single-rope system, on the other hand, has the advantage of equal tension throughout, so that there is no loss of power in consequence of any one section not performing its due share of the work. The rope also is of the same diameter throughout, wearing equally, points which do not hold good of the separate-rope system, in which if some wear more than the others, and if they are not removed, slip, and unsteady driving will result; just as when some stretch more than others, the some results will follow. But against this is to be set off the fact that the use of a single rope introduces the tension pulley, which may also be of too small a diameter, and around which the rope has to make an additional bend in its travel. This bending also often takes place in a direction the reverse to that of the main driving, and therefore distresses a rope by the bending back and forth on itself. But some wonderful results have been accomplished by the single-rope system, and it is used to-day in very many of the largest mills in the United States. Here, again, the problem is one confessedly difficult, which, in the hands of specialists, has attained a high degree of perfection, and many of the drives, in all directions, and to long distance would seem impossible to the old millwrights.

Fig. 126 shows a drive in which one extra bend takes place over the binder pulley A. Fig. 127 illustrates one less favourable still, because the direction of bending of the rope is reversed twice, besides being bent over the binder or tension pulley A. In arranging tension pulleys, therefore, the general method shown in Fig. 126 should be adopted, the rope lasting about one-fourth longer than that in Fig. 127.

The tension on the rope is fixed by the weights B B, Figs. 126, 127, and they are hung to pull on the slack side. The tension varies with the speed of rope, the diameter, and the horse power.

A few typical drives are shown in the succeeding figures, from the practice of the Webster Manufacturing Co., of Chicago. Fig. 128 is an elevator drive, the driving being vertical to a height of 134ft. from the centre of a 14ft. seven-grooved driving pulley, A, to the 9ft. 6in. seven-grooved pulley, B. C is a seven-grooved idler, and D is a one-grooved idler leading to the tension pulley E, which has a vertical movement of 20ft. The power transmitted is 260H.P., with a 1¼in. rope.

Fig. 129 illustrates a vertical transmission of

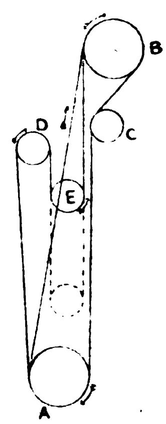


FIG. 130.

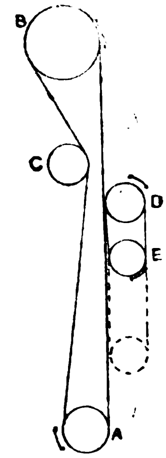


FIG. 131.

900H.P. for an elevator. A 14ft. eighteen-groove pulley, A, drives at a distance of 130ft. away 7ft. 8in. pulley, B. A 4ft. 6in. idler, C, transmits the tension to the pulley D, which has a vertical travel of 40ft. Fig. 130 is another vertical drive from a 9ft. nine-grooved pulley, A, to a 9ft. 7in. pulley, B, 98ft. above. C is the main idler, and D the single-groove idler leading to the tension pulley E, with 18ft. travel.

Fig. 131 is one of the elevator rope drives on the Manchester Ship Canal. A 6ft. nine-grooved driver, A, drives a 9ft. 6in. pulley, 122ft. away, round an idler, C, and a single-grooved idler, D, to the tension pulley E, having a travel of 25ft.

J. H.

THE EXPLOSIVE FEATURES OF ACETYLENE.

THE rapidly extending use of acetylene and the fact that its widening range of application is putting it increasingly into unskilled hands, render the question of its explosive properties a vital one to the community at large. In the earlier stages of its manufacture and use, the new illuminant suffered somewhat in reputation from the recurrence of explosions more or less destructive and fatal, and there was for a while a danger of its field of usefulness being narrowed by a popular fear as to its safety out of proportion to the facts. Thanks, however, says the *Scientific American*, to exhaustive experimental work in the laboratory, the explosive possibilities of acetylene have been determined with accuracy, and it is now possible to manufacture, transport, and use the new illuminant with something of the same immunity from accident that characterises the familiar coal-gas.

Pure acetylene gas, when under atmospheric pressure, is not explosive. This was proved by Berthelot and Vieille before acetylene was looked upon as having commercial value, and as soon as its production on a commercial scale became certain, they took up the question again and confirmed their earlier experiments with the following statement: "Under atmospheric pressure and at a constant pressure, acetylene does not propagate to an appreciable distance decomposition provoked at any point. Neither the electric spark nor the presence of an incandescent wire, not even the detonation of a fulminate primer, exercises any action beyond the vicinity of the region subjected directly to the heating or shock."

As the pressure of the gas rises above that of the atmosphere, it becomes liable to explode, but it is not possible to state the exact critical pressure above which a definite exciting cause will, and below which it will not, render acetylene explosive. Berthelot and Vieille state that when the exciting

cause is an incandescent wire in the gas, the maximum allowable pressure is 10·5lb. gauge, and when the cause is the detonation of a fulminate cap 3·5lb. is the limit. These two causes of explosion were taken as representing the extreme conditions that could obtain in faulty manufacture and manipulation of the gas, the first representing intense local heating in calcium carbide attacked by a small amount of water, or caused by intense friction due to the rush of gas through a valve. The second case, which would be represented in the formation and detonation of acetylides, is not liable to occur in the commercial production of acetylene, but could only happen under special laboratory conditions.

Liquid acetylene, therefore, on account of its condensed state, is naturally susceptible to explosion, detonation being caused by high temperatures, sparks, or heavy shocks to the liquid itself. Berthelot detonated a steel bomb filled with liquefied acetylene by means of an incandescent wire, the crusher gauge showing a pressure of 5 383 atmospheres; but liquefied acetylene contained in cylinders was shown by the same experimentalist to be proof against detonation by shock, a cylinder charged with 300 grammes of the liquid falling repeatedly upon a steel block from a height of 19·5ft. without explosion. A direct blow upon the liquid itself may heat a small portion to a dangerous temperature, whereas the same blow to the cylinder would be only partially transmitted, and what portion did reach the liquid would be absorbed by the whole liquid mass. A real peril exists at the cylinder and reducing valves, due to the sudden arrest of the column of gas at the reducing valve, raising its temperature adiabatically to the explosion point.

Acetylene is more dangerous than illuminating gas in forming explosive mixtures with air, for not only is the ignition temperature lower, but the explosive energy is greater, and the range of the explosive proportions of the gas and air is wider. Thus a mixture of one volume of illuminating gas with one or with two volumes of air will not burn; whereas a mixture of similar proportions of acetylene gas and air burns with a sooty flame. In the case of each gas a mixture of one volume of the gas to three of the air is explosive. The strongest explosive in the case of acetylene is one to nine, and in the case of illuminating gas one to six. But whereas the latter ceases to explode at one to twelve, acetylene mixtures do not become non-explosive until the proportion is one to twenty. The temperature of ignition varies but little with the proportions of the mixture, and is placed at 900° F. for acetylene as against 1,100° F. for most combustible gases.

MECHANICAL TRACTION FOR CANALS.

WITH the general interest which exists in the development of internal waterways in Central Europe there has also arisen an activity in devising substitutes for animal traction. The entire subject of mechanical traction in connection with internal navigation is treated exhaustively in a paper by M. Galliot in the *Revue de Mécanique*, while the application of electric traction to canals is discussed at length in a paper in the *Elektrotechnische Zeitschrift* by Herr G. Klingenberg.

As a matter of fact, the present system of animal traction is most primitive, there having been little or no improvement since the most remote times, and although nearly a century has elapsed since the application of steam-power to navigation, we still see boats hauled along the canals by horses, mules, and even by men.

It is largely on this account that canal navigation has been regarded by some as a system of transport which is gradually becoming obsolete, and which is destined to be superseded entirely by railways; but when we consider that in many cases the canals have been acquired by the railways in order to divert the traffic, and consider the utter neglect which has, until recently been shown towards the older method of transport, we see how mistaken an opinion may be when it is based upon such peculiar conditions.

Apart from any system which merely involves the use of steam tow-boats, the methods which have been seriously applied to canal service may be divided into three classes; (1) screw propellers, fitted to the boats themselves, (2) chain or cable towage, operating by power-driven drums on the boats, and (3) electrical towing machines running on the tow-path or on a track by the canal, and hauling the boat by tow-line.

The use of screw propulsion is one which naturally suggests itself when the question is brought to the notice of the general observer, but the peculiar conditions attending canal transport have rendered it difficult to make a satisfactory solution of the problem in this manner. In the first place it is very desirable that no important change be made in the construction of the thousands of existing canal boats, and so it is hardly practicable to instal an entire engine, boiler, and screw equipment upon each boat, especially since this would detract materially from the carrying capacity. This difficulty has been met by placing a motor in a sort of a box rudder and connecting it directly with a propeller projecting from the rudder. The high speed of the electric motor enables a small propeller to be used, and the electric current can either be taken from a feed-wire running along the bank, or be produced by a small engine and generator standing on the deck of the boat.

While the idea of placing the power in the rudder, first suggested by M. Trouvé, avoids the cutting of the boat and renders the old boats available, yet it possesses the disadvantage of so lengthening the boat as to interfere with the passage through locks, and in many cases the time lost by unshipping and reshipping the rudder is sufficient to condemn the apparatus. The clumsy shape of the stern of the boats as now made also renders it difficult to attain speed, owing to the wake, which causes the propeller to draw air and lose in power and efficiency.

The use of fixed cables or chains in connection with power-driven drums on the boats, is a very old idea, and has been used with some success, especially on the Rhine, where heavy chain towage is still in regular operation; but this system is hardly applicable to the great bulk of canal transport, and must always be limited to motor-boats hauling heavy trains of canal barges behind them. Few, if any, installations of this kind are now being made, and they are very unlikely to come into future extended use.

In all probability the third method, that of haulage by some form of travelling machine running along the bank, offers the best prospect of success, both from a mechanical and a commercial point of view. This method includes not only hauling machines acting by direct towage, but also running cables to which the boats may be connected and disconnected. Running cables have been a subject of experiment since 1869, when a patent was taken out by MM. Troll and Mercier, and since then numerous modifications have been made, principally in connection with the supports and grips, but in spite of the perfection to which these details have been brought, this form of canal towage has not been found acceptable.

Towing machines running along the path have been quite successfully mechanically, and several forms of these are now in use. The first of this kind dates back to 1839, and was devised by M. Larmanjat. In this case a steam traction-engine was used, there being a single rail to act as a guide, while the weight of the machine was carried by large wheels running on the tow-path, but the cost of operation at that early date prevented the system from coming into use.

The same idea, using electricity, has now been revived in France by M. Galliot himself, and in Germany by Siemens and Halske, the principal difference between the two systems being that the first uses a machine which runs on the ordinary tow-path, while the latter requires a narrow-guage railway by the side of the canal. Both of these systems are now in actual use, that of M. Galliot being introduced by MM. Denèfle et Cie on the canals of the Aire and the Deule, in France, and that of Siemens and Halske on the Finow Kanal in Prussia. In the first case there is a separate machine for each boat, the whole apparatus weighing about two tons, and being capable of exerting a uniform tractive power of 1,000lb., or an emergency pull of a ton. The machine is controlled by an operator who rides upon it, and steers it as well. The principal objection which was urged against a machine running upon the tow-path was the possible damage to the roadway; but with the wide-rimmed wheels, and a properly-made road, it is found that there is less injury to the path by the machines than from the horses. Since the power is taken by a trolley-pole from an overhead wire there is no interference whatever with the path for animal traction, and the system can be gradually introduced in connection with the older plant, and no change whatever is needed in the boats.

The Siemens and Halske system is suitable for hauling trains of barges, and is intended to supplant horse traction entirely, and, while it will doubtless be an entire mechanical success, it is much more costly in installation.

The crucial question of commercial economy has yet to be settled, and cannot be decided until after a prolonged trial under actual operative conditions; but there is every reason to believe that if success is attained it will be along the lines of the last two systems.—*Engineering Magazine.*

AN ENDSHAKING TOOL.*

I SHOULD be glad to give the name of the inventor of the tool described in the following article if I could, but it dates too far back in watchmaking history for me to locate its origin. The "Arkansaw traveller" asked the old settler how long he had been there, and, pointing to the distant trees, he replied: "They woz here when I kum."

So this particular tool, with a few others, such as the jewelling rest, wigwag polisher, &c., started in the early days of American watchmaking, and I believe have never been displaced nor substantially improved upon by more recent appliances for the same work. As illustrating a valuable principle in gauging or measuring tools, I trust it will be of interest, not only to watchmakers, but to others who might use the device in other lines of work.

To explain, then, at the outset what is meant by endshaking, I will refer to Fig. 1, in which L is a pinion in a train of watch-wheels. A and B are the shoulders of the same resting in the jewels C C. The allowance made for this pinion to move freely endways between these jewels is called the endshake, and the tool illustrated in Figs. 2 and 3 is called a pillar-plate endshaking tool, as it finds the distance between the jewel-setting seat in the pillar-plate and the face of the jewel inside of the top plate, and also the cut required on the jewel-setting shoulder to give the proper distance for any opinion, including its endshake, that is selected to run in the watch movement to be measured.

The general appearance of the tool is shown in

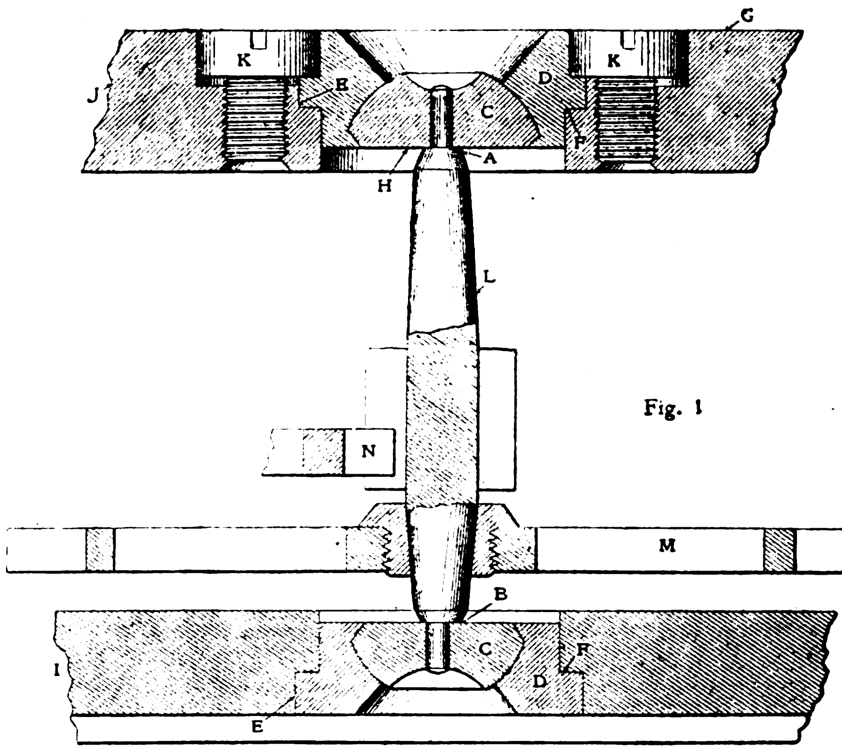
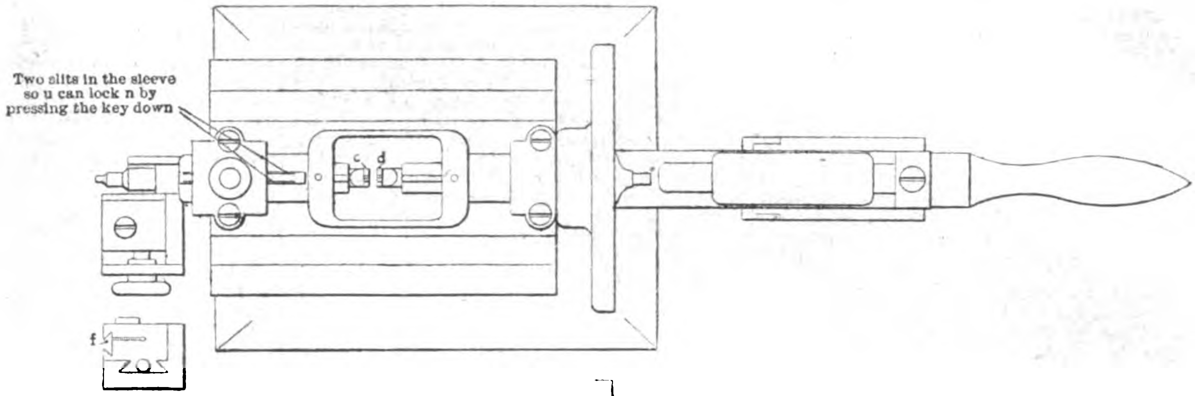


Fig. 1

* By A. H. CLEAVES, in *American Machinist.*



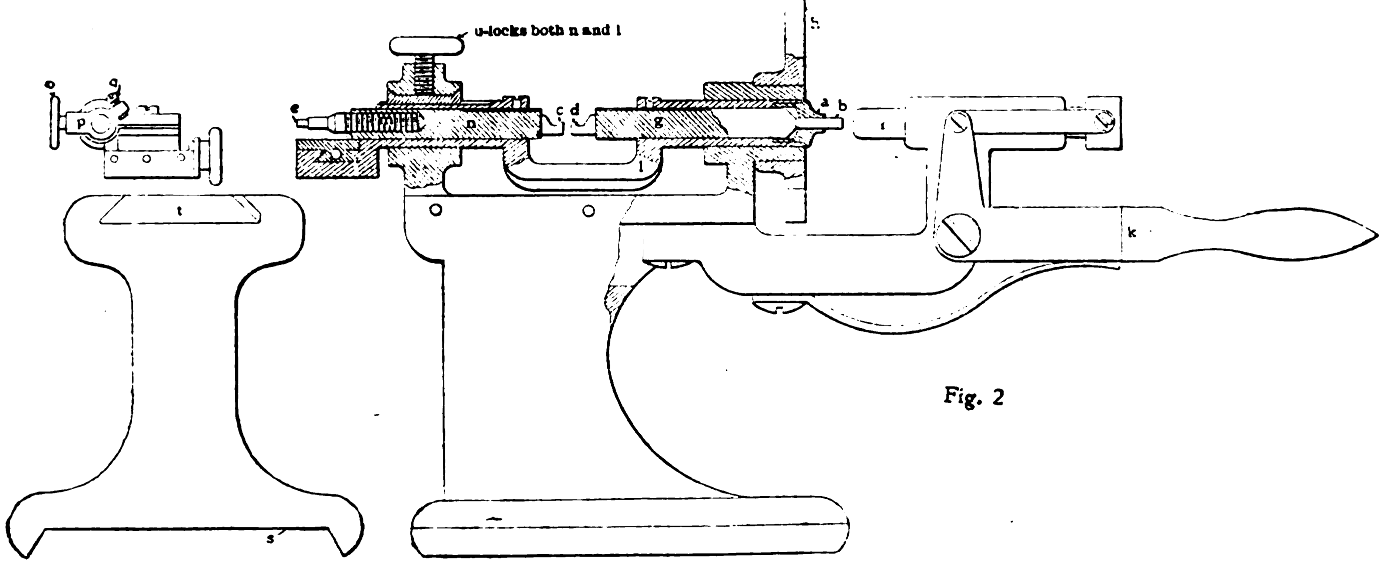


Fig. 2

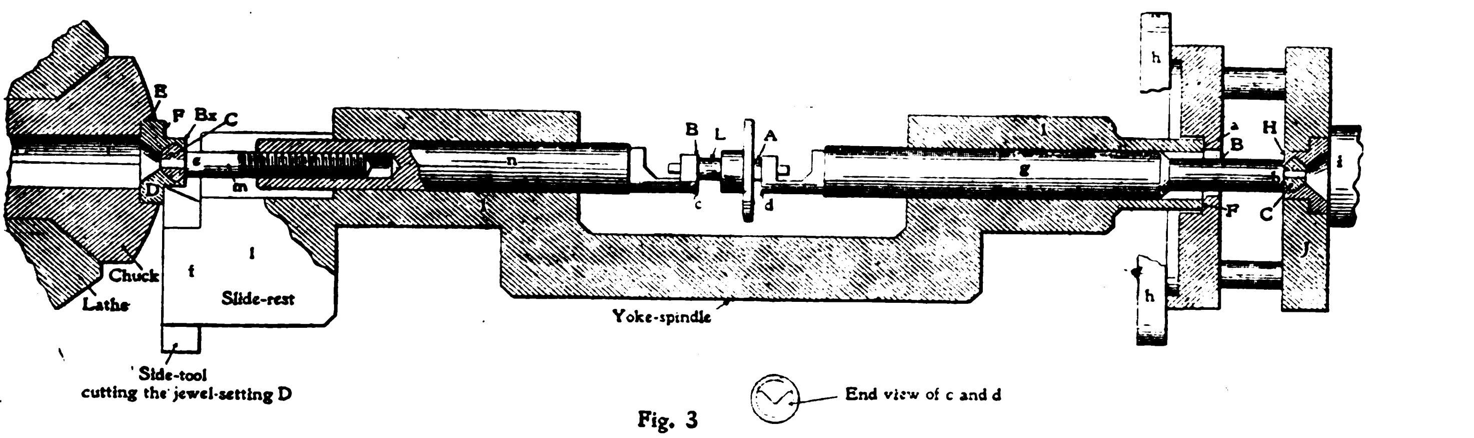


Fig. 3

Fig. 2, while Fig. 3 is an enlarged view of its working parts, showing the method of use. The point *b* of the spindle *g* is brought against the face H of the jewel C of Fig. 1, as shown in Fig. 3, in which the frame of the movement is shown in section, being held against the plate *h* by the tail spindle *i*. Spindle *i* is kept in position by the spring *j* (Fig. 2), a handle *k* being provided to draw back the spindle when inserting or taking out a movement. The shell point *a* of the hollow yoke spindle *l* is brought against the sink shoulder F (Fig. 1) of the pillar-plate. As will be seen from Fig. 3, the two tips *a* and *b* measure the distance between H and F of Fig. 1, which, supposing no endshake, is obviously equal to the distance A B of the pinion plus the B F of the jewel.

The work done by the tool is the cutting of the shoulder from B to F on D (Fig. 1), the latter being held at E (Fig. 3) in a spring chuck running in a lathe. The cutter for this is held in the little slide-rest *f* (Figs. 2 and 3), shown in numerous views, and which is a part of the yoke spindle *l*.

Let *a*, *b*, and *i* be brought together, also the points *c d*, and let the point *e* and the tool *f* be adjusted to be flush with each other. Then if the movement be inserted as in Fig. 3, and any pinion picked up at random be placed in the fork-rests *c d* (Fig. 3), the shoulders A B of the pinion L (Fig. 1) resting against the ends of the forks *c d*, it is plain that the distance between B and F (Fig. 3) will be the difference between the distances A F and A B, or B F (Fig. 1); that is, the tool *f* will be advanced beyond the spindle *e* the amount of the cut on D to give no endshake.

To get the endshake the sub-spindle *m* in the spindle *n* is threaded and provided with a collar, *p*, a thumb-screw, *o*, and an adjusting-screw, *q*, as shown in the end view of Fig. 2, and the adjustment of the tool to give a cut to the jewel-setting which shall provide endshake to the pinion is made by setting *m* forward of the cutter by the adjusting-screw *q*. It will be seen that setting *m* forward gives a less depth of cut to the jewel-setting, by which it is prevented from going so far into the pillar-plate, and thus provides the needed endshake. The base of the tool fits into a lathe-bed at *s* as a tail stock. The whole measuring apparatus is locked when ready by thumb-screw *u*, and slides up to work in the guide-bed *t* until *e* reaches C at B *x*. Open bearings are used to admit the yoke spindle *l*, which, together with *g* and *n* are provided with keyways to prevent revolving. If the thread on *m* is right-hand, the stop-screw is used before the collar in getting the endshake.

A BELGIAN royal decree has approved the resolution of the Provincial Council of Brabant, fixing an annual tax, after January 1st, 1900, on all automobiles. The tax will be 15s. for an automobile weighing less than 880lb., and vehicles which weigh more will pay 40s. per annum.

PETROLEUM AND ITS PRODUCTS.*

PETROLEUM is one of the most wonderful natural substances gotten from the earth. The most generally-accepted theory of its origin is that it is a sort of mineralised animal-vegetable oil, the result of decomposition of animal and vegetable matter beneath the surface of the earth. The same vegetation that produced the coal may have, under different circumstances and conditions, tended greatly to the production of petroleum. The multiplicity of materials procured from petroleum, and the uses to which they are put, is far beyond the limits of the most enthusiastic friend of the oil a few years ago.

Petroleums vary much in appearance and make-up, some are light coloured, some dark, some thin, some thick, some heavy in bitumen and short in light oils, and some the opposite. Some are easy to handle in refining and readily fall to pieces when heat is applied, others are very difficult to handle, and if not complex in composition, are at any rate very hard to refine.

Some contain so much bitumen as to be worthless for any other purpose. I very well remember years ago to have seen, bubbling from the mountain sides in Southern California, little springs of warm fluid, clear as crystal, which was a bituminous petroleum. So heavy was this with bitumen that within, say a thousand feet from where it bubbled forth clear

* By W. J. SANBORN, in *Popular Science News*, N.Y.

and sparkling, it was entirely deposited in a black bitumen paving the mountain roads along which it slowly flowed. The easiest of all the petroleums to refine is the Pennsylvania crude. The proportion of light oils is large, and the amount or residuum and bituminous matter small; simply a straight heat breaks the oil up into its fractions.

The ordinary course of refining for such oils is by means of the cylinder still. Such is usually about 12ft. in diameter and some 30ft. long, of about 600 barrels capacity. The still is set in brick, and looks, in a way, not unlike a big boiler; on the top is a drum-shaped dome, from which a large pipe, more than 1ft. in diameter, passes to the condensing apparatus. The oil is distilled by a fire heat or by a combination of fire heat and super-heated steam. The distillation is a fractional one, and the number of fractions taken off depends upon the oil, the refiner, the conditions and demands.

With the fires under the still—there may be a string of stills from three to twenty or more, according to the capacity of the refinery—and the heat beginning to be felt, the distillate begins to come off. From the condensing apparatus are pipes leading to various big tanks. The first of these pipes to be opened is the one leading to the naphtha tank, as that is the lightest product and the first to be vapourised. The vapour passes into the condensers, is there chilled to oil, and flows to its respective tank.

The specific gravity of this distillate is frequently taken, and when it falls below 0·760 to 0·780, according to circumstances and desires of the refiners, the pipe is closed, and the next distillate is then run into the burning-oil tanks for kerosenes. In other words, all that comes off down to, say, 0·780 is naphtha. The gravity is still watched, and when it reaches the point which the refiners wish, which varies according to conditions, the pipe is closed and all the light oils are off.

From this point forward the process varies with the products desired. All that is left in the stills may be considered as a residuum and put in other styles of sills, subject to a heat of 550° Fahr., with a hot-air blast for about a week. At the end of that time it comes out a thick viscid black matter, which, when cooled, resembles asphaltum, and is used for roofing and paving purposes, for making tar paper, quick-drying black varnish, such as go under the name of "asphaltum" varnishes, and for many other purposes.

Instead of drawing off what is left in the still after the light oils have come off, the balance may be treated to bring off lubricating oils. This will require a much different process. In fact, after the light oils are off, the treatment varies for the product required. It varies, too, as to the processes when more or less of this or that product is required.

If the ordinary distillation is followed after the light oils come off, it will be much on these lines. The degree of heat will be increased gradually, and a heavier oil will be vapourised; this is known as neutral oil, being neither a burning oil nor a paraffin, but neutral to each. After the gravity has shown that all of this oil has passed over, the next oil to come off will be the paraffin-oil from which the paraffin-wax is taken. When this oil is off, all that is left is black oil, tar, still-wax, and coke; these are separated out as the requirements of the refiner may indicate. Black oil is the commonest, cheapest kind of lubricating oil; still-wax is used for many purposes, among them the lubricating of elevator wire ropes, wire cables for cable-car lines, curve grease for street-car lines, and such purposes.

Petroleum coke is a very hard material, especially rich in carbon, and until lately has been used in immense quantities for making carbon pencils for the millions of electric arc-lights. Now it is sold by the ton for fuel, suitable for stoves and furnaces in houses, or burned at the refineries. As a fuel it produces great heat and no ash.

The principal oils that have now come off are naphthas, kerosenes, neutrals, and paraffines. Each oil in its turn is redistilled and separated into other fractions, purified, bleached, debloomed, and passes through many processes, quite too numerous to mention in any short article.

From the naphthas are separated gasolines, for stoves and gas machines, varnish, naphtha, and sometimes other goods. From the burning-oil tanks come various grades of burning oils, oils of varying fire-tests, colours, and degrees of gravity or weights. So down through the list. From the paraffine oils comes the wax known by that name. This wax, in its crude state called "scale," is of a yellow colour, quite hard and brittle, and passes through many processes to refine, bleach and soften or harden, as the requirements may be, before it is fit for the market. Ultimately tons of it reach us through the confectioners and chewing-gum makers, but the great use to which it is put is in candle-making. In the purification of these oils are used hundreds of tons of chloride of lime, fullers' earth, oxide of lead, sulphur, sulphuric acid, bone black or bone charcoal, salt, and other chemicals.

Vaseline, petroleum jelly, and petrolatum are fancy names among the 50 or more given to a product known to the refiners as petrolatum. In pumping oil from the wells in the oil regions, there gathers about the pump-rods a material of a semi-waxy nature, called rod-wax. This, when filtered through bone black or bone charcoal, becomes clarified and lightened in colour, and if filtered enough will become perfectly white, and is the petrolatum of commerce. The colour and price depends very largely upon the number of times it is filtered. It is used for a thousand and one purposes, and is found in almost every house in the land.

There is very little loss, almost none, of material in petroleum refining, everything is used for something, save perhaps the residuum from the clarification of the distillates with acid, which material is known as sludge-acid. Even this is now used successfully for the manufacture of insulating coatings for electric wires and like purposes.

Petroleum is the source from which this country now gets all its mineral oil. The bulk of all lubricating oils, as well as the base-oil for all greases, from the waggon grease, the car-wheel grease, to the lubricating stick for the chains of bicycles, comes from this same great supply-source. The oil for the sewing-machine, for the reaper in the harvest field, and the loom in the factory, are petroleums. The candle, the electric light carbon, the pintsch gas of the railway coach, the chewing-gum, the paint on the house, likewise the varnish on the furniture, the "asphaltum" roof on the factory, and the paving in the street, some of them all, and some more or less, come from the same great head—petroleum. In the preparation and making of the very cloth on our backs we are indebted to the same, for thousands of barrels of petroleum under the name of wool oil are used for treating the wool.

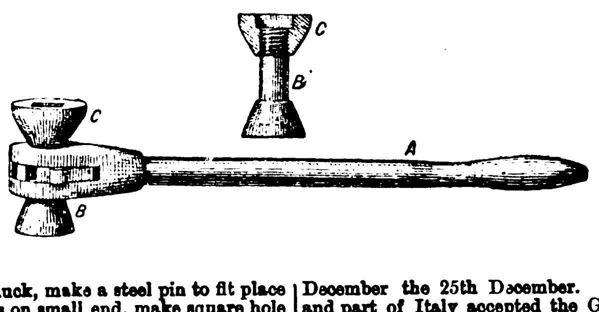
Petroleum in one form or another is used by us from the cradle—and before—to the grave, from the doctor and surgeon to the undertaker and embalmer. It is the great "dust layer" for the floors of our houses, stores, factories, and public halls, village streets, country roads and railway tracks. It will deaden one surface and polish another. It is a germicide, an insecticide, and is being used as a disinfectant.

Petroleum has an extensive use in all it forms and phases as an adulterant, whether it be as naphtha, kerosene, or any of the other oils, or as wax; millions of gallons and thousands of tons are used for direct adulteration of more expensive products.

All in all it is a difficult thing to say where the world would be to-day were it taken from us. Yet many of us did exist for several moons before it was known; for all of that it is to-day one of the greatest products of the age and world.

HANDY RATCHET WRENCH.

THE handy wrench shown in the annexed engravings is described in the *Blacksmith and Wheelwright* by Mr. G. W. Hart, of Angola, Kansas, who illustrates it as a handy ratchet wrench for taking off tire-bolts, with taps in two sizes. Take an old ratchet brace, cut off and weld end at A. Take out chuck, make a steel pin to fit place like B; cut threads on small end, make square hole in large end to fit waggon-tire bolts. Then make small pin like C, drill hole clear through, make large end square, cut thread in small end, and put together. Screw C on tight, rivet with punch, put key through ratchet cog, and you have a very handy wrench. I took the chuck to put in my post drill.



CASTING BLOCK-TIN TUBES.

OF the inventive ingenuity of Eli Whitney, the famous inventor of the cotton-gin, Prof. Silliman, in some reminiscences published in 1846, cites several interesting examples. In the summer of 1808, for instance, he tells, Whitney was applied to for tubes of block tin, for the purpose of drawing through an innocuous metal the soda-water, highly charged with carbonic acid gas, which was then just beginning to be known. Lead and copper tubes were rejected on account of their poisonous properties, and there were then no facilities in the United States for constructing the tubes that were desired. Whitney accomplished the object with his usual precision. The tubes were required to be many feet long, and strong enough to resist a heavy pressure. He caused a mould to be constructed of cast brass, in two parts, each containing, for about 2ft. in length, one-half of the cylindrical cavity corresponding to the desired tube. When the parts of the mould were accurately fitted and screwed together, they contained the entire cylindrical cavity between them, and to secure the duct through the tube a polished steel rod, of the proper size, and made very slightly tapering, was fixed in the centre and the melted metal was cast round it; the rod, being terminated by a ring, was easily knocked out. The separate parts of the tube thus produced were then joined into one, by having the contiguous ends of two of them brought longitudinally into contact, and included in another mould, containing an enlarged cavity, into which melted tin was poured. The duct was preserved by a steel rod passing through it as before, and thus the joint was perfected by a knob of metal which at once united the two tubes into one, and gave them great additional strength. Whitney did not state that this method was original, but up to that time there had, so far as is known, been no similar method of casting block-tin tubes.—*Cassier's Magazine.*

SUBTLETIES OF THE CALENDAR.

AMONGST reasonable people there is by this time an approximate unanimity of opinion as to the true date of the demise of the nineteenth century and the commencement of the twentieth. But there are some subtleties or eccentricities of the Calendar which may be edifyingly stated in the face of the advancing year 1900, which, with the other years marking the conclusion of a century since 1600, is to be reckoned as an ordinary year in contradistinction from a Leap Year to the dignity and length of which its divisibility by four would seem to promote it. At the time of the introduction of the Julian Calendar the Vernal Equinox fell on the 25th March, to the 21st of which it had retrograded at the time of the Council of Nice, A.D. 325, until on the eve of the reformation of the calendar by Pope Gregory XIII., it occurred so early as the 11th of the same month. In order to restore it to its proper place, the Pope, who was assisted in his enterprise by Lilio, an able astronomer of Rome, directed the suppression of ten days in the calendar; and as the use of the Julian intercalation resulted in a redundancy of three days in 400 years, he ordered the said intercalation to be omitted in all the centenary years except those which were multiples of 400. According to Gregorian rule, therefore, every year of which the number is divisible by four, without a remainder, is a leap year, excepting the centenary years which are leap years only when divisible by four, on suppressing the units and tens. Thus 16(00) and 20(00) are leap years, whilst 17(00), 18(00), and 19(00) are ordinary years. The shifting of days caused great disturbance in festivals dependent on Easter. Pope Gregory, in 1582, ordered the 5th October to be called the 15th October; the Low Countries made the 15th December the 25th December. Spain, Portugal, and part of Italy accepted the Gregorian change, but the Protestant countries and communities resisted up to 1700. In this country the ten days' difference had increased to eleven days, and the Act of 24 George II. was passed to equalise the style in Great Britain and Ireland to the method now in use in all Christian countries except Russia, and amongst some Oriental communities. In England, Wednesday, September 2nd, 1752, was followed by Thursday, the 14th September, and the New Style date of Easter-day came into use in 1753.—*Echo.*

THE iron deposits in the Transvaal have not yet been thoroughly exploited, owing to a concession granted in 1883, which prevents others from starting ironworks.

IN connection with the anæsthetic effects of the electric current, it is stated that with a current of 28,000 alternations per second passing between the elbow and the hand, a needle can be painlessly run into the forearm.

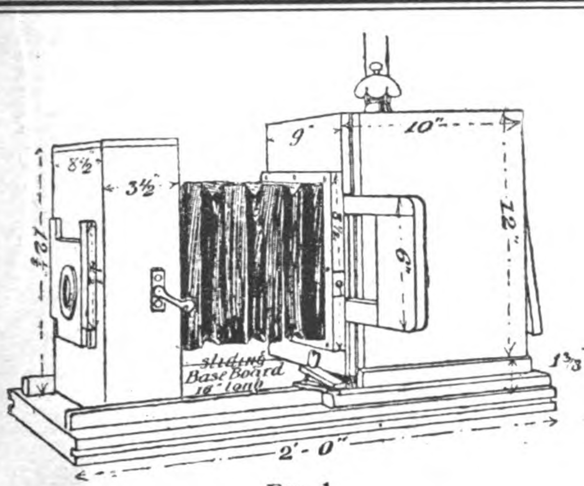


FIG. 1.


FIG. 2.

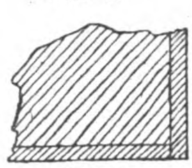


FIG. 3.

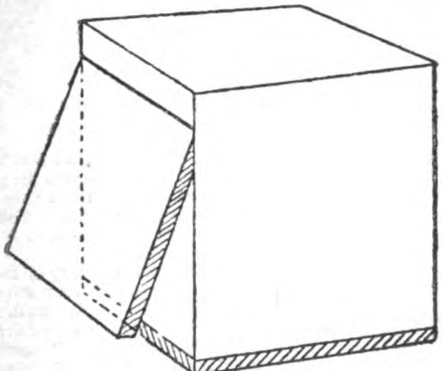


FIG. 4.

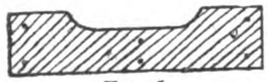


FIG. 5.

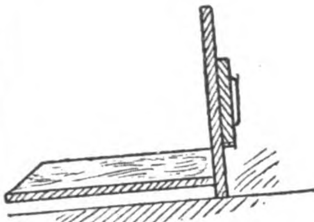


FIG. 7.

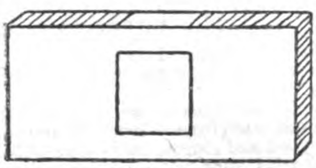


FIG. 8.

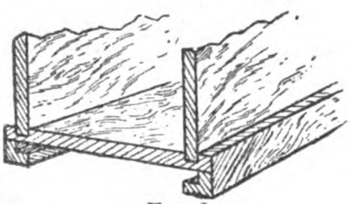


FIG. 6.

ENLARGING APPARATUS.*

AS will be seen in Fig. 1, the body is made box shape, the sides and front of which should be made preferably of hard wood, to prevent splitting with the heat. I have made mine of ½in. oak, which, when planed down, gave me ⅜in. fully, and the bottom out of ⅝in. white wood.

Procuring our timber, we proceed to prepare the pieces necessary for the body. Having planed the wood, we saw out a piece 9½in. by 10in. from the white wood to form base, and plane down to 9in. by 9½in.; this will give a projecting piece each side of the sides of body of about ¼in., Fig. 2.

Then, with the tenon-saw, cut two grooves about ¼in. deep the full length of base, to receive the two sides, the outside cut to be ¼in. from each edge of board, to give the two ¼in. projections at side, as shown at Fig. 2; these grooves can be chiselled out.

Now, out of the hard wood, cut two pieces 12½in. by 9½in., and plane down to 12¼in. by 9in.; these will form the two sides. A piece of hard wood is now required for the front, and, to make this, cut a piece 12⅝in. by 9⅝in. and plane down to the required size to suit the width of body and thickness of base. The mode of fixing up the body will be apparent to the worker. The two sides are glued and screwed into the two grooves, and the front board is fitted on flush over all from the bottom of base, Fig. 3. The top must now have consideration, and must be made of metal. I use a piece of zinc, and, to prevent any injury to the woodwork, have placed a layer of sheet asbestos round the top edges of sides and front before screwing on the top; dirty cuttings of this can be bought at most engineers' stores, sufficient for the purpose, for a few pence.

It is, of course, necessary to have a ventilator in the top.

Before fixing front board it is necessary to cut a circular hole in it to receive condenser, the diameter of which is governed, of course, by the size of condenser it is decided to use. If expense is a consideration, as it was in my case, buy a 4in. dia., which can also be bought at Benetfink's for 5s. 6d. I fancy I hear someone say, "What is the use of that size for a ¼-plate?" Wait a bit, though, and I will tell you. It is not always required to enlarge the whole of the plate, and, should it be necessary at any time to cover the whole of the plate, it is a matter very easily got over by making a decent print and then copying it, reducing the negative to a size suitable to the compass of your condenser. Having fixed up, the door must next be thought about, and this I have placed at the back, as stray light can best be guarded against there, forming the hinges out of two screws.

Before fixing on the metal top it would be as well to try the condenser, to see whether it is held rigid enough in the front board. If not, screw a thick piece of wood inside the body, cut to the sweep of the brass body of condenser, as seen in Fig. 5. This will form a bed for it to rest in. To complete the body it is necessary to fit two angle-pieces along the two undersides of case, to receive the sliding base, that will presently be described, seen in Fig. 6, and two pieces of wood on the front of body, immediately over and under condenser-hole, to enable the carrier to slide in between easily, as shown in illustration, the thickness being governed by the thickness of carrier. We are now ready to proceed with the sliding-front arrangement, which consists, as will be seen from illustration, of a bellows attached to a back and front board, after the style of a camera. The bellows I have in use is one that is described in Benetfink's catalogue as "No. 13, parallel 7⅜in. by 7⅜in., 14 pulls in," price 1s. 7d., and is glued at one end to a piece of wood measuring 8½in. by 8½in., having a hole cut in it larger than the condenser, this piece being screwed to the front of body as shown; the other end is glued to the front board that carries lens. This piece measures 12in. by 8in., and is fitted, as will be noticed, with a rising and falling front—a very useful addition. The sliding front of camera may be used for this, making the grooves out of cigar-box wood. In cutting lens hole care must be taken that you are dead-centre with the centre of condenser.

It will be noticed that I have fixed two side and a top piece of wood to the lens board, and these are really necessary; they not only keep the front board steady, but completely cover in the bellows when the front is closed up, protecting it from injury.

The sliding baseboard should now be fixed, and consists of a board 16in. long by 8in. wide, attached to lens front at one end, the other part of which slides in the two grooved pieces that are fitted to the base of body.

When fixing up lens front, allow the bottom edge to project sufficient distance below sliding base for it to form a rest for the front on the table, or whatever the apparatus is stood on when in use, Fig. 7. The carrier must now be tackled, and is a very simple matter. Cut out a piece of soft wood 9½in. by 6¼in., and cut a hole in centre slightly smaller than a ¼-plate, as shown in Fig. 8, and on this tack pieces of thin wood—cigar-box wood, for instance—to make up to slightly thicker than your negative, and over all tack a similar piece of wood to the first piece described, leaving a slit in top only for the negative to drop in similar to an ordinary lantern carrier. This must now be planed down to the correct size, to enable it to slide easily between the two pieces of wood that are screwed to front of body.

The apparatus is now complete, with the exception of a board to stand the whole upon. It is as well to have this, and it will be seen from the illustration what I mean. It will be noticed that I have screwed on wood strips to act as guides both to the front and back, and find them very useful. It will also be noticed that I have fixed to one of these strips a little arrangement for keeping the front steady when moved out to the proper position, and this is also a very necessary arrangement to have.

* Extracted from an article by "A. T. H." in *Photographic News*.

GOLD IN SEA-WATER.

THE schemes for extracting gold from sea-water are apparently taking definite form; but the following account of an experiment made by a reporter of the *Daily Mail*, who went to Brighton and took some samples of sea-water, is interesting:—

"I could only experiment, obviously, with a very small amount of water, a few gallons—and I did not therefore expect to get a vast quantity of gold. My idea was to prospect for a trace of gold, and then to refer to the ocean itself those anxious for larger quantities of the metal.

"I had been privately apprised of the nature of the particular substance which was to do the main work in wresting the gold from the water; and I had myself purchased, at a tradesman's selected on the spur of the moment by myself, unknown to anybody else, a quantity of this substance. I am not allowed to mention just what it is, but it is a thing in daily use by many people, and is to be purchased in quantities for a few pence or a few shillings, according to the amount desired.

"Having obtained my few gallons of sea-water, I dropped therein the substance I had bought, which, I was assured, would precipitate to the bottom of the water a muddy residuum technically known as 'sludge,' which sludge would contain such gold as the water would contain.

"Of this substance, as I have since ascertained, I ought to have dropped about an ounce only into the quantity of water upon which I was operating. Through a misunderstanding, as I now learn, I placed just about forty times too much; and the result was the quantity of sludge precipitated was greatly in excess of that for which there was any need. In other words, I had, in securing the fixed quantity of gold in the water, made a great deal too much sludge in which that gold was hidden. I brought away with me three 40oz. jars full of sludge, whereas I am assured I should have brought exactly the same amount of gold—no more and no less—if by proper treatment I had only one 40oz. jar of sludge.

"My three jars of sludge I took to an assayer; and in selecting my assayer I purposely avoided, in order to secure greater independence for my test, the assayers who had formerly assayed the sludge taken to them by the patentees, in which they had found 0·150 grain of gold, equivalent to 9·729 milligrammes, from 50 gallons of water.

"Yesterday I received the following

Report from the Assayers

I had selected:—

"CERTIFICATE OF ASSAY.

"Assay Offices and Laboratory,
"6 and 7, Coleman-street, E.C.,
"Dec. 7, 1899

"FRED. CLAUDET, Assayer to the Bank of England.

"To the *Daily Mail*.

"I have examined the sample of sludge received on the 5th inst., and find the following to be the result:—

"GOLD.

	Milligram.	Grain.
Total contents of sample ..	0·2 ..	·0031

(Signed) "ARTHUR C. CLAUDETT."

"Here, then, are the simple facts of the test. What the patentees, or a syndicate to be formed by them, intend to do is to purchase or rent land near the seacoast, and run sea-water on to it at every tide. Precipitating the sludge at each tide, and then

letting the water out; they propose to continue until such time as it might be deemed advisable to have a clean up, when the sludge would be dug up, and the gold separated in the ordinary way.

"The patentees calculate that the 'pay-dirt' thus obtained would be rich enough to yield big dividends. Upon that point it is obviously too early to express an opinion. That it is an imaginative and picturesque scheme cannot be gainsaid; but the infinitesimal trace of gold revealed by this test does not seem to herald a day when a man may go into a bureau de change, plank down a bucket of sea-water, and receive a sovereign or two in exchange.

"Certainly much better assay reports have been yielded by former tests made by the patentees; but the desire of those patentees to permit a syndicate to share the marine gold with them suggests more benevolence than one often meets with nowadays."

STERILISATION OF WATER BY OZONE.

SINCE 1891, the sterilisation of water by means of ozone has been the subject of numerous investigations. M. J. Blondin, in an article in *Eclairage Electrique*, refers to some of the earlier of these, and then passes on to a description of the apparatus designed by Marmier and Abraham, and of the results obtained by them at Lille in 1898-99. The installation comprises an alternating current generator, a transformer giving 30,000 volts at the terminals of the secondary, a plate ozoniser, and an absorbing tower. The special form of ozoniser used has each of the metallic electrodes inclosed between two glass plates. The electrodes are kept cool by means of water. The absorbing tower is built of masonry.

Tables are given showing the chemical and bacterial character of the water before and after treatment with ozone. The ozonised air passed into the absorbing tower contained between 5·8m.gr. and 9·5m.gr. ozone per litre. The organic matter was reduced from ·014gr. per litre to ·003gr. per litre, and the bacteria in several instances were completely destroyed, while in other cases they were greatly reduced in number and activity. It was noticed that the results were best when the bacterial examination of the water did not immediately follow the treatment in the ozonising tower.

The report of the Commission appointed by the Municipal Council of Lille to examine the apparatus and process is given as a note to the article. This report is favourable to the method, and recommends the adoption of the Marmier and Abraham sterilising process at Lille, where the present water supply is contaminated, and typhoid fever is prevalent.

The author, in conclusion, discusses the question of cost, and expresses his regret that Marmier and Abraham have not supplied the necessary data to enable this to be accurately fixed.

Science Abstracts, from which the above is taken, also refers to Mr. Andreoli's paper on the same subject in the *Electrical Review*. After criticising the form of ozoniser used by Marmier and Abraham, he quotes several passages of this report, in which the efficiency of ozone as a germicide is proved.

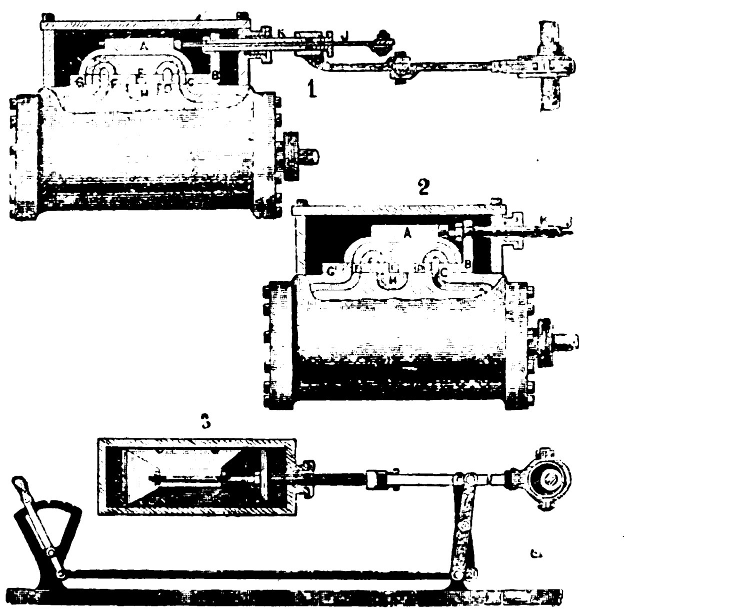
The author next discusses the question of cost, and states his opinion that the two centimes per cubic mètre, given by Marmier in an earlier paper, is too high. In order to throw further light upon this question, Andreoli has himself recently carried out experiments in London, and has measured the consumption of ozone in terms of electrical energy. The experimental plant consisted of a small Andreoli ozoniser worked at a tension of 3,500 volts, a Roots blower for forcing the ozonised air through the water, and five tanks in which the absorption of ozone by the water occurred. The plant permitted the treatment of 440 gallons of water per hour. A table is given showing the effects obtained, with expenditures of electrical energy varying from 138 to 316 watts per cubic mètre (220 gallons) of water.

The author concludes from his experiments upon Thames water that complete sterilisation of water drawn from the river at specially selected spots could be obtained with an expenditure of electrical energy equal to 100 watt-hours per cubic mètre of water.

M. Blondin, in his paper, refers to Andreoli's claim to have designed an ozoniser giving more economical results than the form used at Lille, but points out that, in the absence of more complete data, it is impossible to compare the results obtained by the two forms of ozoniser and systems of treatment.

DAMERELL'S SLIDE-VALVE FOR STEAM-ENGINES.

THE improved slide-valve which forms the subject of our engravings consists of two parts, a distributing-valve, A, and an independently movable section, B, interposed between the ports of the cylinder and the distributing-valve, A. The distributing-valve is independently adjusted by a stem J passing through a sleeve, K, connected with the slide-section, B, and with the eccentric. The sleeve K is offset in the form of an arm, while the stem J extends straight through the offset. Two independent connections are thus obtained for working the parts of the compound valve together or separately.



The distributing-valve is formed with a large exhaust-chamber opening inwardly in the middle and through ports near its ends, and with two induction-ports opening into the steam-chest, to admit steam through the passages, G, F, D, C, into the cylinder ports.

The distributing-valve rod, J, as shown in Fig. 3, representing a side view of the valve-shifting mechanism, is jointed to the upper end of a lever fulcrumed at its middle to an arm, and connected at its lower end with a rod pivoted to an adjusting lever; the upper end of the arm is connected with the eccentric rod.

When the ports are in the position shown in Fig. 1, steam enters through the proper induction opening, and passes through F and the port communicating therewith into the cylinder, forcing the piston to the right. The steam is expelled through the other cylinder port, through C, through the centre exhaust-chamber, through E, to exhaust H. When the rods are together moved to the right by the eccentric, the valve, A, B, shifts to the right, and the port G is over the left cylinder port, D is over the other cylinder port, and live steam passes through D to the cylinder port, forcing the piston to the left; the steam passes out through the left cylinder port, through G, to the central exhaust-chamber through E to the exhaust, H. To reverse the motion of the engine, the relation of the distributing-valve A and the slide-section B is changed by means of the rod J and sleeve K; for this purpose the distributing-valve is slid to the right on the section B, as shown in Fig. 2, by means of the shifting mechanism. As before, the parts, A and B, are reciprocated by the eccentric; but G and C are now changed to live ports, and D and F to exhaust ports, which changes the direction of the engine's motion. The valve is the invention of Henry Damerell, Ludlow, Mo.

FILTRATION MADE EASY.

"CLEANLINESS is next to godliness" is a time-honoured saying which photographers can well afford to bear in mind, for there is little doubt that there would be more of the latter commodity in the dark-room if there were more of the former. There is undoubtedly a great temptation to relieve one's feelings with a little Low Dutch when it is found that an otherwise perfect negative or faultless print has been disfigured, if not hopelessly spoilt, by a little dirt from this solution or a little sediment from that.

All of us, especially beginners and those of the use-it-over-again type, would get better results if we used the filter more often. Who has not been troubled with a black metallic deposit in the twice-used toning bath, and the inevitable specks of dust and straw which delight to fix themselves in our old friend, "Twopence-a-pound"?

It is the experience of the writer that a small piece of cotton-wool, so placed in the funnel as to enter the leg about ¼in., and extend a little way up the sides, is sufficient to remove most of the difficulties. It may not be perfect as a filter, but acts as a convenient screen, and is not intended for the use of the quantitative analyst.

The pad should be wetted a little, in order to drive out the air before pouring on the solution, the latter being done carefully, and not in fits and starts. Again, to screen the broken glass tube from the gold chloride solution with the same pad as has been used to filter a 10 per cent. solution of hypo, is hardly *bon ton photographique*.

We will now consider the best way of keeping the wool so that it is always handy when required. If the amount you expect to use is small, an empty plate-box comes in very well. A semicircular hole from ¾in. to 1¼in. diameter, is cut in one end of the lid, and the box filled with cotton-wool (that known as "medicated" wool being the purest obtainable). This is fed through the hole in the lid, and the requisite quantity torn off against the side of the box. The hole may either be left open or a cover formed by a piece of card, hinged on wide tape and glued to the side. Thumb-holes are cut in the lid to facilitate opening the box when refills are required.

A rather superior article with greater capacity may be made from an empty cocoa-tin. Even if it is "best and purest" the tin must be well cleaned and dried, after which a hole is cut in the centre of the lid, and the piece of tin left on to form a cover and a means of cutting the wool.

An additional feature of this box is a spiral spring, which carries a circular card, and thus keeps the wool up to the mark. The same end may be attained by suspending this card from pieces of elastic fixed to the sides near the top.—C. A. Colyer, in *Photographic News*.

A RIVAL TO CELLULOID.

NITRATED cellulose has long held the field as the basis of a flexible glass, as celluloid has been called; but there seems a probability that before long Messrs. Cross and Bevan's invention, aceto-cellulose, may be found a formidable rival, for it possesses many advantages over the pyroxyline which, in combination with camphor, is the main constituent of celluloid. We learn from a foreign journal that the manufacture of tetracetate of cellulose has, during the last few years, made rapid strides, as also has the butyrate, which is a somewhat analogous substance, the substances being now produced on a large scale.

Perhaps the most conspicuous quality of the acetate, compared with the nitrate, is its non-inflammability—it burns very imperfectly. It differs further from the latter in that it is insoluble in methylic and ethylic alcohols, acetates of amyl and ethyl, acetone and ether, but is soluble in benzoate of ethyl, chloroform, epichlorhydrine, acetic anhydride, glacial acetic acid, and nitro-benzine, the solution in the latter becoming a solid, completely transparent jelly. The solution in the other named liquids can be diluted with acetone without precipitation taking place. The aceto-cellulose resists most reagents in a remarkable manner. Dilute acids and alkaline lyes destroy nitro-cellulose; but, with the exception of dilute nitric acid, do not act act upon the new substance, in some cases even when boiling.

It is probable, too, that, used as a basis for films, it will be possible to dry them quickly by the aid of alcohol in the usual manner, a process quite out of question with celluloid, as anyone knows to his sorrow who has tried it. The acetate does not change by the action of heat below 300° Fah. The hydrate of cellulose possesses very similar properties, but is more soluble in the liquids named,

and is also easily soluble in acetone and in acetate of ethyl. The butyrate is very similar to the acetate, but the filaments formed from it are softer and more flexible. From all these facts the journal alluded to predicts that the new substances will be powerful rivals to celluloid, and especially in cases where non-inflammability is an important consideration. Finally, it is anticipated that they will form excellent lacquers for metal, their resistance to moisture, heat, and chemicals being far above that of the usual basis; of course, any colour can be given to them that may seem desirable.—*British Journal of Photography.*

ALTITUDES OF RAILWAYS ABOVE SEA-LEVEL.

WE propose in the following short article to give some interesting particulars of altitudes attained by the principal railways in different parts of the world. As it would be tedious to our readers to place these details before them in the body of the text, we shall give them in a tabular form, which will enable them to be the more readily compared and appreciated. It might be supposed that the rack railways would head the list, but though they run the others very closely it will be seen from

Table I.—Rack Railways.

Name of railway.	Maximum altitudes in feet above sea-level.
Pike's Peak, U.S.	13,200
Görner-Grat	10,065
Jungfrau	7,613
Rothorn	7,425
Pilate	6,850
Rigi	5,578
Monte Generoso	5,280
Gaisberg	4,243
Semmering	2,912

Table II. that they do not quite bear away the palm. There are three lines which may be referred to independently of those scheduled in the tables, as they are laid out partly on the rack and partly on the ordinary steam traction system. These comprise the lines between Beyrouth and Damas, and between Eisenery and Vordenberg. They are both in Syria, and attain each an altitude 3,960ft. above the same datum. The state railway from Herzegovina to Bosnia, belonging to the same system, reaches to a height of 2,904ft. above sea-level. It will be advisable to tabulate the other lines, which are ordinary locomotive railways, under two heads—viz., those which belong to Europe and those which are situated in foreign countries.

Table II.—European Railways.

Name of railway.	Maximum altitudes in feet above sea-level.
Land-quart to Davos	5,390
Kaltlad to Scheidegg	5,201
Brenner	4,494
Guadarrama, Spain	4,488
Mont Cenis	4,290
Lioran, France	3,800
St. Gothard	3,811
Alais to Brionde, France	3,395

It should be mentioned that the first two lines in Table II., are both located in Switzerland, and have a gauge of one mètre.

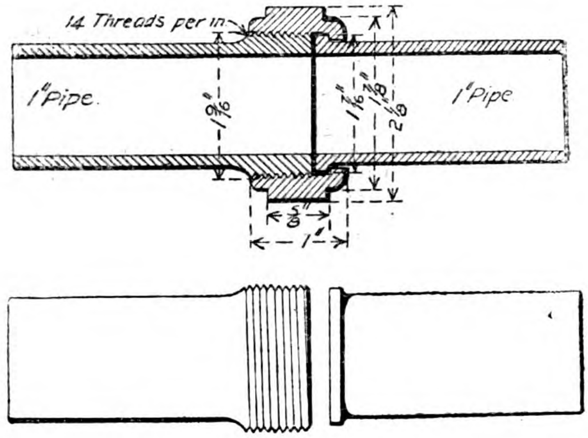
Table III.—Railways in Foreign Countries.

Name of railway.	Maximum altitudes in feet above sea-level.
Central Peruvian	14,555
Chilian and Bolivian	13,000
Danvers and Rio Grande	11,385
Vera Cruz	9,042
Union Pacific	8,292
Canadian Pacific	5,940
Northern Pacific	5,610

The highest altitude to which a cable line has attained is that of one near Stanserhorn, which rises to 6,100ft. It will be observed that with the exception of the Pike's Peak rack railway, the lines which traverse the passes of the Andes, in South America, can give the others a wide berth, although some of them can boast of very respectable figures.—*The Engineer.*

PIPE UNIONS MADE DIRECTLY ON THE END OF THE PIPE.

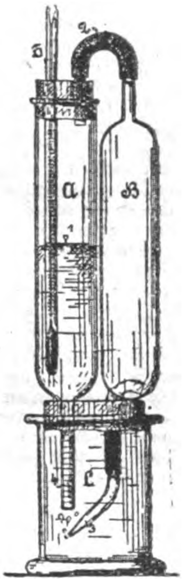
THE accompanying engraving illustrates a new pipe union devised by Mr. T. R. Browne, Master Mechanic of the Juniata shops of the Pennsylvania Railroad at Altoona. The first glance at the sketch shows the clear opening through the joint, which is entirely free from obstruction. This is not true of the ordinary commercial unions. These new unions are made by a very simple process on a bolt header, by use of a pair of dies. In each case the external die is formed to the shape of the finished piece. The internal die consists merely of a plunger of two diameters, the larger repre-



senting the larger diameter of the union and the smaller diameter corresponding with the inside diameter of the pipe. The dies are so made that before any upsetting takes place on the pipe the internal die has entered the external die in such a way as to form a closed or solid die. This method permits of the use of the next smaller size of standard union nut than would be used with the standard union. For example, for a 1in. union made in this way, a standard nut for a ¾in. union may be used. These unions are very simple and neat, and they possess the advantage of reducing the number of joints and opportunities for leakage, as well as making a very strong joint.—*American Engineer*, N.Y.

TESTING AMMONIA FOR USE IN REFRIGERATING MACHINES.

IT having been established that ammonia, whilst delivered with an initial impurity of 0·1 to 0·3 per cent., chiefly water and a little piridine, gathers impurities by frequent additions of fresh ammonia, as also through the machinery—as, for example, by



condensation of air moisture on the piston-rod, &c.—may ultimately be found to have accumulated impurities to amount to as much as 10 per cent. of the ammonia in circulation, according to experiments made by Dr. Lange, who has got this result in more cases than one, it is necessary in order to obviate the very injurious effects of such impurities on the working efficiency of cooling machinery to take periodical tests of the fluid, as may be done by evaporating a fixed quantity of the ammonia to be tested in a measured glass, the contents (i.e., impurities) left behind being easily calculated.

C. Richter's method is to take a glass tube, A (see illustration), with its lower end (4) elongated, reduced, closed, and marked off in distances equal to 0 2 per cent. each. Fill with the ammonia to be tested up to mark 1. Plug the top, and lead with rubber tube, 2, into glass tube, B, which, with open tube, 3, at bottom, admits the evaporated ammonia into the glass cylinder, C, the water contents of which absorb the escaping ammonia, whose combination with the water generates sufficient heat to completely evaporate all ammonia in tube A. What remains in tube 4 is an impure fluid, whose percentage to the total can be read in the tube itself. This should never exceed 1 per cent. If this point is exceeded, the ammonia must be thoroughly rectified. Indeed, all ammonia should be tested on delivery, and if found to contain over 0·5 per cent. of foreign stuff, it is not so pure as may fairly be claimed by the buyer.—*Cold Storage.*

USEFUL AND SCIENTIFIC NOTES.

In Chicago there are 956 miles of "surface railways" or tramways, and 70 miles of elevated railways.

A system of electrical driving and lighting has been adopted in the new shops of the Thames Ironworks and Engineering Company at Blackwall. This company has in hand orders from the Admiralty for ten sets of machinery for 56ft. vedette boats, nine sets of machinery for 40ft. steam pinnaces, and six sets of water-tube boilers for 40ft. pinnaces. In addition to these the Admiralty have given them the order for a third set of battleship machinery of 18,000I.H.P.

The Coming of Man.—Prof. Grenville Cole has a fascinating article on this subject in the current number of *Knowledge.* He says:—"The remains of man are notably subject to decay, and the signs of his former existence in this or that locality often depend upon the more enduring objects that his skill has left behind. Baked pottery, chipped stone implements, the very charcoal of his fires, may survive in places where his own bones are extremely rare. Much of our knowledge of early man is derived from interments conducted with careful ritual by his tribal fellows. Is it likely that, in a ruder age, when ceremonial burial may have been utterly unknown, the skeleton of man would have much chance of preservation? . . . . Unlike many other mammals, early man was not compelled to collect in vast herds around the lakes and water-courses. His very intelligence, his variety of aim, made him a wanderer across the earth. Dying in the forest, or on the barren rock, or isolated in his log-canoe, his skeleton was rarely covered over and adequately preserved. He was small in comparison with the giant carnivores, with which he competed for his food. Even if he died a natural death, the very fowls of the air could combine to scatter his remains. . . . Hence, as we work backward, from the present deposits to those of earlier days, the number of human skeletons discoverable decreases with extreme rapidity. Yet there are, up to a certain point, abundant evidences of the occupation of the earth by man. The conclusion is that the earliest types of humanity, without arts, and perhaps without tribal organisation, have probably left very few traces through the strata of the entire crust. . . . . Man presents himself to the calm and inquiring eye of science in so many aspects, in so many fields of enterprise, that it is difficult to deal comprehensively with his career upon the earth, as we might with that of the cockle or crayfish. He is so near us, even in the Malay or the Negro, that we are apt to place him in a category apart from the rest of animated nature. Even the young science of anthropology, by its very title, confesses that zoology cannot cope unaided with the details daily provided by the aberrant activity of mankind. . . . Have we already advanced since Zittel wrote, in 1895, 'The problem, where man first appeared on the earth and from what form he sprang, has, in spite of all efforts of modern geology and anthropology, up till now found no solution'? If we have indeed advanced, along the lines indicated by the discovery of Dubois, it is but as yet a single step, founded upon a single skeleton. To some thinkers, however, this single step provides a field of vision surpassing all that went before; to others, the coming of man remains, to this day, one of the profoundest secrets of the crust."

SCIENTIFIC NEWS.

SOME time ago it was proposed to have at Harvard College Observatory a telescope of unusually long focus for photographing the stars and planets. It is now announced that the funds have been provided by anonymous donors, and that before many weeks have passed a telescope with 12in. of aperture, and rather more than 100ft. long, will be ready for work.

The *Bulletin* of the Société Astronomique de France for December contains an interesting article by MM. F. Quénisset and Em. Touchet on "La Lumière Cendrée de la Lune," illustrated with reproductions of photographs taken at various times and places. M. Camille Flammarion has quite a valuable article entitled "En quelle Année commencera le Vingtième Siècle?" in which he quotes several passages which may help to explain how the idea got about that the 19th century ended with 1899. He says "Le vingtième siècle commencera donc le 1er janvier 1901," and he gives a map showing "le ligne géographique du changement de date quotidienne."

It is stated that Mr. Coddington, of the Lick Observatory, discovered a new minor planet by means of a photograph taken with the Croker telescope, and afterwards obtained a series of observations during October and November from which he was able to determine an orbit.

Mr. Horace Darwin suggests that the striking colours of recent sunsets are possibly due to the dust in the air from the Leonid meteors. It has been shown that even in mid-Atlantic the air is always full of dust—cosmic dust it has been called—and if that shows itself or is detected in abnormal quantities it may very well be urged that it comes from the meteoric stream.

In the course of some remarks introductory to a series of lectures by Mr. William Peck, astronomer to the City of Edinburgh, Lord Provost Mitchell Thomson said it was very gratifying to know that the City Observatory had been largely taken advantage of by the public since it was thrown open to them. Certain nights of the week were set apart for visitors, and already thousands had taken advantage of the arrangements for seeing the observatory and of obtaining some definite instruction in astronomy and astronomical methods. Among the visitors were several gentlemen eminent in that particular science, who had expressed astonishment and admiration at the fact that Edinburgh possessed so fine an observatory. Classes for the teaching of theoretical and practical astronomy had been established at the institution, and arrangements were nearly completed for the holding of classes for pupils from the secondary schools, who would receive instruction in a science which, as Mr. Peck would show the audience that night, was associated in so practical a way with the everyday life of the people. Mr. Peck's lecture was on "Time," and in the opening he dealt with the various methods of time measurement, and explained how time was determined by observations of the heavenly bodies, the star sphere being to the astronomer as a perfect clock. In the second part of the lecture Mr. Peck described the various time cycles in use, as the sidereal day, the true solar day, and the mean solar day. Then he dealt with the week, the sidereal and synodic months, as well as the sidereal, tropical, and lunar years, and the perfecting of the calendar under Julius Cæsar in 45 B.C., and Pope Gregory in 1582 A.D.

The 200th anniversary of the Königliche Preussische Akademie der Wissenschaften of Berlin will be celebrated about Easter next by a special celebration, to which foreign delegates will be invited.

An international congress of mining and metallurgy will be held in Paris next June (18-23). It will be under the direct patronage of the French Government. M. Gruner, Rue de Chateaudun 35, Paris, is the general secretary, and will give all particulars.

It is announced that a course of twelve demonstrations in experimental psychology will be given in the Psychological Laboratory of University College, Gower-street, during the Lent Term, by Mr. W. McDougall, Fellow of St. John's College, Cambridge. The class will meet once a week on the day and at the hour that are found to be most convenient to the majority of the students. The methods of investigating experimentally all the chief types of elementary mental process will be demonstrated, and the students will be afforded opportunities to practise the methods. The subjects of investigation will include skin-sensibility and the muscular sense; the colour sense and visual distance; appreciation of tone-intervals and localisation of sound; the measurement of sensibility to pain; simple measurements of memory; estimation of periods of time, &c. Students should send in their names to Mr. McDougall, St. John's College, Cambridge, before Tuesday, Jan. 16, 1900, when the term begins, and should be present at the first meeting on Friday, Jan. 19, at 4.30.

At the Society of Arts on Wednesday, Dec. 20, Mr. H. Bloomfield Bare, F.R.I.B.A., will read a paper on "Bi-Manual Training by Blackboard Drawing."

At the meeting of the Royal Geographical Society on Monday last, Mr. H. Weld Blundell read a paper describing a journey through Abyssinia, in the course of which he said that from Bilo was a march of two and a half days over an extraordinarily rich country, hilly, but well watered. The country along the road showed the destruction wrought by passing expeditions, though probably this cause had not been so pauperising as the appalling loss of cattle through rinderpest, which had in many places almost annihilated the principal wealth of the inhabitants from Harar through the whole breadth of the country. Cotton seemed to grow luxuriantly, as well as tobacco. The great grass fires disfigured the landscape with patches of blackened desolation in early spring, but the verdure that sprang up with rapid luxuriance showed the value of this primitive expedient by which the natives clear the ground for grass and cultivation. The younger growth of trees got killed off, but the great monarchs of the forest that had held out against the conflagrations stood out here and there in the landscape, and looked worthy of being invested with the religious reverence of the Salla race. The party reached the town of Gatama, immediately below which could be seen the valley of the Didesa, with dense forests and hot jungle. Lekemti was described as a large scattered town of some 40,000 inhabitants, situated on undulating ground, with all the evidence of prosperity, corn and honey being the principal produce, and there being also large quantities of cotton, native and American; iron and copper from the west, too, were to be seen in the markets. Arrived at the frontier, Mr. Blundell learned that the Blue Nile was at no great distance, and in barely five and a half hours' marching found the valley of the Abai at his feet, and the silver sheet of water not six miles off. According to the maps, this point of the Abai would be nearly 70 miles from the camp at Mendi; and he thought the explanation of the error lay in attributing this stretch of the river to the lower reach of the Didesa, which, however, could be traced from this point of view joining the Nile at the range called the Chochi, some 20 miles further south than its junction as placed in the maps. On May 6 they crossed the Blue Nile and joined hands with the commandant of Famaka and his detachment of 10th Soudanese, which had distinguished itself at the desperate fight with Ahmed Fedil, near Rosaires.

In the course of a lecture before the Royal Courts of Justice Temperance Society on the "Physiological Aspect of the Temperance Question," Mr. Victor Horsley said that though he was a rabid teetotaler he had often heard statements on temperance platforms as to the effects of alcohol which he could not endorse. But quite recently it had been definitely ascertained that even in small doses the effect of alcohol was physiologically maleficent. Alcohol injuriously affected the nervous system, diminished the oxidation which was necessary to the protoplasm of the brain, and produced a certain amount of degeneration of the tissues even in healthy persons. As to the use of alcohol in disease, about 50 years ago every patient undergoing an operation or suffering from pneumonia or typhoid fever was largely treated with alcohol. But nowadays the practice of any general hospital was very different. The expenditure on alcohol had been largely replaced by expenditure on milk. In surgery this reform was largely due to the antiseptic system introduced by Lord Lister. The dosing of a patient with alcohol before an operation and during the recovery from it was now no longer necessary; and in this connection the enormous amount of pain as well as of life which had been saved by Lord Lister's system should be remembered. As to the remedy for intemperance, he thought it most important to establish the principle that the moral responsibility for drunkenness rested primarily on the man who sold rather than the man who bought the drink. In answer to a question, Mr. Horsley said that, in cases of faintness, alcohol was often the worst treatment that could be administered.

An interesting paper on injurious insects in Indian forests has been prepared by Mr. E. F. Stebbing, and published by the Government printer at Calcutta. Amongst the most destructive pests in the insect world infesting the forests of India are locusts and white ants, or termites, the former of which invades the fertile plains of India from its home in the sandy deserts of Rajputana, Sind, and the Punjab, leaving not a green leaf or field in the line taken by it. As the life-history of the locust proves that forests and moisture are its greatest enemies, the reclamation of arid sandy areas by means of plantations is recommended as a means of checking its multiplication. Although the white ant is a most unwelcome intruder in any building, it renders service to man in the forest by rapidly converting dead branches, fallen trees, and decaying wood of all kinds into soil, each particle of wood eaten being replaced by humus. Where termites are numerous, they only feed on the outer dead portions of the bark of trees, and do no damage to healthy trees. The instinct of these insects, Mr. Stebbing says, is marvellous. He has often noticed that should a tree have a dead branch on its trunk, no matter at what elevation, an earthen gallery is run up by white ants and the branch attacked, the decaying wood being replaced by soil, which soon falls to the ground.

According to M. Lanfrey, in a communication to the Paris Academy of Sciences, a one per cent. aqueous solution of picric acid applied during June—August is useful in destroying the Phylloxera. It is also useful as a syringe-drench for other fruit trees. Amongst dyers, picric acid has been well known for years; there is a suspicion that it is used by brewers, and it is quite certain that it forms, when properly treated, a very powerful explosive.

"A curiosity in the shape of a pied woodcock has been shot near Blofield, in Norfolk. The bird was an unusually fine one, weighing 12oz., and had the white feathers evenly distributed in both wings. One of the leading ornithologists of the day, to whom it has been submitted for examination, observes that he has never seen a woodcock marked as the one in question." The name of the leading ornithologist is not mentioned in the paragraph quoted.

Some years ago the late Prof. Huxley made a report about the herring fishery, and stated that there was no reason to suppose that the somewhat alarmist rumours as to the number of fish decreasing were based on facts. In this connection it is worth mention that, so far as Yarmouth is concerned, the past season is the record—the value of the fish captured amounting to over £300,000. One boat alone has £3,000 to its credit, and the amount paid to the cleaners and salters was £13,000. Many of the cleaners come from Scotland, and they had a special train to take them home.

The death is announced of the distinguished pathologist, Dr. Birch-Hirschfeld, professor of pathology in the University of Leipzig. He was only fifty-seven.

It is notable of the progress of bacteriological science that a patent has been obtained in America for a sanitary attachment to telephone transmitters, by Mr. W. Lenderoth, of Manhattan, New York. It is described as a wire frame, having a ring and bent arms to clamp it on the front of an ordinary conical transmitter. Three wires project forward from the ring forming a cage, in which is inserted a temporary paper cone, which may be removed and destroyed after the telephone has been used.

It is stated that heavy cannonading does not interfere with the transmission of signals by Marconi's system of transmitting by "wireless" telegraphy. A "school" for training operators has been established on one of the hulks in Portsmouth harbour.

There is a probability that electric traction on the Metropolitan Railway will be adopted soon, as the experiments which have been made have

proved quite satisfactory. The "motors" are nearly 40ft. in length, and will draw long corridor coaches similar to those on the City and Waterloo line.

Before long the telephone will be established between Vienna and Constantinople. The Hungarian and Servian Governments have arranged for a telephone wire between Budapest and Belgrade, which is expected to be working at the end of January. From Belgrade the Servian Government has granted two more telephone wires, one to Sophia and another viâ Uskub to Constantinople. There is a telephone already working between Budapest, Vienna, and Berlin. It may be expected that the German capital will soon have telephonic communication with Constantinople.

Aluminium is being extensively used for the manufacture of cooking utensils in India. The metal has also been used for the bearings of shafting at the Madras College of Engineering, and is said to have proved satisfactory.

At a meeting of the Royal Irish Academy, Mr. Trouton showed an apparatus with which he had determined the heat required for evaporating steam from saline solutions. The subject is of considerable importance, as it would be of immense advantage if sea-water could be readily converted into steam without too much "refuse" being left behind.

A chair of geology at McGill University, Montreal, has been founded by Sir W. C. Macdonald as a memorial of the late Sir William Dawson. The income of the endowment is to be paid to Lady Dawson during her life, and afterwards will become available for the maintenance of the chair.

THE Compagnie Générale de Traction, which owns sixty miles of line in Paris, will eventually equip the whole of it on the Diatto electrical traction system.

Human Teeth an Index of Race.—"The size of the jaws will be largely determined by the size of the teeth," says Prof. Arthur Thomson, in the December issue of *Knowledge*, "and as in savage races the teeth are, as a rule, larger than in the more highly-civilised peoples, it naturally follows that the architecture of the face will be modified by the massiveness of the jaws and their associated structures. The late Prof. Sir William Flower was amongst the first to recognise this fact, and by comparing the length occupied by the upper molars and premolar teeth with the length of the cranio-facial axis (basi-nasal length) he determined the dental index by the following formula:—

$$\frac{\text{Length of 5 molars} \times 100}{\text{Basi-nasal length}} = \text{Dental index.}$$

In this way he was able to group the races of man according to the size of their teeth into three varieties:—(1) The Microdont, with an index below 42, including mixed Europeans, ancient Egyptians, low-caste natives of India, and Polynesians. (2) Mesodont, with an index ranging between 42 and 44, comprising Chinese, American Indians, Malays, &c. (3) Megadont, having an index over 44. This group embraces Melanesians, Andamanese, and the Australian and Tasmanian races. The reduction in the size of the teeth in the higher races is probably explained by a reference to the more common methods of preparing the food by cooking, &c., which renders unnecessary a powerful masticatory apparatus. On the other hand, the size of the teeth in the lower races is oftentimes much larger than might be at first assumed from a casual inspection of a large number of skulls. This fact was borne out during the discussion which took place on the remarkable fossil remains brought from Java by Dr. Dubois. These included a skull, a thigh-bone, and two molar teeth, presumably all belonging to the same individual. We are not at present concerned with the skull or thigh-bone, which the discoverer claimed, with much show of truth, belonged to an intermediate form between man and the higher apes, which he distinguished under the name of *Pithecanthropus erectus*, but rather to draw attention to the aspects of the case as determined by the teeth. These were of large size, and, among other points, it was urged that they were too big to be human. This assertion at once put all the anatomists who had large collections under their charge on the *qui vive*, and many hundreds of specimens were examined with the object of determining this point. It soon became apparent that this argument against the Trinil teeth being human would have to be abandoned, as a number of instances were forthcoming in which undoubtedly human teeth equalled, if they did not excel, the fossil specimens in size. It would therefore appear extremely hazardous to express any opinion as to the limits of size within which we should regard teeth as human."

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE LATE REV. G. F. CARRUTHERS—THE "ENGLISH MECHANIC" AND A SCOTTISH WORKING MAN—ALPHA ORIONIS AND RIGEL—ADJUSTING A TELESCOPE—REFLECTING STEREOSCOPE—THE HEAD MASTER AND THE USSHER — CALCULATION OF SUN'S TRUE BEARING AND ALTITUDE—GRAVITATION—EROS.

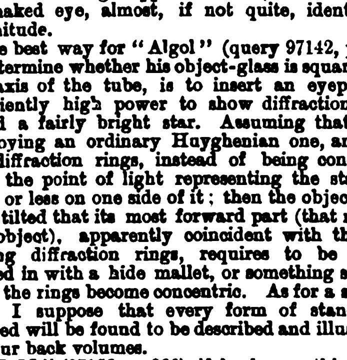
[43106.]—BY the death of the Rev. G. T. Carruthers, a quondam Chaplain in the Bengal Presidency, yet another paradoxer disappears from the columns of the ENGLISH MECHANIC for ever. His letters in these columns on numerical relations in our System, vapour in space, the cause of gravity—and a great deal more *ejusdem generis*, must be well within the recollection of many who will read these lines. In private life he was a most blameless and estimable elderly gentleman.

Mr. Smith (letter 43079, p. 361) is thoroughly right in his belief that I should be pleased to learn how successfully Mr. Glass had mounted his reflector equatorially from any sketch or directions given by me. I could hardly receive a more acceptable reward for the pains I took to make the subject intelligible than that derived from the knowledge that my unpretending efforts have enabled a genuine working man to construct such an instrument as that figured on p. 360.

Referring to reply 97060 (p. 364), it happened curiously that on the night of November 29, α Orionis and Rigel appeared to me, as viewed with the naked eye, almost, if not quite, identical in magnitude.

The best way for "Algol" (query 97142, p. 366) to determine whether his object-glass is square with the axis of the tube, is to insert an eyepiece of sufficiently high power to show diffraction rings round a fairly bright star. Assuming that he is employing an ordinary Huyghenian one, and that the diffraction rings, instead of being concentric with the point of light representing the star, are more or less on one side of it; then the object-glass is so tilted that its most forward part (that nearest the object), apparently coincident with the projecting diffraction rings, requires to be gently tapped in with a hide mallet, or something similar, until the rings become concentric. As for a stand—well, I suppose that every form of stand ever devised will be found to be described and illustrated in your back volumes.

"F. M." (97156, p. 366), if he be anything of a mechanic, can easily make a reflecting stereoscope for himself. I did so myself years ago. A plan may help him. In the sketch, B represents a large



flat board, on which are mounted two mirrors, M, M', forming an angle of 90° with each other. These face (obviously at an angle of 45°) the vertical slabs of wood P, P', upon which, by the aid of grooves, slides, or any other simple device, the photographs are placed. I have represented the course of the rays of light in my diagram by dotted lines; so, taking the left-hand photograph, it will be seen that the light from the picture will travel by the route P *r*, *m*, *r* E to the observer's left eye at E, while it will reach his right eye E' by the route P' *r' m' r'*. The size of the mirrors, board, &c., will obviously depend upon that of the photographs to be employed.

Put shortly, letter 43092, on p. 381, comes to this, "Ussher was a painstaking and learned chronologist"—when he happened to agree with Mr. Garbett,—whose identity is veiled under the euphemism, "the genuine Bible, and all other good chronology." Otherwise, like that poor creature and most incompetent mathematician Le Verrier, he is to be brushed aside as unworthy of any attention. I protest against this sort of argument (if it be not a gross solecism to dignify it by that name). For myself, I believe that Ussher is just as much—or as little—trustworthy as a chronologist, as any one of that brotherhood, not even excluding the infallible and omniscient Mr. Garbett himself. This being so, I find that he places the date of the Flood at 2,349 B C. But there is actually extant a Chinese Observation of the Conjunction of Mars, Jupiter, Saturn, and Mercury in the Constellation "Shi" (i.e., between 10° and 18° of Pisces), and this occurred on February 18, 2,446 B C., or 97 years before the mythical Deluge; whence it is abundantly evident that while Mr. Garbett's Steam Comet was flooding Armenia, China was left high and dry, and the Celestials were going about their daily avocations as usual.

Perhaps I may be forgiven for referring "Fleur-de-Lys" (query 97187, p. 387) to pp. 173, 241, and 242 of Vol. LVI., of the "E. M." as containing practical replies to his questions.

"Newton" (query 97217, p. 388) apparently forgets that the earth is surrounded by the atmosphere. In a very familiar lecture experiment a tall receiver is exhausted of air and a sovereign and a feather dropped simultaneously from the top of it, which both reach the brass plate at the bottom at the same instant. If, however, the feather and the sovereign are together let go from a height in the air of the room, the coin will fall on the floor very notably the sooner of the two. The balloon to which "Newton" refers must have collapsed and come down "all of a heap," while the resistance of the air to the lighter sand must have retarded its progress.

I think that "Garsdale" (query 97222, p. 388) will find that Herr Osten's value for the eccentricity of the orbit of Eros is 0·222911.

A Fellow of the Royal Astronomical Society.

THE SUNSPOT CYCLE.

[43107.]—WHEN I asked if it was not premature to assume that we have reached the turning-point of the sunspot curve, I had in view the ordinary smooth curve, in which the degree of solar spottedness in each year is expressed by means of an average number. I suppose it would be hardly correct to assign such a number for the present year till the year is complete, and that we cannot properly say whether 1899 is a minimum year (in the sense indicated) till the character of next year, at least, is ascertained.

Alex. B. MacDowall.

THE MOON AND THE WEATHER.

[43108.]—ONE meets with many dogmatic statements in meteorology, and the truth of these is generally not so apparent as the dogmatism. In the "E. M." this week, we find trotted out once more the view that the moon has nothing to do with the weather, because weather is local. Now there has been published this year a "Traité Elémentaire de Météorologie," by Prof. Angot, an admirable work by a recognised authority, and one which all who want to know the best thought in meteorology up to the present would do well to "read, mark, learn, and inwardly digest." He indicates some new and more scientific directions which the study of the moon in relation to weather has recently taken. Thus the position of the moon in declination is considered not in relation to a particular meteorological phenomenon (temperature, rain, change of weather, &c.), but to the general distribution of pressure on the surface of the globe.

"The fundamental idea of these researches," says the Professor (p. 399), "is that the movements of the moon in declination may cause general displacements of the air, an oscillation (balancement) between tropical regions and higher latitudes, and thus change periodically, e.g., the limit of the trade winds and the law of variation of pressure within the latitude. We can thus understand how the movement of a zone of high pressures, e.g., may bring good weather on one side of the zone, and at the same time bad weather on the other side, and how these variations, contrary at first sight, might nevertheless be due to the same cause. These studies are still too recent and too little developed to have already given results which may be considered sufficiently conclusive and general. It was interesting, however, to refer to them here, for it is by following this course that we shall perhaps succeed in discovering real relations between the movements of the moon and meteorological phenomena, where the older researches have not reached any serious conclusion. *En résumé*, in the present state

of our knowledge it cannot be affirmed that the moon has an influence on weather; but as little can it be denied that such influence may exist. In any case, it might be manifested by complex phenomena, such as the displacement of zones of high and low pressures, and might thus produce immediate results very different in different regions."

I should be glad to know what "S. R." and "F.R.A.S." have to say on this view of the matter, and whether they do not admit Prof. Angot's argument? A. B. M.

THE MOON AND THE WEATHER.

[43109.]—Although I am more than doubtful as to the influence of the moon on the weather, such an argument as that of "S. R." (p. 382) does not appeal to me at all. I take it that those who believe in lunar weather influence do it on the assumption that a tide is produced in the atmosphere. If so, "S. R.'s" objection to an aërial tide—viz., that the weather in London is not momentarily identical with that in other quarters of the globe—either proves nothing, or it proves too much, and would equally well show that ocean tides were not due to the moon. Glatton.

THE "LITTLEMORE" METEOR.

[43110.]—I was pleased to find from your report on p. 378 last issue, that this meteor had attracted special attention. As far as I was concerned it was almost the only reward of three mornings of watching. The meteor burst midway between Castor and Capella, leaving a brilliant stream in its rear of, perhaps, more than 5° in length; time, 5.40 a.m. on the 15th. The direction of the tail was at first N.W., but after some two minutes' observation I was convinced that it was slowly assuming a position differing from its original line of flight, and after about four minutes, when it was still visible, its direction was decidedly N.E. I hope others also noticed this peculiarity.

Northants. Frank H. Wright.

NEWTONIAN—GREGORIAN.

[43111.]—Since I wrote my last letter, I have been busily comparing the performance of my telescope as a Gregorian and a Newtonian, and think some account may be interesting to many readers, even if it bring down on me again the animosity "H." exhibited in his comments on my previous recital.

Testing upon ζ Boötis and η Coronæ as close doubles, both are completely divided with 400, ζ Boötis being rather the closer. There is no advantage in the one form over the other, the G. and N. are equal in results. The angles were estimated at 290° and 340°, and the observations made in August last.

For light test we selected μ Andromeda, and here the comparison was more easily seen in the N., being visible with 1in. less aperture than in the G.; while 4½in. in the one case does it, the other requires 5½in.

For flatness of field, the cluster in Perseus was observed. There the G. had undoubtedly the flattest field. The only planet available has been Neptune. There we got a sharper disc with the N., and only the N. would show the satellite, which was still a faint object. On the moon there is little to choose, but the G. has the flatter field. The N. exhibits all six in θ Orionis; but until now the G. has only shown four, although the small concave is now of solid silver. My optical friend who made it tells me he tests in the same manner as the large concave, but uses a microscope to examine the image.

Can any reader tell me anything of John Birch as an astronomer? I have read that an account of him appeared in an old *Leisure Hour*; but a search of some hours in old volumes has been fruitless, and I am inclined to think the story imaginary.

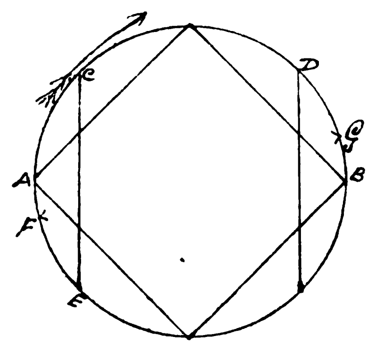
Eli Hay.

INTERNAL COMBUSTION MOTORS.

[43112.]—I have hitherto had nothing to say respecting the above, because I have had no experience with them, and these things are getting very numerous now; the while, from a series of accidents, I have been compulsorily idle. I have attended and witnessed some experiments with a gas-engine. I have stated some years ago that an engine driven by gas could be made very simple; there was no necessity for one half the work usually put on them. I first became acquainted with a gas-engine between 30 and 40 years ago; it was a Lenoir, and it was dismantled; I might say upon a scrap heap. My attention was called to it by an old shopmate. I heard tell and read about them, but had never seen one. When my eye rested upon the cylinder, I asked whatever that thing was for? The cylinder was 2in. thick, 4in. bore, and about 2ft. 6in. long, as near as I can recollect, and the stroke 16in. "Why," said I, "what a preposterous thing!" "What?" he asked. "Why, to make a cylinder like that." The answer was, "My dear boy, you evidently know nothing about it, I can see. You see, the explosive force of gas is so enormous that things are bound to be very strong." "How about a cannon?" "Oh, a cannon is nothing to compare with this." Well, I gave him my theory relative to the action of these things. Well, I said, the explosion is something, but there is no continuous expansive force, and there is no necessity for its being so cumbersome: it is a waste of material without adding to its strength. The action of the gas exploding is only momentarily; a reaction takes place—even the while the explosion is going on a vacuum or partial vacuum, and it is a kicking and sniffing engine to work properly. Well, I never had an opportunity of this until recently; the engine is made on the lines I set down, and very simple, with this exception—there is no turning-valve for the ignition. I maintain that ignition did not ought to be left to chance; that there should be four valves—ignition, exhaust, air, and gas—all independent, and all positive action.

Now in taking in the charge, you cannot get a full charge owing to the heated state of the cylinder; but instead of very near 15lb. as atmospheric pressure, it would be about 12lb., independently of the gases left in the cylinder. Now, when ignition has taken place, an explosion follows—i.e., if the gas and air are in due proportions. What is the result of explosion of the gassed water in the state of miniature globules?—and it takes time to convert that into vapour; and when converted into vapour, there is no mortal power that can expand it to make it occupy the same space that it does before with any pressure. This I have proved by this engine; it is 3⅜in. bore, 5in. stroke, and will run 700 revolutions per minute. It has given out a good half-horse. Now the valves have been adjusted by the springs in various ways, and the best result is when she is allowed to breathe—i.e., sniff, and that she does pretty stiffly immediately after the explosions.

I have given a diagram here for setting the cams, and the cams, as a rule, are not made to open sharp enough: it must be prompt action at the desired points. The points for exhausting seem in a fog. There are several engines—gas, oil, &c.—in my neighbourhood, and they cannot all be right. There is one sounds like a rifle, another like a pistol-shot; another goes with a blob, and another with a cackle; another three shots and a crash, and one three shots and a rest. There is one in a front shop—a large one—that, if you did not see it, you would not know it was there; the while one emits clouds of black smoke and soot, and another exhausts very mildly, with a "sush" and steam. Now these cannot be all right, and I am going to give you my points for the various purposes in the diagram. Let A B represent the stroke. Now, in working, it is very evident that the stroke travels



five times as fast from C to D as it does from E to C. Do not let your ignition take place before C. Your exhaust opens at D and closes at A; gas opens at F; air opens at A; gas and air close at G; then compression takes place with ignition again. There is nothing gained by expansion. By keeping D closed the springs of gas and exhaust and time valve should be strongest, and the air-valve hung as light as possible that it may snift its fill. I have never seen these lines given in print before, and they are very necessary. This does not only relate to gas-engines, but all engines driven by internal combustion and hydro-carbons. The points are four valves positive action each; the air-valve allowed its own sweet will. Early and complete exhaust water in a fine hot spray at the moment of explosion may prove a help; but I do not think there is any certainty of its action, and therefore prove more plague than profit, and the more simple the engine the better.

Jack of All Trades.

SPLICING.

[43113.]—"J. H.," the author of the articles on "Millwright's Work," informs us in one of his works "that fitting is one branch of that extensive practice of engineering to which the whole of his life has been devoted." Hence, as a practical fitter, he will know the importance of "erectors," having a thorough knowledge of the best "practice" in rope-splicing, hemp, cotton, and wire, and I hope he will not slip through his articles on "Millwright's Work" (as I am afraid he is going to do) without treating the matter in as an exhaustive a manner as he has done the jointing of belts.

I am constrained to write you on the above matter from the fact that I know two ways to make an eye-splice and short-splice. I also know two ways of "tucking" strand-ends in long-splicing. I have heard there is a third. Then there is the question what length to allow for splice, some allowing three and four times as much as others.

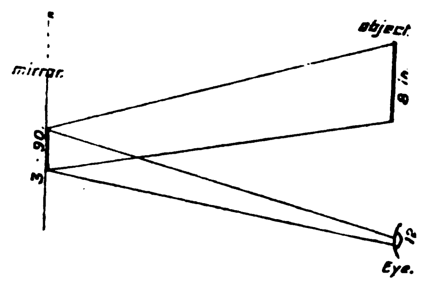
Now, there are many in the same boat as myself whose practice is not extensive enough to ascertain for themselves which is the best "practice," and when we turn to our textbooks they only bewilder us, as witness page 374, fifth series, "Spon's Workshop Receipts" "about 84ft. of rope is required to put in a good smooth long-splice." This refers to a wire rope. Now, would not a quarter of this length make just as good a job, say, in an inch rope? "J. H.," in his "Principles of Fitting," writing on the splicing of cotton ropes, says, "the splice is carried over a length of 4ft. or 5ft." Then in Article XIX., "Millwright's Work," he says not *less* than 6ft. to 12ft. Then he gives below a firm's table which runs from 9ft. to 20ft.

Will "J. H." give us the benefit of his experience, with diagrams, of the splicing tools in use, and I am sure he will earn the thanks of "ours" who, like myself, cried "hang it," when they opened the issue of Nov. 24?

Grenside, near Sheffield. Richard Hudson.

WHERE IS THE IMAGE FORMED?

[43114.]—Mr. Naylor (96871, p. 342) may be assured that I read his reply, and I do not see anything in his reply to induce me to withdraw aught that I have written; but, seeing the marks of the book strong in his reply, I elected to go for the textbooks instead of noticing the reply.



To his second communication I am induced to offer some remarks. In No. 1809 of the "E. M." he gives a diagram which is scarcely correct, inasmuch as that, in dealing with the reflection of an object from a plane mirror, we are dealing with converging rays, not with diverging, and actual measurement will make this plain. Given the observer and object at equal distance from a reflector, the object being 8in. in height, rays from it will converge towards the reflector, and have a measurement of a little less than 4in. Theoretically, supposing the pupil to be ·12in., it should be 3·90in.; the reflected rays converge towards a vanishing point, and enter the pupil before reaching that point.

Is Mr. Naylor in earnest when he asks "what angle?" If he will look to his diagram he will see that his imaginary point with dotted line forms an angle with a line in the plane of his object point, which line is frequently produced in similar diagrams. His imaginary point is simply a mirror ghost, and is an encumbrance to the simple phenomenon of plane reflection. Like churchyard ghosts, which resolve themselves into a bush or a gravestone, or are found to be composed of a hollow turnip, stick, and sheet, so this mirror ghost resolves itself into an optical illusion, not to be found when seriously hunted for.

"Light is composed of vibrations of luminiferous ether." I have seen that before, but don't like it. The phrase is beautiful, but the value of a phrase is in its meaning and consequent adaptability, so we will analyse it to find out if it is able to resolve the question, "What is light?" The first of the three words need give us no trouble; it is evidently used here in its generally accepted sense. The word ether "is a name given to the medium which is assumed in astronomy and physics as filling all space, and capable of transmitting energy, a necessity of the theory of light on the hypothesis of undulations." The scientists knew what they wanted, and have invented a something admirably adapted to their needs, and the intelligent explanation that it enables them to give of a thousand phenomena of nature argues strongly in favour of its being there. They have endowed it with certain properties, as infinitesimal density and enormous elasticity, with consequently the capa-

bility of carrying energy from suns to their planets, and with equal facility transmitting Marconi messages over land or sea. So ether is an assumed something—a hypothetical what-is-it. The meaning of luminiferous is the difficulty. Webster gives "producing, light yielding"; Latham, "conveying, generating light"—the "Imperial Dic."

As it is not claimed that this something either produces, generates, or yields light, we may take it that the word is used in the sense of carrying, and that the carrying medium is as distinct from its burden as the pigeon is from the message which it carries. We may put the sense of the phrase, then, into simple English, thus: Light consists of the vibrations of light-carrying what-is-it. As to the origin of the vibrations and the manner of transmitting I have given my conclusions for what they are worth in the "E.M." Vol. LXIII. pp. 303, 327, 354, 400, 449, and 238.

This hypothetical something is called ether, a bugbear to Brewster and abomination to Leslie, and giving it a name which indicates but a small part of the load it has to transmit, shows the immaturity of idea in its early conception, and since it has to transmit the totality of motion which it receives from disturbing bodies, it might be more correctly named energy carrying or transmitting ether; but as it is distinct from this energy, it is questionable whether any adjective is necessary. Ether is all-sufficient. Mr. Naylor's explanation based upon the provisional name of a hypothetical something can hardly be deemed satisfactory.

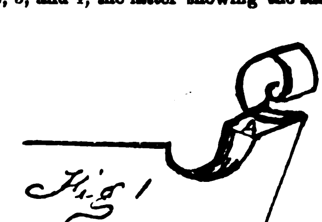
One proof that there is no light outside the eye is found in the fact of a ray of vibrations crossing a dark chamber or box without making its presence visible, unless received directly, or deflected into the observer's eye (see "E.M." Vol. LXII. p. 261). It is answered to this that the light is not on the sides but at the ends of the vibrations, as when they enter the eye, or strike a body, and are reflected. Easily disproved: place a light in front of a mirror so that its rays fall upon it perpendicularly, and if the ends of the rays are light, we should find an image of the source of the rays, and focus it on the face of the reflector. This, I showed in my reply, we cannot do. Here is one of the uses of showing that there is no image on the face of the mirror, nor in it, nor behind it.

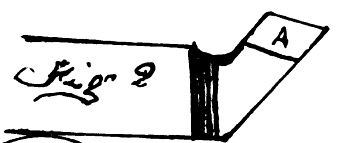
In the well-known experiment with the dead eye, using a bullock's, more easily obtainable than a rabbit's eye, I have seen the inverted reflection of a lighted candle, but it is evidently off the posterior surface of the crystal lens, and very faint. From the fact that some of the rays reflected into an eye are sent back to the eye of the observer behind it, I see some possibility of success in the experiment I suggest; but the distance between the eye and instrument is too short to allow of measurement of the focal distance. Notwithstanding Mr. N.'s dictum, I do not yet consider it as hopeless.

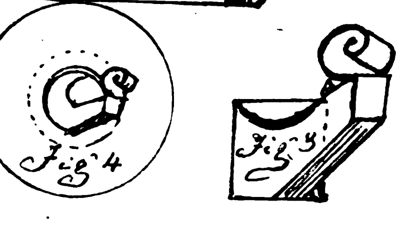
Fred. H. Ewers.

ON ANGLES OF SLIDE-REST TOOLS.

[43115.]—There is no tool that I am aware of that presents its proper cutting angle in a proper position, but the sketch tool, of which I forward sketches 1, 2, 3, and 4, the latter showing the same







for a boring tool. It is the easiest to forge, and can be used by a practical man for anything. It is the tool that I have used for years, and I have been informed that it is the tool used for testing the truth of lathes, before they are passed, and the only tool that can be used for these tests. Fig. 1 is the side—i.e., near side view, Fig. 2 is the top, Fig. 3 end on facing work, and Fig. 9 shows one for boring tool in position.

Jack of All Trades.

POISON IN FISH.

[43116.]—I am very sorry for "L. C." and his family, but am even more surprised at his people partaking of a single fresh whiting than at the evil consequences. Is there not a mistake in the name of the fish? One whiting is usually not more than enough for one person.

Glatton.

MASSES SMALLER THAN ATOMS.

[43117.]—Apropos of the statement quoted by "Density" (p. 383), that molecules are supposed to be all of the same size—a statement universally accepted hitherto—is this assumption in any way affected by Prof. J. J. Thomson's discovery (see p. 128) that atoms are not, as usually supposed, the smallest forms of matter?

Glatton.

USEFUL AND SCIENTIFIC NOTES.

There are fewer applications for letters patent in this country than in 1898. This is largely accounted for by the decrease in the number of patents connected with cycles.

The British Journal Photographic Almanac, 1900, edited by Thomas Bedding, F.R.P.S., consists of 1,516 pages, and is the 39th yearly issue. The principal contents include an article on "Stereoscopic Photography," by the Editor; about ninety contributions on practical subjects by prominent photographers; a series of pithy "Practical Notes and Suggestions of the Year"; an "Epitome of Progress during 1899," giving a *résumé* of the latest important discoveries and advances; miscellaneous information, many illustrations, and the completest collection of photographic formulæ and recipes ever gathered together in one volume. In its many hundreds of pages will be found a mass of information of use to all photographers, professional and amateur.

The "Firewalk" of the Tonga Islands.—In the *Englishwoman* an account is given of the "firewalk," as practised in the Tonga Islands:—A pit about 26ft. long by 16ft. wide was filled with large stones which had been heated for some 36 hours with logs of burning wood placed among them. Men with long poles were removing the blazing wood from the stones, so that there should be no flames. We could all feel the great heat reflected from the stones at a distance of ten or twelve yards, so there was no deception in the matter. A procession of about 40 or 50 men, and a few women, adorned with flowers and fringes, advanced through the leafy glade and halted at the edge of the pit. The leading fire-walkers carried large branches of ti leaves, with which they beat the ground in front of them, and after pronouncing some mystical words, they stepped down on to the hot stones and marched solemnly across the pit with all their followers, singing or chanting the whole time. The procession then marched past us to the edge of the glade, and retraced their steps to the pit, which they crossed at least twelve times. One or two women fell down, and were rather severely scorched. The men said the principal discomfort was the heat on their faces. No one could tell us the real meaning of the performance, and we only heard that it was an old superstition of heathen days.

Fossil Dinosaurs of Wyoming.—There have been set up in the American Museum of Natural History a series of fore and hind limbs of carnivorous and herbivorous dinosaurs from the great fossil beds of Wyoming, whence they were resurrected, singularly well preserved, by scientists from the museum. Dr. J. L. Wortman, who conducted the operations in the Bone Cabin Quarry, where these magnificent relics were found, had perfected field methods by which every piece is kept and transported in the position in which it was found, and this, supplemented by the methods used by the museum authorities, have brought it about that the world's knowledge of those vast and strange creatures, the dinosaurs, soon not only will be practically complete, but almost exact. In the Bone Cabin Quarry, the bones of all of the most characteristic dinosaurs were found mingled, and among them were discovered nine almost priceless objects—six upper limbs complete and three forefeet. In an interesting paper prepared for the museum, Henry Fairfield Osborn describes these finds, and explains their great importance to the scientific world. He says that the late Prof. O. C. Marsh had described five genera of flesh-eating dinosaurs—allosaurus, the largest of the flesh-eaters; creosaurus, a smaller allied form; laborsaurus, still another type; coelsaurus, a small animal distinguished by hollow bones; and ceratosaurus, a large animal with horns on its nose. Two of the huge legs are believed to be those of the allosaurus, or of the creature to which the allosaurus was allied most nearly, the megalosaurus.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96922.]—**Stylographic Ink.**—I invested in a fountain pen, and have been in a terrible fog relative to inks. At last I made up one, as follows:—A few scraped shavings of curd soap, about as much as you could lay upon a threepenny piece, is placed in a teacup, and about 2oz. of boiling water put upon it. When cold, put about ½oz. of "unsweetened" to it. Bottle it for use to rub up with Indian ink, or make your bottle up. This has more than one advantage—it is anti-corrosive, it flows very freely, is black, drys quick, and, if wetted, it will not blur or run, as the paper may be soaked in water (as drawings made by this can be), and strained upon canvas. This is written with some that has been in my pen for over two months put by, and occasionally used to test its keeping qualities. It is indestructible, as it is a carbon ink.

Jack of All Trades.

[96973.]—**Sand-Blast.**—The sand-blast was described in these columns when it was first patented, and it has been used for many purposes since—chiefly, perhaps, for abrading the surface of glass. What "Regent's Park" (p. 322) means by a "vertical tube 2ft. high by 60in. long and 1in. diameter," is best known to himself. The sand-blast can be used with a fan, of course; but unless the work in hand prevents, steam is generally used, as in sharpening files. As to the query, it might be pointed out that when the term "blast" is used that implies that "power" is required. If querist stated the purpose, he would no doubt obtain full particulars.

M. T.

[96975.]—**Fishing Lines.**—"Angles" says he would be glad to learn of a good dressing for fishing lines. He can find many suggestions by searching the back volumes, and knowing the material of which his lines are composed, he can form his own opinion. Had he stated of what his lines are composed, he would no doubt have received many replies. Lines of silk, cotton, or hemp, are, I think, best treated with boiled linseed oil; but they require careful drying, and should never be put away until dry. I do not think there is any better line than the usual oil-dressed silk.

T. L.

[96977.]—**Varnishing Calico.**—For the special purpose what is known as rubber varnish is best; but the calico must be damp or must be dressed with liquor in which a little soap and some linseed has been boiled. The varnish is applied while the calico is still damp. For ordinary purposes a copal varnish will suit; but I suppose "W. M." knows that balloons are not generally made of calico.

M. T.

[96992.]—**Petroleum-Drinking.**—My query (p. 282) referred to a statement that petroleum drinking is at present prevalent in Paris, and asked why it is taken, in what form it is taken, and what are its effects. The reply on p. 323 may have been written with a "good intention," but it does not answer my questions. May I ask whether it is true that some Parisians have taken to drinking petroleum?

W. A. D.

[97003.]—**Rothwell's Engines.**—The replies to this query are most unsatisfactory, because the question deals with a simple matter of fact, and if that cannot be answered correctly, what price "ancient history"? Mr. Stretton says, on p. 302, that the firm had a factory (the Union Foundry) at Bolton; "Regent's Park" (same page) seems to be in doubt, but thinks it was at Bristol. I have little doubt that Mr. Stretton is correct; but what must the querist think of replies so contradictory?

M. E. V.

[97071.]—**Age of Violin.**—Perhaps by Alexander Hardie, sen., who chiefly lived about Dumfries and district. "Scottish Violin Makers" (Kohler) gives "A. H., sen., 1776-1855," and "A. H., jun., 1811-1890." I know two violins by the former—one is stamped "A. Hardie" on back at junction with neck. The best Strathspey player I have heard preferred this violin. From this point of view the tone is excellent.

Pont Hyle Fan, Rhayader. J. Matthewson.

[97121.]—**Geometrical.**—Draw a line from P^1 perpendicular to the base. Make the point where this line meets the base the vertex, and P^1 the focus of a parabola. The curve will cut A B at P^2, the point required.

J. Matthewson.

[97151.]—**Oil-Engine.**—York paving has a crushing weight per square inch in tons of 2·56, 1½in. length of cube; Darley Dale ditto 3·16 tons, 2in. length of cube; strong Yorkshire (mean) ditto 4·38 tons, 2in. length of cube; Park Spring ditto 3·38 tons, 2in. length of cube; all above sandstones. Limestones: Ketton rag ditto 4·01, 2in. length of cube; Listowel ditto 8·33 tons, 1in. length of cube; Longhome ditto 7·68 tons, 1in. length of cube; Moyne ditto 8·03 tons, 1in. length of cube; Irish, various, 5 to 14 tons ditto, 1in. in length of cube, &c.

The safe working of leather belting is 20lb. per inch in width, for each $\frac{1}{10}$in. in thickness of the belt, or 40lb. per inch in width for $\frac{1}{5}$in. in thickness. The breaking strength per square inch of section of best quality leather belting is 3,360lb., ditto best quality stout stitched cotton belting is 6,800lb., ditto of best woven solid cotton ditto is 10,420lb. Foundations (dynamo): If machine is properly proportioned, and if fitted with rigid brush brackets, heavy foundations are not necessary. Many dynamos perform well when merely bolted to flooring of factory, a sheet or two of vulcanised rubber or asbestos being interposed. If placed in basements, keep their foundations separate from house-walls. Weight of engine: Divide the diameter of cylinder in inches by 46 for tons, for cwt., by 2·3 for approximate weight; 50 volts × 4 ampères = 200, or less than $\frac{1}{4}$H.P. electrical, 746 units being 1H.P.; hence your dynamo cannot be very large or heavy. Small gas-engines use more gas as a rule than large ones; possibly 18 cubic feet per indicated H.P. in large, and 25 cubic feet in small. Average pressure about 70lb. per square inch on piston. See "Electric Light Fitting, by Urquhart." No doubt Stuart and Lloyds are likely makers for both engine and dynamo. By a curious coincident *Work* for Dec. 2 gives for gas-engine foundation: Solid mass of Portland cement concrete, solid brickwork also used, but larger excavation required. Best shape as near cubical as possible. If site is near wall, lay concrete floor under footings of wall, and make it form part of same mass as engine foundations. Stone bed-plate between concrete and engine-bed. Holding-down bolts, with anchor-plates at bottom end buried in concrete, placed in their exact positions with aid of templet marked off bed of engine's upper ends, screwed, of course, to secure nuts. Another method is to cast holes in concrete through which bolts pass downwards, in which heads of bolts may be at top, and nuts are tightened up through hand-holes at bottom ends; but this needs a trench for access. Cotters at bottom ends of bolts are easier to adjust than nuts. REGENT'S PARK.

[97177.]—**Cold Feet.**—You had better persuade your lady friends or relatives to knit you some thick woollen socks, or, better still, stockings, and when watching the slide-rest tool in future keep your feet well on the move. You need more exercise to keep up the circulation, and this is exactly what you do not get at the lathe. If you could give the striker man at the forge a spell you would not suffer with cold feet—that is, of course, provided you are in good health. T. J. LENEY.

[97154.]—**Bone Bearings.**—It is a very old saying "That one tale is very good until another is told," and I am sorry that "Hardwood Turner" should have found them a mistake; but I know that there is a mistake somewhere. The saddle-lathe that I have mentioned, from '47 to the fall of '49, I spent many long days with, doing heavy and light jobs in it without any signs of fatigue. The centre was 15in., and I have turned small bone fittings in it for fancy cotton-stands and workbox-fittings, and many small skittle-pins $\frac{3}{4}$in. high, little more than $\frac{1}{4}$in. thick, with a tail or pin to it a bare $\frac{1}{16}$th and $\frac{1}{16}$ths long, for cribbage-pegs, for cribbage-boards, trenchers, or waiters, 2ft. in diameter, and naves for wheels for coaches, carts, and waggons of wet elm. If that was not enough to test them, I do not know what should be. The old chap who it belonged to, I became acquainted with in '40, when I was out of collar. He gave me permission to go and make myself at home there, and do any jobs I could pick up. You must understand that I had been suffering from a long illness—rheumatic fever. He used to come in when I was at work, and any jobs that he had got I would take and do for him. It kept me from rusting. He used to say "I cannot make out how you manage to make the old thing 'gee.' Does it never pull up?" My answer was "No." "Well, well, it is always pulling up with me," he said. Well, I then had no notion of what it was running in; but when warm I smelt a most delicious smell of ham one day. Some theatricals came to town, and, in their combats, i.e., stage-fencing exhibits, they broke some of their swords. At a country smith and wheelwrights, a very little way off, the things were taken to have a new tang welded on. I was at the shop door looking on when the master, looking up, said to me: "Jack, how is that job to be jobbed?" "Oh," I says, "that is easy enough." "With taking the temper out?" he says. "Yes, that is all right." "Well, look here, I will stand a gallon of best ale if you will show me how to do it. Can you do it?" "Well," I said, "I will try if you will let me have the tools and fire." I off with my jacket, and up with my shirt-sleeves. "Is there anything you want? There is sulphur, borax, salammoniac, soda, plaster of Paris, &c." "Nay, I'll have none of them. But some clean silver-sand and two good-sized, long, raw potatoes." "All right." After a few minutes he returned, and with them. "Now, what are you about? You are not a-going to use, or weld the sword tang on with those potatoes and sand?" "I certainly am. I shall not attempt to do it without." He was a bit of a wag in his way, and, scratching his head, said: "Ah! put it in your pocket, eh!" "No," says I, at the same time taking hold of a potato and splitting it. Ran it down to within a short distance of the tang end. Having prepared my fire the while, I mounted the sword tang downwards, through a hole in a hollow fire. "Damn," he said, "but that's good." Well, I done the job, and more than one got tight over it—i.e., elevated. I was free of that shop to do what I liked in it, and free of the scrapheap for material ever afterwards. One day I took home a pair of naves for cart-wheels. "Look you here," he says, "you are an engineer, turner, fitter, or something of the sort. Can you rig me up a lathe?" "Well, yes, but I have no shop or materials." "Just so, then look around and hunt up what you are likely to want." I did so, and fitted him a 7in. lathe or somewhere there, about 6in. or 7in. When done, it went a treat; the old gentleman, my friend, seeing it, tested it, and saw me working it. He was very inquisitive. "What is that bearing made of?" he asked. "Well, steel, and hardened as hard as a stone," was the answer. "Ah!" he says; "and you made it. Would you mind altering of mine, and put a steel bush in mine? The while you are a doing of mine, I can come here, I know, to do what I want." So I dismantled his lathe, and was somewhat staggered by the look of the cone, a perfect black polish, not a scratch or rib in it, a bearing 3in. long. I started pegging away to get the cone-bush out, and when it came, I found it to be a ring-bone of a ham; it had been nicely smoked too. Well, I showed him the affair, and said: "You should never have this altered; it is a mistake, and in a very little time you will find it out. Well, as you like, but it is the most beautiful bearing I have ever seen, or anybody ever saw. Shall I put it back?" "No, no; I want a hard steel bush for it, it always was a nuisance." "Well, don't blame me for what will surely come; the day is not far off when you will be truly sorry for it." I fitted it up, and work having accumulated, I done a good sample of it, when I was called away to another job. In a week he found his mistake out; his bearing had seized, and no amount of oil would make it move in any sense, and when I got back, his bearing was galled all to pieces, and no grinding or anything else would put things right. He offered up a prayer. "The old bush—put it back again." "But that is impossible; the spindle wants re-turning." "Very well, turn it, and put the bush in." "But it will not fit." "Well, make it. Do so. Where is it?" After hunting, he recollected that he had thrown it into the fire. "But we will get another bone and make a bush." But the other lathe had changed hands, so I had no plant to do the job, so I ground it the best I could for a makeshift, until I could see my way to alter it. Day after day he complained of it. The filthy black mess and the grinding and continued cutting of the bearing was cruel; but I could not help him, as I was called away to a job in the Midlands, and I saw the poor old chap no more. Now, if your bone was not prepared, the gelatine would not let the bone dry properly, and when it got hot, which it certainly would, it drives all the grease out, and the sweating would pull you up sharp. Your cone, perhaps, is very shallow and binds. The principal cause of the old gent's pulling up was because he insisted in using the muck that is sold for neat's-foot oil, which is charged with gelatine. When I used the lathe I always used lard. JACK OF ALL TRADES.

[97156.]—**Reflecting Stereoscopes.**—For viewing large pictures may be constructed in three different ways. I will give particulars first of Prof. Wheatstone's design, and then two others by myself. In Fig. 1 two mirrors are placed at right angles to each other in the position shown. The

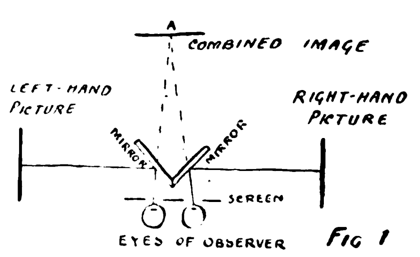


FIG 1

eyes looking into these see the combined image of point A, the same distance behind the mirrors as the actual pictures are from the mirrors. In Fig. 2 let AB represent the two dissimilar pictures, GH the eyes of the observer, and CD the two mirrors, the essential parts of the apparatus. On placing this to the right eye H, the observer will see at point A the image of B in the mirror C, by reflection from B to D, D to C, and C to A. A stereoscope constructed on this principle may be used for any size pictures; but, of course, the larger the pictures the greater must be their distance from the observer. In Fig. 3 four mirrors are employed. The actual dissimilar pictures being situated at A and B. They are seen by reflection at point F. In this instrument the

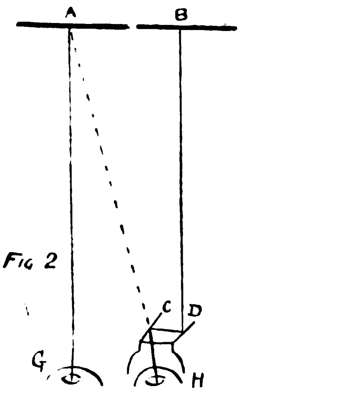


FIG 2

two outside mirrors are fixed, and the two inside ones fixed back to back, and so arranged that they may turn on a centre pivot. Hence, by the move-

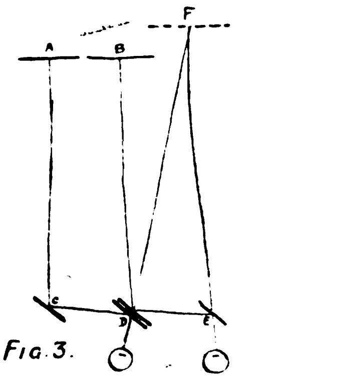


FIG 3.

ment of this centre pair of mirrors the reflected images of A and B are shifted together. THEODORE BROWN.

[97178.]—**Joint and Piston Packing.**—The quickest and cleanest method to make a cylinder cover-joint is with thin rubber insertion. This consists of indiarubber sheet in the centre of which runs a sheet of canvas, the two being perfectly amalgamated. Another good joint which answers equally as well for rough surfaces as machined is made with tar-band and white-lead, mixed with red-lead to the stiffness of putty. Smear the tar-band, apply paste to joint, then run a few rings of tar-band on paste; put on cover, screw up nuts regularly in succession to produce equal pressure all round. This makes an excellent joint for man and mud-hole covers in boilers. To pack stuffing-box on cylinder run nuts of studs, slide the gland along piston-rod, then take spun-yarn well greased and wind round piston-rod two or three times, force into box tightly with caulking-tool, then wind again, and so on till full; bring gland to front of box, put on nuts, and screw up a few turns. In using chalk packing of $\frac{1}{4}$in. and above diameter, I cut it into lengths that will just barely go round piston-rod once, being careful to place joints of rings at different positions in stuffing-box, tighten up gland nuts from time to time to compensate for wear. RICHARD HUDSON.

[97188.]—**Asbestos Packing.**—Asbestos sheet or a skin best; but asbestos powder or filling would practically answer same purpose, if thick enough. REGENT'S PARK.

[97189.]—**Razor - Sharpening.**—Hollow-grounds are usually done with small corundum, emery, &c., wheels. Very often on Continent by Germans. Expect you would have ill-success if not accustomed to it, steel being worked very thin, and many blades giving out ere done. If edge is rounded by stropping, can be brought to flat bevel on edge by placing on perfectly flat hone with little thin oil—lard or machine—letting back rest upon stone, and, with small circular motions of hand, without pressure, grind down bevel until stone-marks meet on both sides in a fine feather edge. For strop use fine, even calf-skin glued to piece of wood, or use canvas strops sold at cutlers' and tool shops. Paste of rouge and olive-oil, or oxide of tin and oil. REGENT'S PARK.

[97190.]—**Launch Boiler.**—The reason for the boiler not steaming well is, no doubt, because the tubes are clogged with soot. Possibly the heating surfaces inside boiler are covered with mud and

scale. If a water-tube boiler, the inside of tubes may be furred up. Clean out boiler with strong soda water, after which thoroughly wash out with plain water. IGNITION TUBE.

[97190.]—**Launch Boiler.**—Why not clean it inside and out. Put in about 1lb. of pure soda, boil with about 5lb. of steam, blow right off altogether; then refill, raise steam again, and allow to cool off before blowing off. The sediment will not then set hard, and can easily be washed out. MONTY.

[97192.]—**Dynamo.**—As you do not give the type of armature, whether drum or ring, nor the gauge of the present wire on the armature, it is not easy to assist you satisfactorily. If the machine were mine, I should unwind the armature, take the gauge of the wire and its weight. I should then rewind the armature with the same weight of a wire having ten times the sectional area. Without rewinding the field-magnets, and presuming these to be shunt-wound, it would probably be necessary only to put the two F.M. coils in parallel to bring down the resistance sufficiently. The speed would certainly not exceed 1,650, and probably would be less. S. BOTTONE.

[97194.]—**Carsak Cell.**—To MR. BOTTONE.—As far as its polarisation tendencies are concerned, the above behaves just like a good Leclanché. It polarises in about twenty minutes, if full current is taken off, and requires a good long rest to recover itself. S. BOTTONE.

[97195.]—**Sizes of Wire.**—To MR. BOTTONE.—As there are 88 yards in ¼lb. No. 24 and only 7½ yards in ¼lb. No. 14, you would need use 11lb. odd of No. 14 to get the same result with the same battery power in the primary. No. 36 runs 1,650 yards to the pound, or practically ten times as much as No. 24; hence 5lb. of this latter would be required. The gauges mentioned are therefore totally unsuitable for a coil of that size. S. BOTTONE.

[97196.] — **Science and Art Department Certificates.**—Write up to the secretary of the above department, stating you intend to become a candidate for examination. He will send you forms, &c., for you to fill in, and give you information as to where you can be examined locally. You can also purchase complete sets of questions that have been propounded in previous years. These will help you very much, in showing you what kind of knowledge you are expected to acquire. Then read up, and, above all, experiment; this is the key to success—practical knowledge. Do not forget to enroll yourself in good time, and to send up your fee for the exam. S. BOTTONE.

[97196.]—**Science and Art Department Certificate.**—You would have to apply to Science and Art Department, South Kensington, about January, for permission to sit. Exams are held annually in May. Fee for each, 2s. 6d. You would not have to attend classes, and the Department would inform you of the nearest centre where you would be required to sit for examination. Get "Science and Art Directory for 1900," price 1s. 6d. It will explain much, and give syllabus of subjects. Suggested books for these exams: Jago's "Chemistry," elementary and advanced, or Newth Thornton's "Elementary Physiography," and Simmons's "Advanced Physiography"; Poyser's "Elementary and Advanced Electricity," or Silvanus Thompson's "Electricity." Write to Science and Art Department—they will give all information. CLARA.

[97196] — **Science and Art Department Certificates.**—The querist can "sit" at any of the centres appointed for examinations to be held. He should procure the "Directory" (price 6d.) published by Eyre and Spottiswoode, and to be had through any bookseller. It is a pity that "Lux" cannot attend some class, as he would probably benefit by contact with other students. For example, what does he mean by "I teach myself"? How is that possible? M. T.

[97197.]—**Change of Wheels.**—Rule 1: Place number of threads per inch of leading screw for numerator, and number of threads per inch of screw to be cut for denominator; add cipher to each, which gives required change-wheels. Example: To cut screw eight threads per inch, with leading screw two threads per inch.

$$\frac{2 \text{ threads leading screw}}{8 \text{ threads in screw to cut}}$$

Adding cipher $= \dfrac{20 \text{ driver}}{80 \text{ driven}}$ Wheel representing numerator is placed on lathe spindle; wheel representing denominator placed on the leading screw. Rule 2: When number of threads to be cut is uneven—say 2¾ threads per inch—multiply the whole number by the denominator of fraction, and multiply also number of threads per inch of the leading screw by the same multiplier.

$$\frac{2 \text{ threads per inch in leading screw} \times 4}{2\frac{3}{4} \text{ threads per inch in screw to be cut} \times 4}$$

$$= \frac{8}{11}. \text{ Add cipher} = \frac{80 \text{ driver}}{110 \text{ driven}}$$

When numbers of teeth of wheels found by this rule are too large, they may be reduced by dividing them by any suitable common divisor; and, if too small, may be increased by multiplying by any suitable common multiplier. When double train or four change-wheels are used, fix in any three wheels for lathe-spindle and stud-wheels, and fourth or leading screw-wheel may be found by Rule 3: Multiply number of teeth in wheel on lathe-spindle by ratio of screw to be cut and leading screw, and by number of teeth in second driver or stud-pinion, and divide the product by number of teeth in first driven wheel. Thus, to cut a screw of 16 threads per inch, with a leading screw of two per inch, the ratio is 8 to 1. Lathe-spindle wheel 20 teeth, stud pinion or second driver 50 teeth, stud-wheel or first driven wheel 80 teeth; required number of teeth in leading screw-wheel. $\dfrac{20 \times 8 \times 50}{80} = 100$ teeth. Above will cut right-hand thread. To cut left-hand thread:—Place another wheel between a driver and a driven wheel to reverse the motion of the saddle. Rule 4: The wheels may also be found by assuming pair of wheels in conjunction with Rule 1, say, $\dfrac{100}{100}$, and by dividing one of the drivers and one of the driven wheels by any suitable number. Thus, to take screws in last example—

$$\frac{2}{16} \quad \text{Add cypher} \quad \frac{20 \text{ driver}}{160 \text{ driven}}.$$

Assume pair of wheels $\dfrac{100 \text{ driver}}{100 \text{ driven}}$, then, by dividing first driven wheel and second driver by two, the required wheels are $\dfrac{20 \;\; 50 \text{ driver}}{80 \;\; 100 \text{ driven}}$. Rule 5: Proof of correctness of change-wheel when screw to be cut is finer pitch than leading screw, multiply driving-wheels together, multiply driven wheels together, and divide greater product by lesser. The quotient, multiplied by number of threads per inch of leading screw, gives number of threads per inch of screw to be cut. To prove wheels in last example, $\dfrac{80 \times 100}{20 \times 50} = 8 \times 2 = 16$ threads per inch in screw to be cut. Coarse pitch screws. Rule to prove: Multiply driving-wheels together, also driven wheels; ditto product of driven wheels by number of threads per inch of screw, with which product divide product of driving-wheels. Thus—

$$\frac{50 \times 100 = 100}{20 \times 25 \times 25 \times 2} = \frac{500.000}{25,000} = 20\text{in. pitch, \&c.}$$

See W. S. Hutton. REGENT'S PARK.

[97198.]—**Screw Gear-Wheels.**—If you refer to reply No. 96711, p. 212, Oct. 13, 1899, you will get the lines and for the angle-plate to cut them. You must not attempt to cut them between centres as a screw with your change of wheels, or you will break your wheels up. Why not make angle-plates to put upon surface-plate of lathe? There is not much trouble, and then you can cut them with a single point in the rest. Your wheels are not in it the other way you speak of. You might manage the 20 teeth, but the 10 the angle is too much for your stud; it would sheer it off, I am afraid. In the page I have mentioned is every information that ought to put you right for the job. If you don't comprehend, state your difficulty. The price asked for the cutting of these up would more than pay you for fitting up angle-plates for the job, and you would not be tied for pitch, and, therefore, the diameter of wheels. JACK OF ALL TRADES.

[97199.]—**Hertzian Telegraphy.**—To MR. BOTTONE.—(1) No. Lead in with ordinary copper wire. (2) It does not matter whether the home coherer does act during transmission, as it is not generally prevented from acting; but it can be prevented by shielding with a metal cover, and by metallically connecting the two wings. (3) The waves can be directed by means of parabolic reflectors, as even by lenses made of pitch; but the usual plan is to use wings and syntonisers of different capacity both on sending and on receiving instruments when speaking to different stations. It is seen that there is room for much improvement in wireless telegraphy. S. BOTTONE.

[97201.]—**Dross from Type Metal.**—This is usually run out either by crucibles or reverbatory furnace. J. W. Woolford, 73, Boundary-road, Barking, has a patent furnace specially for this work. W. G. CLEARE.

[97201. — **Dross from Type-Metal.** — Have small cupolar furnace, 3ft. or so diameter, and 4ft. high, or larger if you prefer, or smaller. REGENT'S PARK.

[97202] — **Gas-Engine Piston Rings.** — A piece of cast-iron tube of the right size is gripped in a chuck and turned on the inside, after which the outside is roughed down to nearly the proper size. It is then cut off to the right width by a parting tool. The ring is then put in a tool and clamped up tightly, and driven between the lathe centres and the finishing cut taken; it is then cut in two to make it springy, and is then ready to put on the piston. IGNITION TUBE.

[97203.]—**Ivory Dust.**—Immerse in somewhat diluted solution of a mineral or vegetable acid. Maceration quickened by heating in water bath to 95° to 100° Fahr. Strain and compound with three-quarters of volume of ivory glue free from excessive moisture by air-pump. Mix mass with solution of copal in alcohol, and pour into sulphur moulds where it soon becomes hard. Has appearance of genuine, then plates of it as translucent, and can be dyed. Magnesite or petrifite being also a very plastic and mould-taking material, white in colour, mixes with almost anything, would be a useful adjunct. The price, however, is somewhat high, say 6s. or 7s. per cwt. at Blackwall depot. REGENT'S PARK.

[97203.]—**Ivory Dust.**—Clean ivory dust stewed makes excellent jelly, and the refuse is a valuable manure to mix with potting mould. I suppose it is now worth more than it was twenty years ago, when I used it for making jelly. The ivory-turners and cutters are glad to get rid of it, as in heaps it is liable to heat and spontaneously combust, especially if it is that obtained by the cutting of ivory slabs for making pianoforte keys, as they are cut when wet. Clean ivory dust has a considerable market value, and is readily sold to the restaurants and to chefs. I do not think it can be moulded up into "objects" with so much profit. Several other materials are cheaper. S. R.

[97204.]—**Daniell Battery.**—(1) No, because the internal resistance is so great. It can be done, but the cells must be very large—say 1gal. size. (2) 1·079 volt. (3) Resistance varies with size of cell, distance of elements apart, &c. Average for 1pint size 10ohms. (4) By melting zinc, and adding to it its own weight of mercury, stirring with a stick, and allowing to cool. S. BOTTONE.

[97205.]—**Inkblots.**—Put on concentrated solution of chloride of lime, eau de Javelle, or oxalic acid—either will do. As soon as marks disappear, blot off as quickly as possible with clean blotting-paper, and wash thoroughly, as any of the above will spoil a print if they are not removed soon. The exposure depends so much upon local circumstances, sun, time, &c.; but, as a rule, exposure for snow is only about half what it would be without snow. CLARA.

[97207.]—**Multiplate Wimshurst.**—To MR. WIMSHURST OR MR. BOTTONE. —If by trunnions you mean the bearings, then I can only say that in all cases the moving parts should be bushed with either brass or steel tubes, these, of course, being covered with wood. The main driving-spindle must be of steel, and this has a wooden sleeve round it, which carries the wooden pulleys. The holes in which this spindle rotates must be bushed with brass tubes. The upper spindle is also of steel; but, as it does not rotate, the bearing holes do not require bushing. On the other hand, the bosses which bear the plates do rotate, so they must be bushed. All this woodwork should be polished after having been soaked in melted paraffin wax until the pores are well filled in. As the upper spindle is in the centre of the plates practically at a neutral point, it does not affect the machine injuriously. But keep the standards as far as you conveniently can from the first and last pair of plates. S. BOTTONE.

[97207.]—**Multiple Plate Wimshurst.**—In reply to "T. M. C." By far the best bosses for these machines, are made of well-seasoned yellow pine with brass tube through its centre. The best way to proceed is to select a length of polished steel rod of suitable size and length; then obtain a stout brass tube which fits the spindle closely. Cut this tube into suitable lengths. Next cut up your pins into suitable lengths, and size to form the boss. Bore a hole through these "length" way of the grain, and force in the short lengths of brass tube; put a mandrel through the tube, and then turn up the boss, leaving a slightly projecting spigot to fit the holes in the glass. Next get some vulcanised fibre about ⅛in. thickness, and cut-out washers; the hole in these fits upon the tube. This washer cements to the glass with Chatterton's compound, and takes the screws which attach the glass and washer to the boss. It is disadvantageous to have any more metal than the spindle, the brass bush, and the screws. J. W.

[97208.]—**Voltage.**—Voltmeter A showed the voltage or pressure needed to drive the current through the resistance of the lamp and the battery in circuit. Voltmeter B showed the lesser pressure needed to drive the current against the E.M.F. of the battery, and its resistance only. The "fall of potential" in the lamp, &c., was 69½ volts or thereabouts, and that in the battery 10½. Querist might possibly state his difficulty more in detail.
Belfast. J. BROWN.

[97209.]—**Incandescence.**—To MR BOTTONE.—Mr. W. H. Preece made a series of experiments to determine the ampères required to fuse wires of different metals of several sizes. Tables showing these may be found in almost all textbooks. Platinum wire 1 millimètre in diameter takes 20 amps. to fuse it. One foot of this wire has a resistance of

about $\frac{1}{10}$ of an ohm; hence any battery giving 2 volts, and having *no* internal resistance, would fuse it, since $2 \div \frac{1}{10} = 20$. But no such battery exists. We have several, however, the internal resistance of which is below $\frac{1}{10}$ ohm. In practice, nothing would be better than two large-capacity accumulator cells in series, say L 11 or L 15. The next best would be two chromic-acid batteries, gallon size, in series. S. BOTTONE.

[97210.]—**Steel-facing Copper Plates.**—To MR. BOTTONE.—Your 50v. dynamo is utterly unsuited in every way for this work—first, because the voltage is too high; second, because you do not wish to use more vats than one to balance this; third, because it is series-wound. Read Bonney's "Electro-Plater's Handbook" for fuller details. S. BOTTONE.

[97211.]—**Cockroaches.**—The querist can, with a little perserverance, rid his kitchen of cockroaches. He should put down a few heaps of the well-known insect powder—about a tablespoonful here and there—and, when the morning arrives, he can sweep up the stupefied specimens of the genus Blatta, and consign them to the flames. I live in a locality where cockroaches spread in a very lively manner; but we have cleared the house, and when we see a fresh arrival down goes some insect-powder in likely haunts (warm and damp), and we soon get rid of the pests. The insect-powder is the ground flowers of the Pyrethrum roseum, of Dalmatia and Asia Minor. It is well known. S. R.

[97211.] — **Cockroaches.** — Borax, red-lead, carbolic acid, corrosive sublimate, poke soot by themselves or in solution are enemies to such; but it is rather doubtful whether in the form of mortar or ordinary make they would have original effects can only be the test of experiment. REGENT'S PARK.

[97213.]—**Chaff-Cutting.**—In your case I should use a 1¼in. hemp rope drive, using pulleys about 5ft. diam. at least, with supporting pulleys and an idle tension weight pulley at end to take up slack and avoid resplicing, which is always a trouble. This is cheapest and best way to do it. MONTY.

[97213.]—**Chaff-Cutting.**—The simplest means of working your chaff-cutter would be by electricity. You would require a small generator and motor, cable, &c. It would not be cheaper in the end to buy a small oil or gas engine, especially as you have a steam-engine.

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[97213.]—**Chaff-Cutting.**—Forty yards is a good distance. If you have roller bearings on your cutter instead of common bearings, the friction of sliding is eliminated. The safe tension of leather belting is 20lb. per inch in width for each $\frac{1}{16}$in. in thickness of belt, or 40lb. per inch in width for each ⅛in. in thickness. Breaking strain per square inch section of best leather belting is 3·360lb.; of best quality stout stitched cotton belting is 6 800lb.; of stout solid woven cotton belting is 10·420lb. One would think a suitable oil or gas-engine for the cutter would be best. REGENT'S PARK.

[97214.]—**Softening Brass.**—Both brass and copper are softened by heating and hardened by pressure. In the case of brass, however, I find that heating to a red in a fire often spoils it—probably some action between the zinc and the copper—and it breaks readily; therefore heat the brass without actual contact with fire, and it can be bent into any shape; then to harden hammer it, roll it, or, if wire, draw through a plate, and it will become hard and springy. Copper wire is not injured by making it red hot—apparently at least—and is hardened again in the same way as brass—by pressure. Querist can easily make an experiment with a bit of wire heated in a candle flame, and then hammering it on a slab. S. R.

[97214.]—**Softening Brass.**—Heat to low red heat, and plunge in salt water. REGENT'S PARK.

[97214.]—**Softening Brass.**—Brass is softened by heating to a red heat, and cooling quickly in water, being just the opposite to that of steel. Brass is hardened by pressure, as passing through the rolls or hammering. To get the best results with spring brass, a special mixture of metals is used. For small quantities, careful hammering should answer. This is frequently done in the workshop if the metal happens to be soft, and is required hard. Wire is drawn through a hole smaller than the stock. WM. PROBERT.

[97214.]—**Softening Brass.**—Hard brass can be softened by heating until it turns a slight blue colour. It can be rehardened by compression, such as hammering or passing through rolls; the latter would be the method used for sheet brass such as you describe. T. J. LENEY.

[97215.] — **Hektograph Stains.**—Mixture of aquafortis and water, or oxalic acid and water, rubbing parts by means of cork, till colour is restored. Afterwards wash well with water, and dry and polish as usual. REGENT'S PARK.

[97219.]—**Rope Drive.** — For a small drive like this, if you wish to get satisfaction, I should advise you to throw out rope-drive altogether, and substitute a Dicks' belt. It will run equally silent, and, if first put on with a jump-joint fastener, then, after a month's run, it should be tightened, and an endless splice made, which Dicks's people will do very cheaply. You will then have a belt which will run for years without any further attention whatever. It will not stretch or slip, and is not affected by damp or heat appreciably. I have seen hundreds in use for some years, and know what a boon they are; and have also had considerable experience with rope-driver, using both endless system and multi-rope, and, except for very large driver, think it is greatly overrated, and, in many cases, belts would be preferable. With the single-rope system it is equally impossible to get tension on all strands alike, as with the multi, which you can easily see by watching sag of ropes while running. Use a three or four ply thickness of belt, certainly not more than four, and, if to transmit much power, increase width of belt instead of thickness. You will find it repay first cost in less than 12 months. Your pulley is far too small for satisfactory driving with ropes. MONTY.

[97219.]—**Rope Drive.**—In my query, p. 388, I meant to say the rope has to be very flexible, so I use cotton—not "collars," as it has been interpreted, probably owing to my indistinct calligraphy. What I want is a flexible but strong rope that will not continue stretching in use, as the cotton rope appears to do indefinitely.
Belfast. J. BROWN.

[97219.]—**Rope Drive.**—We should recommend you to have five separate ropes, as each rope would take up its share of the pull, and the tendency to stretch would be equally reduced.

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[97220.]—**Sizes of Wire.**—To MR. BOTTONE.—You cannot do better than procure Allsop's "Electric Light Fitting." S. BOTTONE.

[97223.]—**Staining Deal Cabinet.**—Remove varnish with some detergent. If necessary, stain, then polish. To as much yellow ochre as you can take in your hand, add half-teaspoonful Venetian red. Mix to thickness of paint, or rather thinner, with glue size. Simmer mixture for some time in pan, stirring well. Apply, when dry, sandpaper, and polish with French polish, or, if preferred, turpentine and beeswax. If deeper colour is required, add more Venetian red. REGENT'S PARK.

[97227.]—**Wimshurst.**—In reply to the question of "W. G. C.," may I first advise 12 plates, for he will then have the driving bands, and the brush holders uniform and a more symmetrical machine: (1) I prefer glass, it is better in many ways to ebonite; but it is very free to breakage. This latter is a consideration. (2) There is no advantage in making the driving pulleys of ebonite instead of wood. (3) Brushes made of fine gilt lace wire answer all purposes they last for a year or two, and the wire is only 6d. per ounce, or thereabouts. Get ½oz.—it will answer for three or four machines. (4 and 5). Tinfoil of the best and thickest quality is better than brass for the sectors—it lasts many years. The expansion and contraction of brass cause them to frequently break off the plates, no matter what cement is used. (6) Glass rod is best to support the collectors. (7) The machine never reverses under excitement. (8) Unless sectors are used, the machine is not self-exciting, except only when all is new. I have occasionally shown them at meetings many years ago; but they are most unsatisfactory. (9) Condensers are neither desirable nor necessary for X-ray work, except perhaps when the tube is very hard. (10) Get the archives of the Röntgen Society. (11) The secretary is F. H. Low, M.B., 12, Sinclair-gardens, West Kensington Park, W. J. W.

[97228.]—**Blue Printing.**—Potass. ferricyanide 2½oz., water 10oz., ammonio-citrate of iron (ferric salt) 2½oz., water 10oz. Two solutions dissolved separately and mixed, kept in the dark. Smooth surfaced paper is coated by means of a sponge, crossing strokes obliquely to get as even a coating as possible. As long as paper is actually covered, streakiness matters little. CLARA.

[97228.]—**Blue Printing.**—Ferricyanide potash, bichloride mercury, oxalic acid, iron and ammonium citrate, borax, nitrate silver, hydrochloric acid, iodide potassium, uranium nitrate, potassium oxalate, and potassium chloride. REGENT'S PARK.

[97228.]—**Blue Printing.**—A sensitising solution for these can be prepared as follows:—Citrate of iron and ammonium 44 grains, dissolve in water ½oz., then dissolve 35 grains of ferricyanide of potassium (red prussiate of potash) in another ½oz. of water. When the above are dissolved, mix the two solutions. This will form 1oz. only of solution; but, of course, you can increase the quantities by simple multiplication. Conduct all the operations by lamp light. On mixing the two solutions a precipitate will form, but there is no necessity to filter this off. Proceed to coat the paper, using a clean sponge or rag, and making the strokes in one direction, and afterwards crossing them in order to get a uniform coating. This will colour the paper a dirty brown, which will, however, rapidly change on drying to a greenish yellow. Allow the paper to dry, and when dry roll up and keep dark. It will be better for standing a day or two before using. To print, place the prepared surface in contact with the back of tracing to be copied in a printing frame to sunlight until detail is almost lost, which usually takes about five minutes in direct sunlight; remove from frame and wash in water face down until water ceases to be coloured green, usually three changes are sufficient. Use smooth faced paper, and, if possible, shrink it first, and see that the ferricyanide is of good quality. T. J. LENEY.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Expansion of Rails.—The following figures, relating to the expansion and contraction of railway rails, 30ft. long, but of different weights, have been obtained by actual experiment in America:—Contraction caused by change of temperature from 5° above zero to 20° below zero, 56lb. rail contracted $\frac{3}{16}$in., 75lb. rail $\frac{3}{16}$in., 85lb. rail $\frac{3}{16}$in.; expansion caused by change of temperature from 5° above zero to 70° above zero, 56lb. rail $\frac{1}{12}$in., 75lb. rail $\frac{1}{16}$in., and 85lb. rail $\frac{1}{17}$in. Several railroads in the United States are using rails 45ft. and 60ft. long. They have not, it appears, proved entirely satisfactory.

Coal in Canada.—The coal areas of Canada are estimated at 97,200 square miles, not including areas known, but as yet undeveloped, in the Far North. There are (1) the coalfields of Nova Scotia and New Brunswick, (2) those of the North-West Territories, (3) those of the Rocky Mountains, and (4) those of British Columbia. The coal areas of Novia Scotia cover about 635 square miles, and are divided into the Cape Breton, the Picton, and the Cumberland basins. The workable thickness of the coal is very great. In Cape Breton it ranges from 25ft. to 60ft., in Picton to at least 70ft., and in Cumberland at least 30ft. The fixed carbon averages from 58 to 60 per cent., volatile combustible matter 29 to 37 per cent., water 0·75 to 1·46 per cent., and ash 3·25 to 9·34 per cent.

Cost of Electrical Conductors.—A method for calculating the costs of electrical conductors made of copper, iron, or aluminium was recently given in *L'Industrie Electrique*. For a line of given length and resistance the weight of the conductor is proportional to the product of the specific resistance and the specific gravity of the material used. This product for iron is 78, for copper 14·24, and for pure aluminium 7·54. Thus we see that if aluminium costs about twice as much per pound as copper, the cost of the line will be the same for these two materials. The actual weight of a line will be $W = 0\ 000205 \frac{L^2 r S}{R}$, where W = weight in pounds, L = total length of wire in feet, r = specific resistance in microhms per cubic centimetre, S = specific gravity, and R = resistance of line in ohms.

QUERIES.

[97233.]—**Isle of Man Steamers.**—Will any kind reader oblige with particulars of the steamers *Duchess of Devonshire*, *Empress Queen*, and *Tynwald*, especially the first- engines, size, speed, pressure, &c.? as I spent a portion of holiday there, and boat-trips were very numerous. I should also be glad of the distances in miles from Douglas to Fleetwood and Liverpool and Ardrossan and Belfast, as we travelled in remarkably short time.—MANX VISITOR.

[97234.]—**Model Boiler Blow-Lamp.**—Will any reader give some idea or sketch, or refer me to a suitable blow-lamp burning benzoline for generating steam in a model boiler quickly? I find charcoal soon burns out, and methylated spirit is too weak.—AMATEUR.

[97235.]—**Melting Old Brass.**—Is it possible to melt old brass on a smithy fire for small model castings? Will it want anything mixed with it?—ANXIOUS.

[97236.]—**Chimes.**—Can any of "ours" inform me of the musical relation between the hour-bell and the chimes known as the Westminster chimes, and also the Cambridge chimes? I mean that supposing the Westminster chimes rang, say, in the key of G major, what is the correct note for the hour-bell. It seems that as G is the dominant of C major, C would be the note.—WESTMINSTER.

[97237.]—**Jewish Calendar.**—I should be glad if "F.R.A.S." would kindly answer the following queries: (1) What is the exact method of determining the commencement of the Jewish months? I find, from *Whitaker*, that it sometimes corresponds to the day of new moon, and sometimes to the day following. And this anomaly does not seem to be accounted for by the fact that the Jewish day commences at sunset. (2) Is it possible to determine on what day of the week new moon, or the 1st of Nisan, occurred in A.D. 31 (or was it 30?) the year of the Crucifixion? If so, we should then know on what day the eating of the Passover (14th of Nisan) occurred—whether it was on Thursday, the day preceding the Crucifixion, according to the first three Gospels, or on Friday, the day of the Crucifixion, according to the 4th Gospel. Or possibly it might be found that it occurred on some other day.?—STUDENS.

[97238.]—**Truing Emery Wheels.**—Can any reader supply instructions for truing up emery wheels in the lathe, and what kind of tool is used?—G. BOUSFIELD.

[97239.]—**Motor for Safety.**—Can any reader tell me what horse-power oil motor is required to drive a safety bicycle at 12 miles an hour, and which kind of motor and driving gear is most suitable?—G. BOUSFIELD.

[97240.]—**Invalid Carriage.**—Will someone give a sketch of an invalid carriage with side levers and crank, for invalid to work it himself?—S. REYNOLDS.

[97241.]—**To Mr. Bottone.**—I want to make a ½in. spark induction coil. Could you kindly tell me the length and diameter of iron core, size, and number of convolutions of primary wire and weight, and also weight of secondary wire and gauge, and number and dimensions of sheets of tinfoil for condenser, and would sheets of mica do instead of sheets of paraffined paper to separate the sheets? What battery power would produce the maximum spark?—G. EVANS.

[97242.]—**Plating Dynamo.**—I should be obliged if some reader would kindly tell me how to wind, and what size wire to put on, field-magnets and armature for nickel plating. It is a model Siemens pattern. The size of field-magnets and H armature are—field-magnets, 2in. by 2⅛in. winding space; armature groove, 2in. by ⅜in. by 5/16in. How much wire shall I require?—SECULARIST.

[97243.]—**Razors.**—I should feel extremely obliged if any of your numerous correspondents could tell me how, in a simple manner (if possible), to distinguish a hard razor from a soft one.—H. NEWTON.

[97244.]—**Grammaphone Experiment.**—I shall be much obliged if someone will help me out of this difficulty. I have been experimenting with a grammaphone, and have succeeded in taking the sound from both sides of the diaphragm at the same time, with a much louder result, as may be imagined. A little while ago I thought of using two diaphragms and two needles. This I did, and arranged the two diaphragms so that the needles were ½in. apart, getting an excellent result—in fact, twice the volume of sound. But what I want to know is this, Why do the two needles reproduce the sounds simultaneously? I can get the two needles very nearly 1in. apart (of course, in the same groove) before I can detect any "see-sawing" in the music or sounds. Of course, as there is double the weight on the sound-box arm, I have counterbalanced this with an extended arm and weight on the side away from the record.—LA VILCOQ.

[97245.]—**Horse-power for Car.**—What formulæ are there for finding the horse-power required to drive an electric car of a given weight on a given incline, and what would be the size of cable and trolley wire required? What would be the loss per cent. of theor. power derived from a waterfall transmitted to a car?—ANXIOUS.

[97246.]—**Air Heating.**—I am anxious to know if there is any formula or scale for determining the amount of heating surface necessary to heat air from 32° Fahr. to any temperature up to 500° Fahr.? For instance, how many feet super. would be required to maintain a temperature of 40° Fahr. in a room containing 3,000c.ft. when the outside temperature is 32°?—NEMO.

[97247.]—**Static Machines and X-Ray Work.**—Will someone kindly tell me (preferably "J. W.") as to (1) whether an eight-plate 24in. diameter Wimshurst can be worked by hand, and what length spark it would be likely to give? (2) I have a two-plate machine, which gives when forced an 8in. spark. What would be the right length tube exhaustion to procure? (3) In the machine mentioned which took a photograph of a thorax in four minutes and a half, what was the kind of machine, the length of spark and tube, and where could I procure a similar machine? (4) Is there any work written on this subject from a practical point of view?—SCALPEL.

[97248.]—**Compressed Gas as Motive Power.**—Can any correspondent give information upon compressed gas for motive power, and, if possible, give the address of any maker of small compressed gas-meters? I believe a car was designed for compressed gas, but I never heard with what result.—W. W. J.

[97249.]—**Vertical Boiler.**—What can be done to prevent corrosion of the inner plates of a vertical boiler which has to stand ten months in the year?—CHEMICUS.

[97250.]—**Phonograph.**—Will some correspondent oblige by reporting on the performance of the double diaphragm reproducer recently described in this journal?—SOUTH AFRICA.

[97251.]—**Parrot Cage.**—I have a parrot cage which I cannot use on account of a blackish grease rubbing off the wires on to the bird. This grease in the course of a week got all over the bird, so that I had to transfer it to another cage. If I rub a wire between my finger and thumb, I get a deposit something like lead. Can any reader suggest a remedy? The cage is an expensive one, but I do not know the maker's name. The bands bear a mark, "Mohr's Patent Indestructible."—SOUTH AFRICA.

[97252.]—**Telescope.**—A telescope has recently come into my possession, the object-glass of which is not cemented. When I cement it it will no longer focus. What is the reason, and the remedy, please? I do not think the o.g. is the original one, as a liner has been put in to reduce size of cell from 2⅝in. to 2⅜in.—SOUTH AFRICA.

[97253.]—**Crankshaft.**—I have a 3½in. cylinder, 5in. stroke. Would any kind reader tell me the diameter of crankshaft, crank-pin (overhung crank), piston-rod, and valve-spindle 80lb. pressure? Also rule for working out the same would be thankfully received.—ROBERT CRAWFORD.

[97254.]—**Covering for Bandsaw Pulley Rims.**—Can any reader give a good way of fastening leather on pulleys of bandsaw? The way I do at present is to get enough good leather to go round pulley and join end to end with cobbler's twine, then cover pulley with glue and spring leather on tight; when dry, pegging with wood pegs about 6in. apart on both sides of rim. But I find the leathers work loose after a few days' work.—SAWYER.

[97255.]—**Steam Turbine.**—Will any kind reader supply sketch of machinery of the above, as I wish to make one to drive small dynamo about ½H.P.? Also size of boiler and pressure required? Do they require very accurate making?—ANXIOUS.

[97256.]—**Windmills.**—Where can I get up-to-date information about windmills, &c.? Also, could any reader give instructions for making an instrument for accurately measuring wind-pressure and velocity?—ALTERNATOR.

[97257.]—**Coherer.**—Could any of our kind friends give details of construction of the latest and best form of coherer for wireless telegraphy? I should also be much obliged for any details of construction of a small alternator to give very high voltage for Tesla effects. Also for particulars of the latest form of the Wehnelt electrolytic current-break.—ALTERNATOR.

[97258.]—**Annealing.**—Will any of "ours" explain how to anneal small steel stampings and steel castings? I have tried charcoal, &c., in boxes and heated slow, but still some come out very hard.—R. W.

[97259.]—**Keeping Oil-Engine Cylinder Cool.**—I should be glad to know the best way of keeping oil-engine cylinder cool, without using water, for a 2H.P.? I want to save the trouble of taking water about with the motor. I want to use engine for motor-car. What I want is a superheated cylinder?—A CONSTANT READER.

[97260.]—**Electric Sparking Plug.**—Will anyone please say what is the most suitable cement to use for jointing the brass terminal and conducting wire to porcelain plug as fitted to the De Dion motor? Any information will oblige.—F. W. B.

[97261.]—**Pattern Making.**—Will some reader help me in the following matter? I wish to make several patterns to obtain malleable iron castings from, as I only want two or three of each kind. I do not want to go to more trouble than possible. I have had no experience at all in this matter, so wish to know if I can make the three following patterns solid, or shall I have to make them in sections? (1) Hub, same pattern as ordinary cycle-hub, only much larger; (2) pulley-wheel, with double flange on to keep belt from slipping off; (3) cap for screwing on to end of hub pattern, similar to shallow teacup. A reply to this will greatly oblige.—METAL TURNER.

[97262.]—**Frogs.**—Can anyone tell me what to feed green tree frogs on during winter?—M. FAKER.

[97263.]—**Organ Building.**—I read with much instruction the articles on above subject by Mr. Matthews in "Ours" some months ago. But as the stops I have at hand are somewhat different, would any reader give me some advice as to their allocation, and the smallest dimension of bellows that they will require to carry them on a 2in. wind? Would the following specification answer well?

Great Organ.

Open Diapason, 8ft (metal)	56 pipes.
Principal, 4ft. (metal)	56 „
Piccolo, 2ft. (metal)	56 „

Swell Organ.

Stopt Diapason 8ft. (wood)	56 pipes.
Flute, 4ft. (wood)	56 „
Gamba to Fid. G, 8ft. (metal)	37 „
Vox Angelica to Tenor C, 8ft. (metal)	44 „

Pedal.

Double Stopt Diapason, 8ft. (CCC to BBB).	12 „

—BACKFALL, Edinburgh.

[97264.]—**Glass Harmonicon.**—I should be glad if any of your readers could give me information as to how to construct one of these. I wish to know the greatest compass that can be used, the most suitable thickness of the glass, and whether there should be a constant proportion between the length and breadth of the strips. I think I should have no difficulty in fixing the strips, and only require information as to the glass portion of the instrument.—WYNFELL.

[97265.]—**Orion.**—Will "F.R.A.S." give me the R.A. and Declination of the three stars in Orion which are in a line? Also, can he recommend a cheap book on the position, magnitudes, and other remarks about the fixed stars, where I can obtain it, and the price?—ORION.

[97266.]—**Optical Lantern.**—I should be much obliged if any reader would give me information upon the construction of an optical lantern. Could I make one, and would it be essential to have a condenser and to get good results on the screen? Could I make the condenser myself? I am in an engineering shop, and go in for photography. Could I in any way make a rectilinear lens do instead of a special lens, or would it be essential to have a special lens for the purpose? I should be very grateful if I could get the information, and would be pleased if diagram were given.—C. W. C.

[97267.]—**Indelible Marking Ink.**—The recipes given some time ago for non-metallic marking inks have turned out failures, as they were anything but permanent or proof against washing. Could anyone furnish one to equal melanyl, jetoline, &c., or those adopted by shirt and collar makers, in durability?—JERSEY.

[97268.]—**Hektograph Ink.**—Would anyone kindly state how to prepare an ink, colour of it immaterial, to be used with the hektograph (slab of a mixture of seven parts glycerine and one gelatine), easily destroyable or removable? It is required for the printing of patterns for embroidery on materials of cotton, linen, wool, or silk. On the present occasion, the work concerned being all white, the application of chemicals to remove the ink would not be objected to, so long as the fibre of the material was not injured, though for more general use a suitable ink available in connection with coloured work, where, for instance, the stronger acids would be debarred, would be more valuable. Aniline inks are otherwise employed for hektographs, which would, however, not answer, as they seize the material, and cannot be destroyed. These afford, it is claimed, up to 150 copies; but half a dozen would be as much as would be ever needed in embroidery. Iodine, if it left better traces in printing, would do otherwise admirably, as even heavy iodine stains yield without trouble to a hot iron or ammonia.—JERSEY.

[97269.]—**Cloudy Lenses.**—I have a Leitz one-tenth and a Reichert one-twelfth which are useless, owing to the clouding of the lenses. Last year I sent them to their respective makers to be repolished, and they are now as bad as ever. Can any of our readers tell the cause, or if they can be cured by having new lenses put in where the faulty ones are?—J. J. CLARKE.

[97270.]—**American Organ.**—Can someone recommend me a good instruction book on the American organ, explaining the stops, &c., also telling something of its construction, if possible?—M.

[97271.]—**Motors.**—To "THE WRITER OF THE ARTICLES" or "MONTY."—Will you please inform me how I should set the taps on a De Dion latest tricycle when going down a hill, so as to save petrol? Up to the present I have simply switched off the current; but I presume I am using petrol at the same rate as if I was taking power from it. I have not had an opportunity of looking inside a carburettor, so I am unable to trace the connections of the regulating taps. I judge the left hand tap is for regulating the quantity of gas and air after being mixed, and now passing to cylinder, and I presume that the right hand tap will have another opening opposite to the one which is open to the atmosphere, so that if you take more air you are compelled to take less gas, and therefore reduce the richness. Is this so? Any hints on saving petrol will oblige.—F. W. B.

[97272.]—**Languages.**—I shall be glad if some of your readers will tell me of any books written for Englishmen on the Dutch, Danish, and Swedish languages?—W. H. MURGATROYD.

[97273.]—**Magnet.**—Can any reader tell me what size magnet (permanent) I should require to suspend a steel ball, 1in. in circumference, through a slab of ivory ½in. in thickness?—R. J. GOODMAN.

[97274.]—**Motor Cycle.**—Would the writer of the Motor Tricycle be kind enough to give me the following information regarding the motor? I am about to build a tricycle to your dimensions, but would prefer to have it 2¼H.P. I notice that certain firms are converting 1¾H.P. motors into 2¼. I presume that they will alter the diameter of cylinder and valves, the stroke being the same. Would you give me the necessary dimensions of alterations? Will it alter the dimensions of the tricycle at all?—OLD READER.

[97275.]—**Smoky Chimney.**—Can any readers recommend an alteration likely to cure a smoky chimney? It is a large, old chimney in a farmhouse, and smokes when the door is shut. When the door is kept open it is all right. I have tried putting what is called a louvre chimney-pot on the top, and when this proved useless, or worse, I tried closing it up at the bottom; but neither did this do any good. Perhaps some experts can help me?—AMATEUR.

[97276.]—**Boiler.**—I wish to make a water-tube boiler, the tubes to screw into a central hollow casting of aluminium bronze. Can anyone tell me if ⅛in. is thick enough, or unnecessarily thick, for the substance of casting? Also, what alloy of aluminium is the best? I want to work at 100lb. pressure.—B. E. S.

[97277.]—**Condenser.**—I am making a tube condenser in which the water is to circulate outside the tubes. Must there be a chamber at one end for the condensed steam to accumulate in? Where do I put the pipe connecting to air-pump? Could any reader who has time and inclination kindly give me a sketch of such condenser?—B. E. S.

[97278.]—**Force Pump.**—Whereabouts should the water from the condenser be pumped into the boiler at—above or below the water-level?—B. E. S.

[97279.]—**Harp-Playing.**—Is this as difficult to learn as the piano? What is the meaning of single and double action? Would a four-octave be a useful instrument for home use, or would a bass guitar be more useful, considering the difference in price?—HARPING FOR A HARP.

[97280.]—**Steam Pressure in Locomotives.**—Can any reader tell me what is the highest steam pressure carried by any locomotive running in this country? I mean, of course, the blow-off pressure to which the valves are set.—SELIM.

ANSWERS TO CORRESPONDENTS.

*** All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

CHRISTMAS WEEK.

The CHRISTMAS HOLIDAYS will practically necessitate our going to press with the number for Dec. 29 on SATURDAY, DEC. 23. The office will, of course, be open on Wednesday, Dec. 27, and advertisements and late communications will be taken up to the usual time of going to press on that day; but advertisers and others who want to make sure of their communications appearing in the issue of Dec. 29 had better see that they reach us on SATURDAY, DEC. 23.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 13, and unacknowledged elsewhere :—

JACK OF ALL TRADES.—John Bywater.—G. Dobbs.—Meteor.—W. T. N.—F. B.—T. Richards.—Try Again.—Hyde Park.—W. H. Daw.—F. Fitzpatrick.

W. INGRAM.—About 22 knots for the fastest—that is, the liners running to New York. The trip there takes, roughly, six days; to the Cape 14 days.

CELLULOID.—Have not heard of any complaints. It is more probable that the gold-plating is too thin.

PLANT.—The questions are for a professional man who understands such work, and will want to see the place before he advises as to the water-supply for a town, or even a village.

W. HALL.—Do not suppose there is any such class in existence in this country or elsewhere, as you seem to have discovered by inquiry at "neighbouring polytechnics." Such work as that is learned only by practice as an apprentice under skilled workers. You can find a great deal about French-polishing, enamelling, &c., in back volumes, which you can probably see in one of the free libraries.

B. BROWN.—Good starch paste is as good as anything, with a little alum or other preservative. The plates should be damped as well as the mount, and be stretched until dry on a proper mounting board.

HARPING FOR A HARP.—It is a matter of personal taste, and of the ability of the individual. The query is inserted, but do not be disappointed if a full answer is not forthcoming. Most of the dealers would answer the questions. Rather hard-tipped fingers are needed, or skin that does not easily peel.

FOR A PRESENT.—The average cost of carriage of our set of "Twenty-five Best Books" seldom exceeds two shillings anywhere in the three kingdoms. If you send us P.O.O. for £1 12s.—that is, 30s. for the books and bookcase complete, and 2s. for the carriage, we will despatch the set by rail to the address of any friend to whom you wish to make a Christmas or New Year present, packed in a thoroughly strong and well-made wooden case to insure arrival without damage.

J. A. SARGENT.—Lists of all important lectures for the forthcoming week are published in such periodicals, amongst others, as the *Journal* of the Society of Arts and the *Athenæum*. Many of the daily papers give a list under the head "To-Day," and some evening papers do the same under the head "To-Morrow."

W. N. BARBER.—The paragraph is of American origin, extracted from a report of experiments made either at Cornell University or Harvard. The experiments do not seem to have much to do with the steel used in watches.

E. G. WOODHOUSE.—Photo too small to be of any use. It is little use offering to give "full instructions" privately. When we insert queries, we want replies for the benefit of many—not one reader. Many good-natured correspondents seem to forget this.

J. R. F.—Cassell's publish a good cheap one, but at the bookstall at King's Cross or Euston on arrival you will find several on sale from 1s. upwards.

ON the basis of results of previous exhibitions at Paris, it is expected that 52,588,280 people will pass through the turnstiles, and it is thought possible that the total number may reach 60,000,000 in 1900.

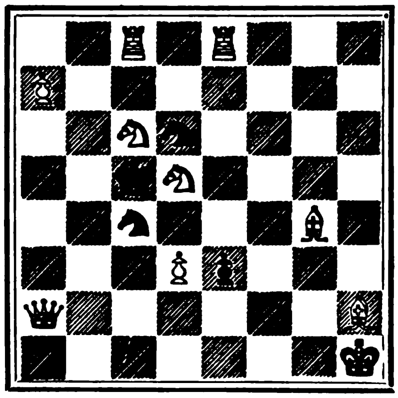
THERE are nearly 10,000 miles of railways now in operation or under construction in Africa. Already 1,400 miles of line northward from Cape Colony, and 1,100 miles southward from Cairo are complete, the intermediate distance being about 3,000 miles.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1705.—By L. HAWKINS.

Black. [4 pieces.



White. [10 pieces.

White to play and mate in two moves.

(Solutions should reach us not later than Dec. 25.)

Solution of PROBLEM No. 1703.—By B. VALLE.

Key-move, R-B2.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1703.—Correct solution has been received from S. Woollen, Richard Inwards, J. E. Gore, A. Tupman, T. Clark, F. B. (Oldham).

REV. DR. QUILTER, H.J.B. F., A. M. M., W.-H.—Only solution as above.

FIELDTHWAITE.—Problem received with thanks.

MR. P. H. WILLIAMS, 36, Downshire-hill, Hampstead, writes that he is offering for one shilling his small collection of problems, and intends to devote the money received to the War Fund.

USEFUL AND SCIENTIFIC NOTES.

M. VALLOT, the director of the observatory on Mont Blanc, has been considering the advisability of installing the Marconi wireless telegraph system upon the mountain. The ordinary system is used normally, but the great snowdrifts have played havoc with the telegraph wires.

Natural History Stories.—While some men were digging some peat at Bottisham Lode, a village near Newmarket, they came upon a species of bog-oak about 100ft. long, some 8ft. below the surface. The men were in the act of splitting open the tree when they found in the centre a honeycomb in a perfect state of preservation. In various parts of the comb were bees. The entrance to the comb was through a big knot, and it is supposed when the tree fell the opening was downwards, and thus imprisoned the bees in the comb. The tree in course of time sank into the peat, and on to the gault, where it remained until found by the men.

MR. P. H. BAGENAL, the Poor-Law Inspector for the Eastern Counties, in presenting his annual report, describes East Anglia as "the home of octogenarians and nonagenarians." He has ascertained the average age of the ten oldest paupers in each workhouse. The Norfolk ancients showed an average age of 84, Essex 86, Suffolk 84, and Wisbech 89. In the Essex workhouses there were 23 inmates of the age of 90 and upwards; in Suffolk 13, in Norfolk 31, in Wisbech Union 4; total 71. In Norwich Workhouse one inmate was 100 years old; in Henstead one was 99; and in Rochford one was 98; while in Chelmsford, Tendring, King's Lynn, and Thingoe there was one each aged 97 years.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except Index numbers, which are 3d. each, or post free 3½d.)

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed :—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows :—

For advertisements on inside pages, except page facing leader, for less than a quarter-page; per inch single column—

1	6	13	26	52	insertions
7s. 0d. ..	6s. 6d. ..	6s. 0d. ..	5s. 6d. ..	5s. 0d.	each.

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	£ s.	£ s.	£ s.	£ s.	£ s.	
Per Page....	8 8 ..	7 0 ..	6 0 ..	5 5 ..	5 0	each.
Half-page ..	4 10 ..	3 15 ..	3 10 ..	3 0 ..	2 10	,,
Quarter-page	2 10 ..	2 5 ..	2 0 ..	1 15 ..	1 10	,,

Back Page, £10 10s. A few dates open during 1899.

ORDINARY ADVERTISEMENTS.

	£ s.
Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five-Shillings for the first 40 words, afterwards 6d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the ENGLISH MECHANIC Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to THE STRAND NEWSPAPER COMPANY, LIMITED, and all communications respecting Advertisements should be distinctly addressed to :—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, DECEMBER 22, 1899.

MAKING A SPIRAL DRUM.

SPIRAL, or screw drums or barrels, are made by the crane firms by casting and by cutting. The cost of the cutting is unnecessary, except in some of the higher-speeded drums for wire ropes. There are many large barrels in which the cost of cutting would be prohibitive. Some of the largest of these, as used on Titan cranes, are 8ft. and 9ft. diameter. Many scores of drums, ranging from these dimensions downwards, and of all sections, have been made under the writer's superintendence, the larger in loam, the smaller moulded in greensand from loam patterns, swept up by boards. This article will relate to the latter only.

Fig. 1 illustrates one of the simplest forms of crane barrels, such as occur in diameters of from 1ft. 6in. to 2ft. 6in. Not until a diameter of about 3ft. is exceeded are these swept up in loam.

The section shown is that in which the chain links lie alternately flat and edgewise. When they lie diagonally, the grooves are shallow. When wire rope is used, the grooves are shallow, and closer together. Each form alike is swept up by the devices illustrated in these figures, to which the explanations to follow apply. Fig. 1 is as plain as a drum can be made. The shaft bosses are chiefly internal. There is no lug for the chain, which is screwed with a strap to the outside of the barrel.

Fig. 2 shows a sectional illustration of the loam pattern at a certain stage of the work, and a plan view of the striking board, by which it is swept. The general rig-up will be recognised readily. A A are the iron trestles (compare with Fig. 4) in which the bar B revolves, and upon which the striking-board C rests. This board carries two others, D and E (Figs. 2-4), the first used for roughing up, the second for finishing the loam pattern.

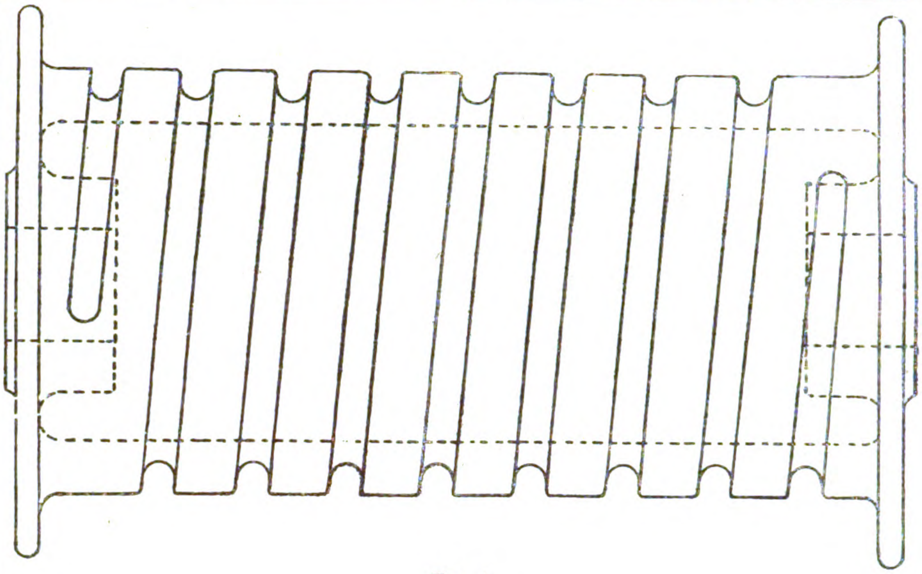


FIG. 1.

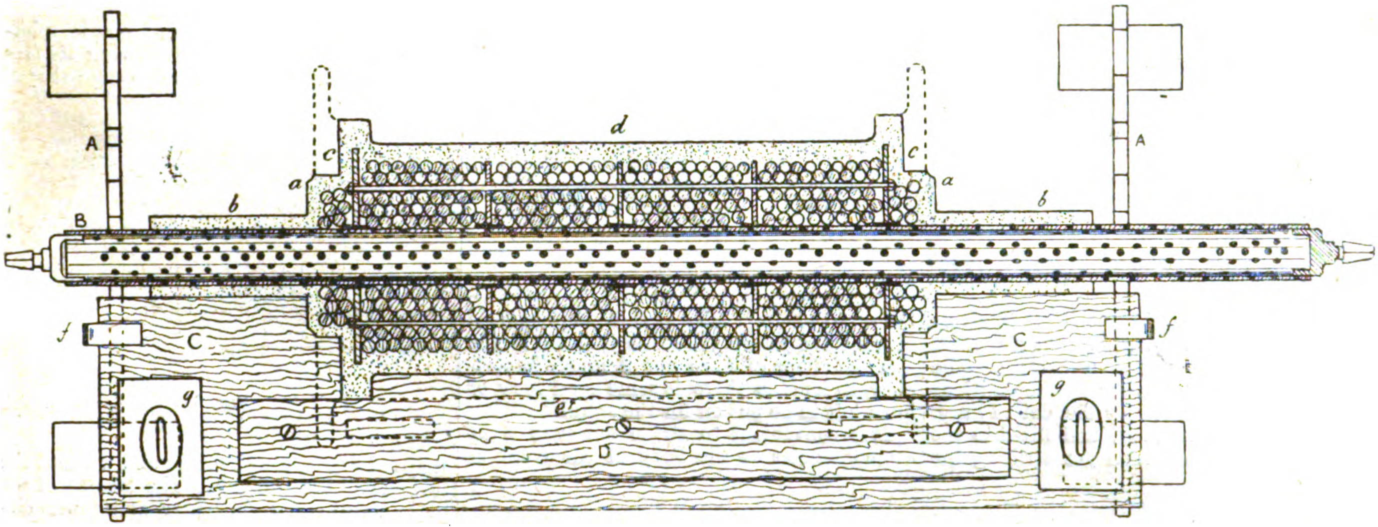


FIG. 2.

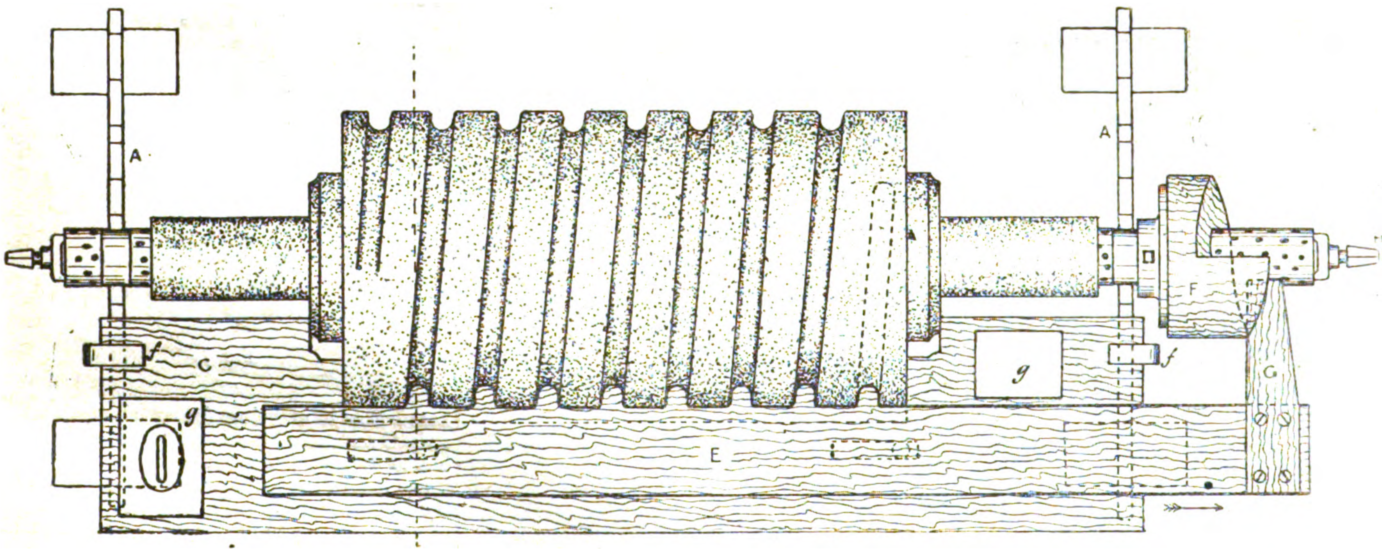


FIG. 3.

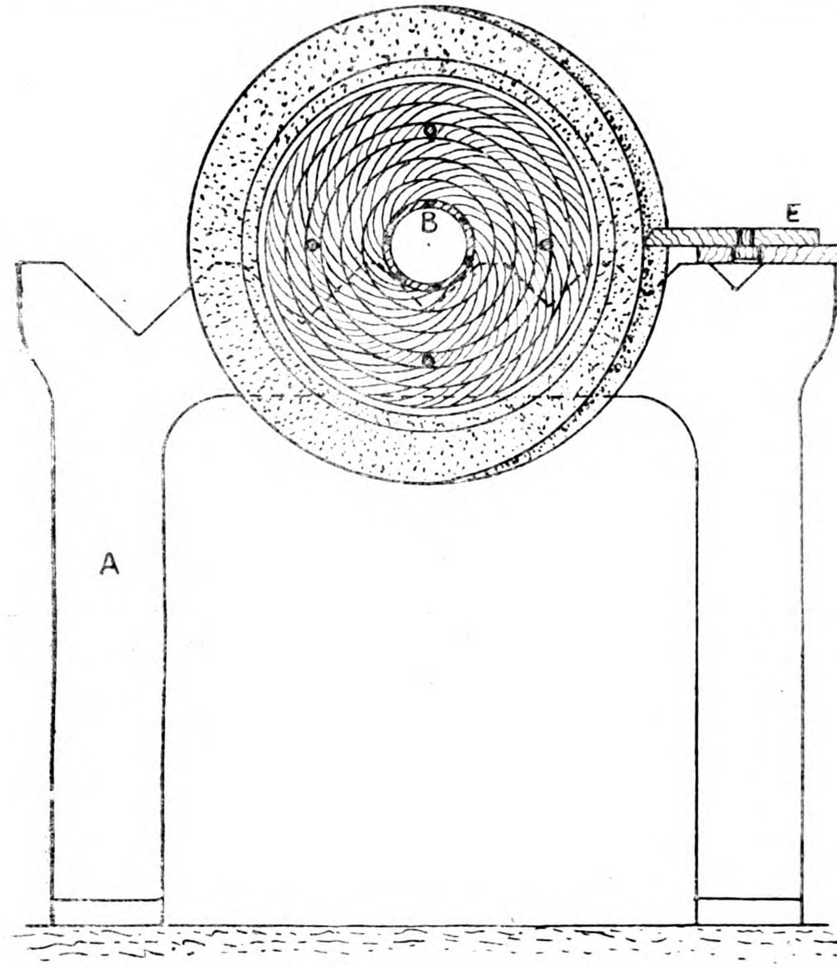


Fig. 4.

The first board C (Fig. 2) is used to strike the end bosses *a a*, the prints *b b*, the shoulders *c c*, and a false foundation body *d*. The shoulders *c* receive the flanges, the positions of which are indicated by the dotted lines. These are turned in wood, and fitted to the loam pattern. The reason for striking the the roughed-up pattern at this stage is dried in the stove before the screw is struck. The size and shape of *d* are not of much importance, so long as there is some good body of loam left to be put on for the spiral.

It is convenient to strike the ends of the same diameter as the body of the drum, as

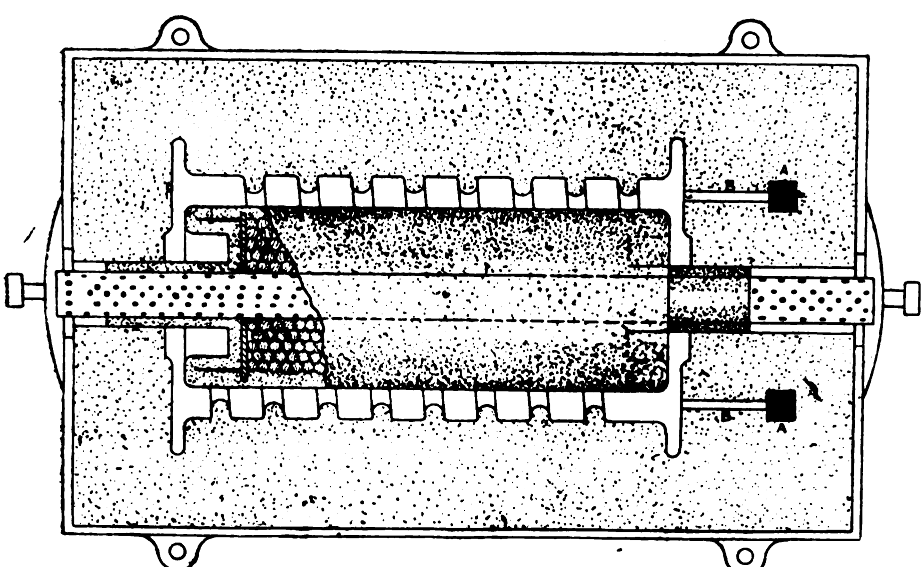


Fig. 8.

portion *d* smaller in diameter than the drum is to have a body dry and hard preparatory to the striking up of the screw. If the screw were swept up at the same time as the soft body, it would, in consequence of the mass of the latter, sag and go out of truth in drying. The board D therefore is used to sweep the body to the section of *d*, after which shown, and this affords a guide for the correct setting of the second board E. The edge *e* of board C does nothing, board D alone striking the body *d*. Board D is screwed to C.

The loam pattern, seen in plan section in Fig. 2, and in cross section in Fig. 4, is swept up on a core-bar, with plates, and hay-bands, in the manner shown. The plates are wedged on the bar at intervals, and secured with through-bolts after the bands have been wound round as far as the circle of the bolts. This makes a firm body which may be easily moulded from a score of times; *f f* and *g g* are clips and weights by which the board C is secured on the trestles A A.

The next stage of the work is seen in

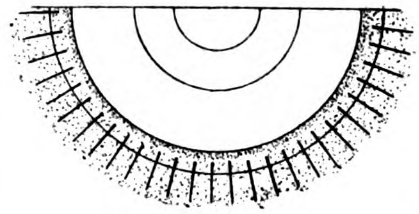


Fig. 5.

Figs. 3 and 4. Here the board D has been unscrewed, and its place taken by board E, which has studs attached to its underside, to move in slot-holes of a length equal to the pitch of the spiral on the drum. Board C has been drawn back from the body, so that no rubbing takes place excepting that of E, which alone is in operation. In the figure, the board E has been slid over C to a distance nearly equal to the pitch, and the screw is shown complete all except the length seen dotted to the right.

The method of striking is by a templet-screw, F. This is of wood, having its face cut to pitch by means of wedge-shaped

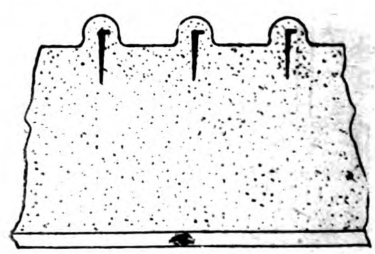


Fig. 6.

strips of paper, glued within and without the turned and bored blank. The lengths of the paper strips equal the outer and inner circumferences of the blank, and they taper from a width equal to the pitch of the screw at one end to nothing at the other. The hypotenuse gives the edges for cutting the faces of F by. It is screwed to an iron boss-plate, which is pinched upon the bar B with three set-screws. On the board E a strip G is screwed, the inner face of which bears against the spiral face of the templet. A boy or man turns a winch-handle at H, while the core-maker or pattern-maker attends to the

Fig. 7.

board E as it is being drawn along by the strip G and templet-screw F. This operation has to be repeated from a dozen to twenty times before the loam-screw is finished. At the termination of each traverse the rotation of the work has to be checked and the board slid back: otherwise the tongues on E would tear up the loam. The groove formed in the loam by the sliding back of the board, and which is equal in thickness to the board, is filled up after the striking is finished. This portion is rubbed correctly when dried. Often a little rubbing and finishing have to be done at the termination of the screw-threads

after the loam has been dried. Finally, the body is coated while hot from the stove with tar, and varnished, the wooden flanges put in place, and the composite pattern moulded, as in ordinary work in greensand.

In moulding drums with deep grooves like this, the sand which forms the grooves would fracture unless supported well with nails, Figs. 5 and 6. Fig. 5 is a section through a groove, and Fig. 6 a view in the joint face, showing the nails *in situ*. The edges in the joint break up, chiefly in the cope, which is lifted from the pattern. A mending-up piece like Fig. 7 is employed to make broken edges good.

Fig. 8 is a plan view of the bottom half of the mould with the body core in place. The left-hand end of the core is broken away, to show the method of carrying the annulus of sand around the internal boss, long prods being cast on the end-plates for that purpose.

The pouring of these drums is from one end. In Fig. 8, A A are the ingates and B B the runners. A A come down through tho cope, B B are either in the joint face of the drag, as shown, or lower down in the mould. They are narrow and deep, and the metal runs along between the core and the grooves without beating against either.

Many barrels have right- and left-handed grooves for chain or rope, distributing the load between two coils. These are swept up by two boards—that is, board E in Fig. 3 would be duplicated. One would strike from left to right, as in the figure, the other from right to left. Then another templet-screw like F, but of the other hand, is required, and this is fastened upon the left-hand end of the bar. This is one particular case only of the many varieties of spiral drums which arise in practice. The large drums made in loam and struck with one or with two screws, and often having internal bosses, smaller cores, and so forth, give much more trouble. Fusee drums, too, for derricks are cast with grooves, and many other variations occur which call for special treatment. Some of these may, perhaps, engage our attention on a future occasion.

J. H.

ORNAMENTAL TURNING.—XXXIII.

By J. H. EVANS.

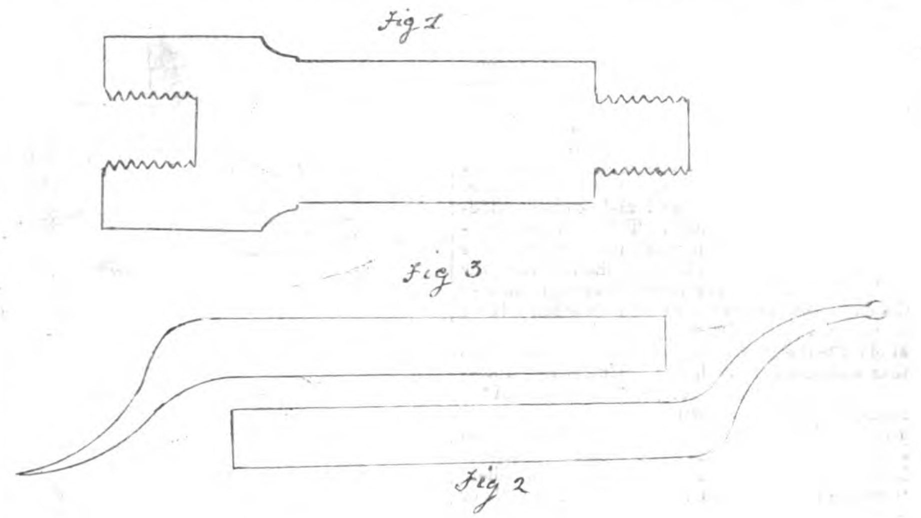
HAVING previously completed the necessary details in connection with the manufacture of the spherical slide-rest, we come now to the necessary tools, beyond those used with the ornamental slide-rest, that will be required, to be followed by a descriptive view of the general manipulation of the rest, for simple and complex works, and these will, I think, be better and more readily grasped if worked in together. By this I mean as we come to a point in the details of manipulation requiring a certain tool it will be there illustrated and described.

The difficulty of producing an accurate sphere by plain hand turning, and ultimately decorating the same, or curves of a kindred nature, by continuous ornamentation, may be said to have been the means of the simple rest of this character, which I stated in my first on the subject, as known to Bergeron, to the present state of perfection, and rendered it one of the most valuable additions to the ornamental turning lathe of the present period.

In its present state the spherical slide-rest is capable of many consecutive movements, by which means convex and concave curves of almost any degree are readily obtained from a small bead around the periphery of work of large dimensions to a complete sphere of from 3in. to 5in. in diameter; and when so turned the bare form may be decorated to an unlimited extent by the substitution of revolving cutters for the fixed tools originally employed.

The curves thus produced, whether concave or convex, and their position, depend entirely upon two conditions: first, the placing of the worm-wheel by aid of the lower slides; secondly, whether the cuting edge of the tool be adjusted to the far or near side of the axis of the worm-wheel.

I will here give as clearly as possible the best



means of making a zero, by which a line marked upon the first slide will enable the operator to place the worm-wheel under the axis of the lathe. The proceeding will be as follows:—Turn a cylinder, then mark on it a fine pencil line, place the slide-rest on the lathe, with the axis of the worm-wheel as nearly as possible under the pencil-line, place the fourth slide parallel with the third by means of its index and division on the ring surrounding the socket of fourth slide, and both parallel to the first slide. Now place a double-angle tool, one of those usually employed in the ornamental slide-rest, in the tool-box, and, by means of the second slide, bring its point exactly opposite the pencil-line. The tangent screw may now be thrown out of gear, and the worm-wheel turned precisely half-way round, and, by means of the first slide, it is so adjusted that the tool shall just touch the line, both on the far and near sides of the cylinder. The axis of the worm-wheel will then be found to be exactly under that of the lathe. This satisfactorily accomplished, a fine but distinct line should be marked across the face of the first slide. The zero—so to speak—being once thus defined, the

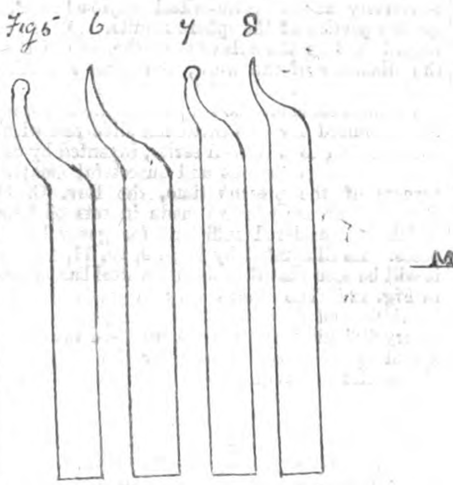
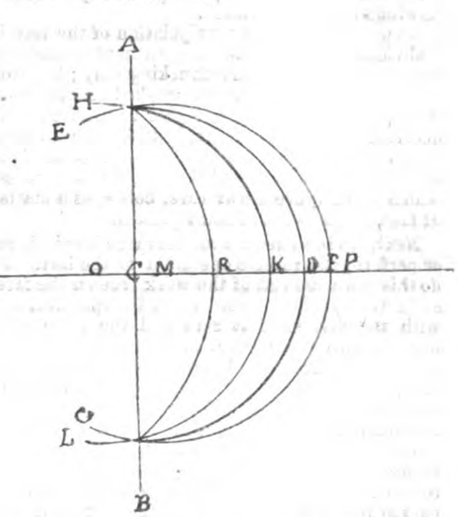


FIG. 4.



worm-wheel can always be readjusted, which will be found sufficient for all practical purposes; in fact, it is all that can be desired, and the presence of it will greatly assist in the future setting of the rest for many purposes.

So far, then, we have before us the means of placing the worm-wheel accurately in a transverse direction. It will, of course, be equally necessary to effect a similar adjustment in the reverse or longitudinal plane. This will be obtained by the following means:—Place the third slide parallel with the second, and then move the slide-rest until a straight edge, placed and held closely against the face of the work, coincides precisely with the zero line which passes transversely through the axis of the worm-wheel.

By the two settings thus explained we have arrived at the method to adopt in thus placing the slide-rest; but I propose to go much further, and endeavour to more fully detail the many ways of manipulating the rest. As a primary illustration, let it be desired to cut a boxwood sphere. I recommend boxwood, as that material is quite good enough for trial purposes. We will take it to be, say, 2in. in diameter. First turn the wood to a true cylinder of the required size, and perfectly true and flat at the end. This done, mark a pencil-line exactly 1in. from the end. We now have a guide to lead us in the right direction, and may proceed to remove the superfluous material by hand-turning, and thus reduce approximately to the desired shape—viz., a sphere. When executing this part, care must be taken not to remove the pencil-line, as we shall require that, as will be seen. We next place the slide-rest on the lathe with the axis of the wormwheel, exactly under the pencil-line, and the first or lower slide must be adjusted with equal precision to the zero marked across the base, which was fully explained in my last.

These two slides, so far set, must not be again moved. Any other alteration may be made as you please, which will probably only interfere with the dimensions of the work in hand. We come now to the tool to be employed. If one of the ordinary short slide-rest tools be used, it will be found that during the semi-revolution of the wheel carrying the fourth slide, the latter will come in contact with the shoulder of the work, unless reduced below the diameter of the work; or, if the chuck should be short, the slide will then be stayed in its progress by the mandrel-frame itself.

I have found it a considerable help over this little difficulty—if it may be so termed—to have an elongated chuck about 4in. in length with a nose on the extremity, to correspond, of course, with that of the mandrel. This is illustrated in Fig. 1, and should always be available, although it is not always necessary. The inconveniences arising from this cause leads up to the intro-

duction of curved tools. Of these there should be several sizes. It is true that with a curved tool that would travel round a sphere of, say, 4in. diameter, would be available for one of half the dimensions; but it will be equally evident that a tool suitable for a 2in. circle would be useless as applied to a sphere of larger size.

By referring to Figs. 2 and 3, the particular kind of tool which is most suitable will be seen. These are made to fit the tool-box of the slide-rest, and are $\frac{5}{16}$ in width. This is for the purpose of strength, as they are generally used for work of increased diameter, and the nature of the tools which it will be seen receives the pressure of the cut at a distance from the main stem. If we study these for a moment, the object of the two kinds illustrated will become evident. Fig. 2 is that which is first used, and having a round nose cutting edge of more strength, may be termed the roughing-out tool, notwithstanding a smooth cut may be taken over the work. Fig. 3, it will be seen, is brought to a sharp front, and acts more or less as a parting tool, as it will sever the sphere from the material it is made of, leaving little or nothing to be removed.

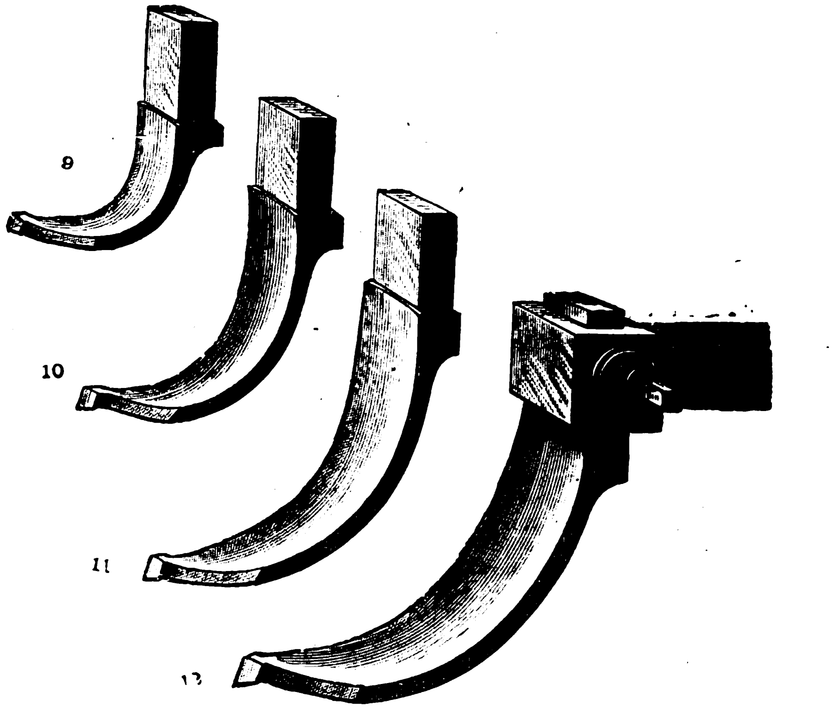
Assuming that a plane sphere only is required, it will be obvious that when severed, even by a tool as described, be the point ever so sharp, it must leave something attached to the ball when it falls, and to remove this without destroying the exact features of the sphere is a difficult and somewhat dangerous process. It must be re-chucked, and the safest plan to adopt is to re-adjust the spherical rest to remove the superfluous material, or it may be attempted by hand-turning if the operator is sufficiently expert and confident to trust to it; but it must not be forgotten that should the least portion too much be removed, we no longer have a sphere, but practically a mis-shapen object of little or no use. I refer to this as illustrating the very great care required to effect the desired object.

These tools are generally made in sets of either six different sizes or ten, to turn from a 1in. to 4in. sphere. Then we have another set made to the same size in the stem as those usually made for the ornamental slide-rest—*vide* pp. 5, 6, 7, and 8. These for small work are extremely useful, being less cumbersome, and altogether more suitable. We have now before us the most improved tools for the purposes of spherical turning as explained. There is, I may say, nothing more to be said with regard to the manufacture of these; the illustrations tell their own tale, except that good sound forgings must be procured.

To proceed with the manipulation of the rest, it obviously impossible to ornament a sphere entirely from pole to pole by one chucking only; but this can be effected by a line marked exactly upon the equator, and when one side or hemisphere is decorated, it can be rechucked the reverse way, with the equatorial line perfectly true with the surface of the chuck. This, however, is a process which will require great care, being, as a matter of fact, a somewhat difficult process.

Next, let it be desired to excavate a hemisphere, or perform the reverse operation to the last. To do this, turn the end of the work true on the face, as in the previous case. Place the spherical rest with the first slide at zero and the third slide parallel with the second, so that the zero line of the worm-wheel shall precisely coincide with surface of the work. This is effected by means of the second slide. Thus: Commence with a straight tool with a round nose, which must be inserted gradually, while it sweeps out the material as the excavation progresses. When the fourth slide comes in contact with the edge of the work, a curved tool must be employed (the particular kind will be referred to later on), and the hemisphere completed. Of course in practice the bulk of the material would be removed by hand-turning, and the hemisphere only finished by.

In furtherance of our object I have prepared a diagram, Fig. 4, illustrating the curves: though simple, it will be found, I hope, very useful. Its explanation is as follows: Let M P represent the axis of the lathe from mandrel to poppet-head, C the centre of the work, and A B the diameter and back of the work. (1) With tool set at radius C B, and worm-wheel coincident with C, the hemisphere A D B results, and any alteration of the radius would only increase or decrease it; (2) if the worm-wheel be ·25 nearer P at M, the curve E F G results; (3) if the worm-wheel be ·25 nearer M at O, the curve H K L results. It will be observed that these curves E F G, H K L, must fall within the diameter A B; therefore this must be compensated by an increase of radius if the



diameter A B is to be preserved. And, again, this increase of radius will necessitate another compensation, E G, if the hemisphere A D B has been cut, and it is desired to cut a curve, A K B, passing through the point A B, and also through K, a point ·25 nearer to M; then by means of the second slide the worm-wheel must be moved from C to O—i.e., ·25 nearer to M; but curve A K B falls within the point A B by, say, ·05 nearer, therefore the radius must be increased by ·05; but this will bring the curve ·05 further from M beyond the point K, consequently the worm-wheel must be moved nearer to M by fully ·05, for as the worm-wheel is moved towards M, so does the curve A K B fall still further within the points A B. (4) It is obvious that as the worm-wheel approaches M the flatter does the curve become, as A R B, provided that by increased radius the tool slide travels through A B, and conversely as the worm-wheel approaches P, a greater portion of the sphere results. (5) If you regard A B as the axis of the lathe, and M P as the diameter of the work, the same reasoning applies to oblate and prolate speroids.

I cannot conclude the subject of the necessary tools required for this particular slide-rest without referring to a special series, invented by one of our most prominent and successful amateur turners of the present time, the Rev. C. C. Ellison. These tools are made in sets of four, which is considered sufficient for general purposes. As illustrated by Figs. 9, 10, 11, and 12, it will be seen that they fit into a steel bar, shown in Fig. 12. The blades vary in form, ·8 to 1·5 in width, and though simple in appearance, are a very difficult tool to make, and are turned by a tool specially constructed for the purpose, to the precise radius of the curve they are intended to cut—viz., 2, 3, 4, and 5in. diameters. By using these tools little difficulty is experienced in removing the whole of the inside of a hemisphere, either of soft wood or ivory, the same being turned out in shells, clean and true to shape, and, so far, ready to be chucked and ornamented without further labour. There not only is a vast amount of labour saved, but a deal of valuable material, which in the case of ivory is a great consideration. Having said so much, I will point out the manner in which they are used.

We will suppose that we have to operate on a solid block of ivory. First turn the face true, and mark four circles of 2, 3, 4, and 5in. in diameter; place the tool-box of the spherical slide-rest level with the front of the fourth slide, and fix it by both depth and stop screw, both being thus employed for security, and to stay vibrations. Now place the steel bar quite home in the tool-box, adjust the rest to excavate a 2in. hemisphere, using the blade made for this purpose, Fig. 9; care must be taken to place the blade quite home in the bar.

Next throw the tangent screw out of gear, release the fixing screw of the socket ring, and adjust the edge of the blade to touch the 2in. circle already marked on the ivory, and the inside of the blade to a trifle less than 1in. from the centre of the face of the material. These positions are more easily made by a brass gauge made for the purpose.

To continue, place the tangent-screw as gear, and secure it by the fixing-screw; the tool may now be passed into the ivory, by slowly rotating the tangent-screw, and a solid hemisphere will be cut out. The same operation is repeated with the various blades when hemispheres of those particular sizes are required. Should the blade have to be removed for the purpose of sharpening, it must be replaced with the greatest accuracy. Now in using these tools, there is one very important thing to notice, without which some difficulty may arise, especially when operating on work of large diameters. It is this: while the blades can be made of almost any strength, the spherical slide-rest, from its construction, is comparatively unstable. In order to counteract the great strain in cutting a large diameter, it is a great assistance to place a piece of soft wood against the face of the work, and between the bottom of the back and the top of the third slide; this prevents vibration, and eases off the strain upon the rest. Should it be desired to cut out shells greater or less than a hemisphere, the axis of the worm-wheel must be moved further from or nearer to the lathe-head.

I think I may claim now to have said all that is to be said with respect to the manufacture of this all-important addition to the ornamental turning lathe, also with reference to the manipulations, and I propose to conclude the subject of the spherical slide-rest in my next, illustrating therein a finished specimen of work that I executed with it from base to summit, accompanied with the necessary details for its reproduction, if it is considered worthy of reproduction.

MILLWRIGHT'S WORK.—XXI.

FIG. 132 illustrates a diagonal drive by the Webster Co., in which a 16ft. eleven-grooved pulley, A, drives B, 7ft. diameter, 96ft. away, measured in a horizontal plane. The idler C has eleven grooves, and a loose sheave for the rope to the tension-pulley D. The leaving one pulley-groove loose was a method adopted at Belfast many years ago. This is a 500H.P. transmission with 1½in. rope.

A curious transmission is shown in Fig. 133. Two driving sheaves at A transmit power in the same direction to the pulley B on one floor, and in the reverse direction to the pulley C on the floor above. One sheave at A has five grooves to drive to B, the other six to drive to C. D has twelve grooves. One groove sheave is loose at D, to drive to the tension E, and one sheave on B is loose, to drive to the tension F.

Fig. 134 shows a section through a rope-drum and its loose sheave; the latter, being narrow, is

fitted with a specially long hub. Fig. 135 illustrates a drive from a twelve-grooved pulley, A, 8ft. in diameter, to one B, 5ft. 8in. diameter,

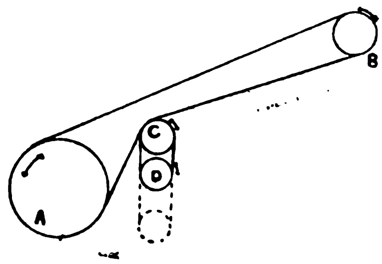


FIG. 132.

situated at 24ft. centres, measured in the horizontal plane. C is an idler with twelve grooves and a loose one, the latter driving to the tension-pulley D, with 15ft. of travel.

For the average length of rope, about two per cent. of the total length of the rope is allowed for tension. The Webster Manufacturing Co. adopt the rule that a single tension cannot, under any

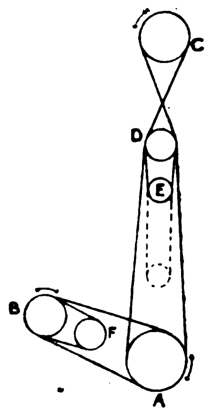


FIG. 133.

circumstances, take up the slack on more than twelve grooves, and then the ropes must run slowly, so that double and treble tensions often have to be adopted. The maximum length of rope for a single tension should not exceed 3,500ft. The tension should take the slack rope from the driving sheaves and loose grooves, as

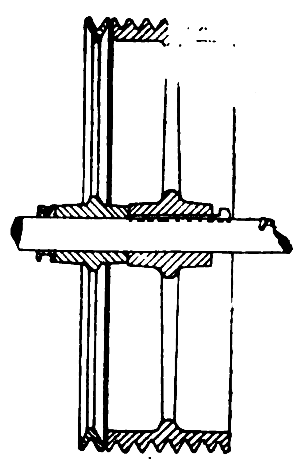


FIG. 134.

previously noted, and must be used in idler-pulleys, which should also be on the slack side.

The tension-pulleys are mounted in a good many ways. Figs. 136 and 137 illustrate two types only: one for horizontal, the other for vertical arrangements.

The idler-pulleys are used to guide ropes in desired directions, to prevent swaying, and to relieve bearings of strain. In English practice sectional forms of grooves have been frequently given to idlers, different from those which are used on driving pulleys. This practice is not much adopted in America, where grooves are kept standard, excepting in regard to depth.

The great value of ropes for twisted drives is on a par with their utility in the transmission of power from the main shaft of the prime mover

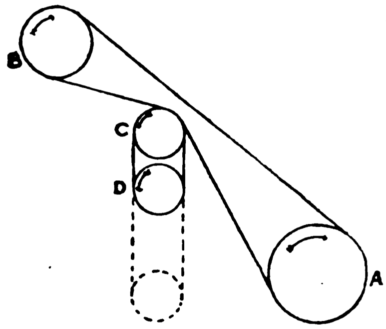


FIG. 135.

to distinct lengths of shafting, driving machinery on separate floors. Belting is ill-suited for this service, because the conditions are unfavourable, the reasons of which are

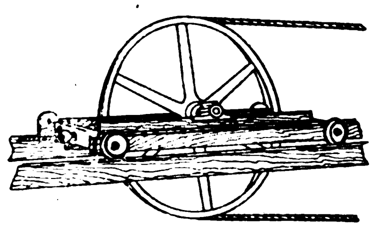


FIG. 136.

apparent from a consideration of the limitations to belt-driving which have been already stated. In fact, belt-driving is so inefficient under such conditions that toothed gearing has

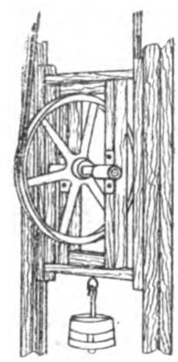


FIG. 137.

been largely used instead. But spur and bevel gears and heavy shafts are not ideal forms of transmission. They are heavy, and generally intolerably noisy if employed to any great extent.

An illustration of the multiple driving system in a large mill is given in Fig. 138. This represents a section of a mill fitted by Hick, Har-

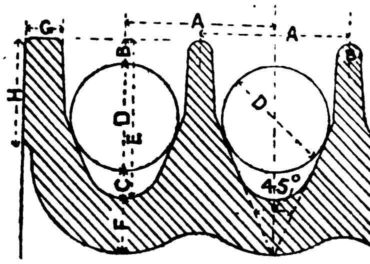


FIG. 139.

greaves, and Co., of Bolton. A broad flywheel A, on the crank-shaft of the engine, has enough grooves turned on its circumference to carry all the ropes required to drive the main shafts throughout the mill. It fulfils the same purpose as the compound driving previously illustrated,

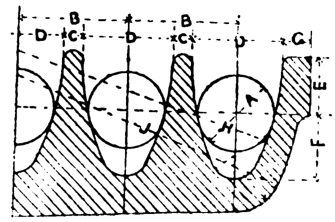


FIG. 140.

only instead of superimposed belts the ropes lead off in successive adjacent sets. In Fig. 138 the flywheel A is grooved for thirty-five ropes. These pass off to the various pulleys on the different floors in sets of four, five, seven, &c. Each rope is independent of the others in this, the "multiple" system. The most remote shafts, therefore,

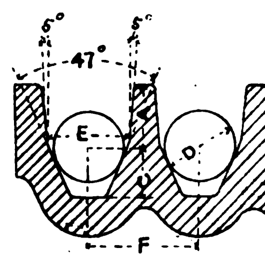


FIG. 141.

are driven directly from the one big driving flywheel instead of through intermediate shafts and gears. Such prolonged transmission would be impracticable with heavy belting.

Extremely long rope drives are also sometimes taken through the open from one building to

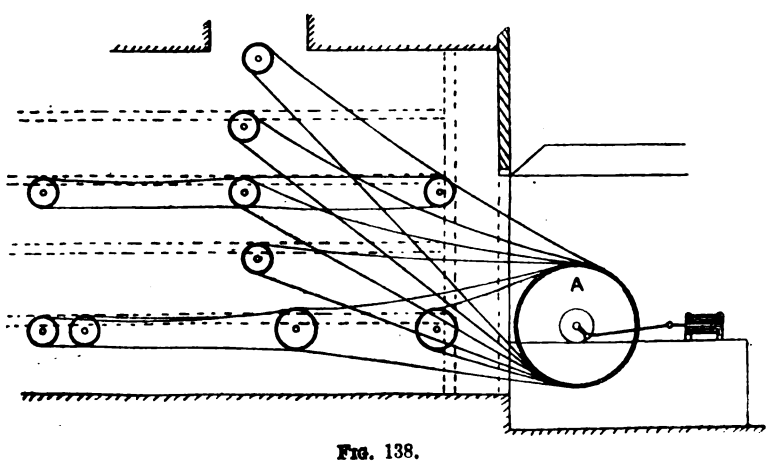


FIG. 138.

As the lesser evil, they have been often preferred to belting. But with the introduction of rope-driving much of this gearing has been taken out, and with advantage.

another. This could not be done with leather belting, and although the canvas beltings will stand weather, they are still open to the other objection to the use of belts for very long drives.

The advantage of the driving of shafts at different angles by means of ropes somewhat resembles their driving by the wedge-shaped leather link belting. Both are highly flexible, and each unit of width takes its fair share of the

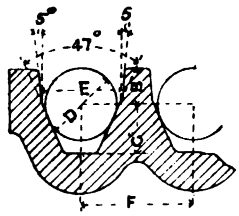


FIG. 142.

work. The single ropes are equivalent to a belt cut up into several strips, each lying closely to its work, which a solid wide leather belt cannot do when the drive is not parallel.

Not much diversity of opinion exists in reference to the angles of the sides of the pulley grooves: 45° was settled many years ago at Belfast. The principal variations are illustrated below.

Fig. 139 illustrates common English practice, and the formulæ give proportions for various sizes of ropes.

D = diameter of rope.
A = $1\frac{1}{4}$ D + $\frac{1}{4}$in.
B = $\frac{1}{8}$ D + $\frac{3}{16}$in.
C = $\frac{1}{4}$ D
E = $1\frac{3}{8}$ D + $\frac{3}{16}$in.
F = $\frac{1}{2}$ D + $\frac{1}{16}$in.
G = $\frac{1}{4}$ D + $\frac{3}{16}$in.
H = D

Fig. 140 is by the Walker Manufacturing Co., of Cleveland, and the table gives dimensions.

DIAMETER OF ROPE:—

A	B	C	D	E	F	G	H	J
in.	in.	in.	in.	in.	in.	in.	in.	in.
1	$1\frac{1}{2}$	$\frac{1}{4}$	$1\frac{1}{4}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	$3\frac{13}{32}$	$3\frac{3}{4}$
$1\frac{1}{4}$	$1\frac{3}{4}$	$\frac{5}{16}$	$1\frac{7}{16}$	$\frac{15}{16}$	$1\frac{1}{8}$	$\frac{1}{2}$	$4\frac{11}{32}$	$4\frac{11}{16}$
$1\frac{1}{2}$	$2\frac{1}{8}$	$\frac{3}{8}$	$1\frac{3}{4}$	$1\frac{1}{8}$	$1\frac{5}{16}$	$\frac{9}{16}$	$5\frac{13}{64}$	$5\frac{5}{8}$
$1\frac{3}{4}$	$2\frac{1}{2}$	$\frac{7}{16}$	$2\frac{1}{16}$	$1\frac{5}{16}$	$1\frac{1}{2}$	$\frac{5}{8}$	$6\frac{1}{16}$	$6\frac{9}{16}$
2	$2\frac{7}{8}$	$\frac{1}{2}$	$2\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$\frac{3}{4}$	$6\frac{15}{16}$	$7\frac{1}{2}$

The C. W. Hunt Co., of New York, adopt an angle of 47° for the sides of the pulley grooves

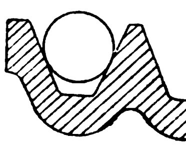


FIG. 143.

for rope driving. The forms designed for deep, medium, and shallow groves are shown in Figs. 141, 142, and 143 with their formula:—

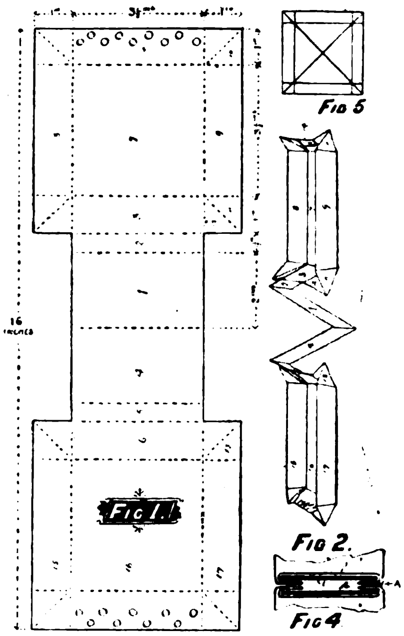
D = diameter of the rope.
A = D − $\frac{1}{8}$in.
B = ·5 D
C = ·7 D
E = D + $\frac{1}{4}$in.
F = 1·375 D + $\frac{3}{8}$in.

These grooves have an advantage over those with concave profiles. They are more easily turned, and easily measured. J. H.

AN AUTOMATIC ROCKER.

THE advantages attached to the automatic rocker that will be described in this article are, chiefly, three:—(1) The simplicity of construction. (2) The cheapness of materials necessary. (3) There is no soldering whatever to be done, and this, to the amateur who has never tried his hand at soldering before, is no mean consideration. The rocker is made out of one piece of material, with no joints of any description. The size of this material, of course, depends entirely upon the size of the rocker required.

The dimensions given in Fig. 1 are those required in the construction of a washing apparatus for lantern slides. The reader will find no difficulty in working out the proper dimensions for larger or smaller size tanks. A sheet of zinc or tinned iron—preferably zinc—is taken and cut to the size and shape given in Fig. 1. The holes are best formed with a twist-drill, but if this method cannot be pursued, they must be punched from the face side of the material. This will prevent any possibility of prints being rubbed against the birr made by punching the



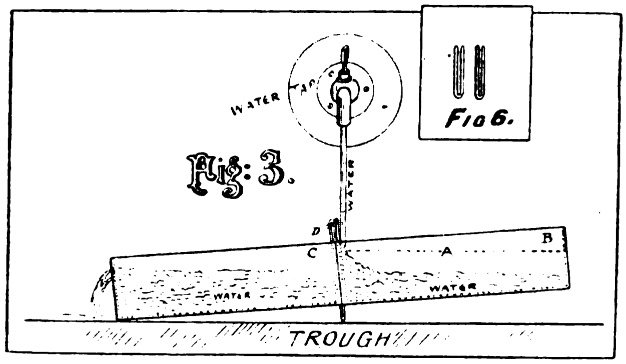
holes. When the material has been cut to the proper shape it is bent up at the dotted lines to form Fig. 2. To understand exactly how the corners are bent up the reader is advised to adopt the following plan:—Take a square piece of stiff paper, and crease in the manner shown in Fig. 5. Then, when the sides are bent up in the form of a dish, it will be seen how easily and naturally the corners fold round. In exactly the same manner must the corners of the metal be bent up, with the aid of a pair of pliers.

It will be seen in the diagrams that the numbers correspond in both Fig. 1 and 2. If this is carefully followed out, no difficulty whatever will be experienced. The four extreme corners of the apparatus are then folded round to the sides of the two dishes. They must not be folded round to the ends, as the holes would then be partially blocked.

The strip 1 (Fig. 2) is then pressed close to the dish nearest it, and the corner piece 11, folded round over it. The same is done with the strip 4, and then both the strips 1 and 4 are pressed closely together. This will bring the dishes in close contact with each other. Two small wire staples (Fig. 6) are then thrust in either side of the middle portion—i.e., referring to Fig. 2, one into the spaces between 1 and 11 and 4 and 13, and the other in the opposite side.

Fig. 4 represents a sectional plan of this middle portion, with the position of one of the staples indicated by the dotted line at A. These staples serve to keep the two vessels together by preventing 1 and 4 (Fig. 2) from spreading open again. When this has been done, the apparatus should be enamelled black on the outside and white on the inside. It is obvious that if this rocker is placed underneath a tap, as in Fig. 3, the water will increase in B by inflowing, as it decreases in C by overflowing, and vice versâ after it has been overbalanced. By this method a continuous flow of fresh water is kept up in both compartments, and the plates or prints, as the case may be, receive a thorough washing. The dotted line A in Fig. 3 represents the level of the water in B, just as it is on the point of overbalancing. By carefully following out the instructions given, a very efficient "automatic rocker" can easily be made.

Theodore Brown.



THROUGH A SMALL TELESCOPE.—II.

By NORMAN LATTEY.

OBSERVATONS of the sun should be conducted with the greatest caution. In no case should the eye be put to the eyepiece unless the dark cap (generally supplied with every astronomical telescope) has been first carefully screwed on. Focussing is best done on the bright edge or

FIG. 1.—Great Sunspot Group, March 25, 1894.

"limb." The whole surface can then be searched for any spot or other signs of approaching activity that may be visible. The most insignificant spot may in a few days develop into a gulf which could comfortably contain all the planets rolled into one. Every speck should therefore be carefully watched.

A low power—about 60—will just admit of the entire solar disc being inclosed in the field of view. The most noticeable feature that will at once attract attention is the curious shading towards the limb, due to the absorptive effects of the sun's atmosphere, which consists of a comparatively shallow envelope composed of glowing hydrogen and other gases, in which float fiery clouds of intensely-heated metallic vapours. Against this darkened background can frequently be seen irregular groups of scintillating faculæ, those strangely luminous streaks that often flicker around the borders of sunspots, or gleam softly in districts where they are about to appear. The exact meaning of these glistening manifestations is unknown; but they are generally assumed to be scudding at much higher levels than the apparent surface of the solar globe.

Ordinarily, the first signs of the impending storm and formation of a sunspot is a tiny speck on the lustrous surface. Within a few hours its growth becomes strikingly perceptible, and by the next day it not only often attains considerable proportions, but is commonly surrounded by clusters of diminutive spots almost imperceptibly gravitating towards each other. If the disturbance be sufficiently energetic, the torn and perforated area ultimately melts into a single yawning cavity of intense blackness called the umbra, which is generally surrounded by a lighter margin styled the penumbra. Within the umbra is occasionally seen a still darker centre termed the nucleus; but the last phenomenon is rather rare. As a rule, the umbra is bridged across by shreds of shining matter, evidently situated much above the gloomy

depths they appear to span. In all probability they consist merely of isolated fragments of faculæ hovering over the vortex of the tempest.

Frequently the larger spots endure sufficiently long to survive a complete solar rotation of 25 days—i.e., they appear at the eastern limb 12½ days after their disappearance over the western edge; but how altered! To give some notion of the rapid and total metamorphosis which these mysterious appearances undergo, three sketches are reproduced from the writer's observing book of the famous group of March, 1894. All the drawings were made at the instrument—a 2¾in. refractor. In Fig. 2 the splitting of the narrow

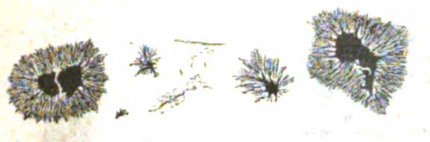


Fig. 2.—The Same Group Twenty-Four Hours After.

end of the pear-shaped umbra of the right-hand formation, and the complete change exhibited by its companion since the previous day, are both well illustrated, besides the fusion into one opening of the most extensive of the broken patches in the chain of perforations stretching between the "spots," and obviously indicating a sub-surface connection of some kind.

Five days later another sketch was made of the same group, which by that time had considerably extended, fresh rifts and openings having broken out in all directions. It would occupy too much

Fig. 3.—Another View Five Days Later.

space to here portray the entire area of commotion; but from Fig. 3 it will be noticed that the original twin formations are now hardly recognisable, the brilliant filament across the black umbra of the left-hand spot having entirely disappeared. The shape of the spot itself had also undergone a change, and the small adjacent spot which was isolated in Fig. 2 had become absorbed in the fringing border of the greater one. The tearing of the right-hand spot had also proceeded apace, the vast fissure now being twice its former length. Across it were shot forth three shining tendrils, one of which had reached to the opposite "bank." Along the same edge could be detected several more contemplating similar movements.

As stated at the beginning, observing the sun should never be ventured on until the dark cap is over the eyepiece. Any neglect of this precaution would almost certainly result in the destruction of the sight of the observer's eye. With the sun-cap—a deep smoke colour for preference—he is comparatively safe, provided the aperture does not exceed 3in. or 4in. Even then the telescope should be turned away from the glowing disc at intervals of a few minutes to allow the eyepiece and cap to cool. For apertures of more than 4in., a solar diagonal is absolutely necessary if direct vision is to be employed. By means of this contrivance the major portion of the light and heat rays gathered by the object glass is allowed to pass harmlessly down the eye-tube, but an intercepting "flat" of clear glass, or a prism, sends a subdued reflection to the eye through a tube placed at right angles. The image thus yielded is sufficiently bright for all practical purposes, and is, of course, perfectly cool and free from all danger. The simplest of these arrangements costs about 25s., yet even then the use of a pale sunshade of coloured glass is desirable. To those who can afford them they are strongly recommended, but for those who are not disposed to go to the expense the following description of a projection apparatus is given (see Fig. 4). It possesses the double advantage of being absolutely safe while permitting the solar image to be viewed by several persons at the same moment. It in fact turns the telescope into a miniature magic lantern.

Get a tinsmith to make a flanged collar of stout tin or brass with three small holes bored in the rim for screws. The collar must be a tight fit on the eye-tube, yet capable of both rotating and sliding up and down. To the face of the flange screw a piece of cigar-box or fret-wood 4in. square, with a hole in its centre to allow the eye-tube to pass through. Having prepared another piece of similar wood 8in. square (but, of course, without the hole), to receive the screen, connect them together with four strips, 1in. wide, ⅛in. thick, and 12in. to 14in. long. Paste thick black paper round three sides of the framework, and the narrower half of the fourth side. The apparatus is then complete.

To use it take out the eye-tube from the telescope, and pass it through the collar as shown in sketch. Then reinsert the eye-tube in the telescope, and pin down with drawing-pins on to the inner side of the larger square of wood a piece of the smoothest pressed Bristol board you can get. This will act as the screen. All that now remains to be done is to turn the telescope on to the face of the sun, and focus. Sliding the whole thing up and down the eye-tube—and, of course, the magnifying power of the eyepiece—will determine the size of the image. With a low power, say 40 diameters, and the framework drawn out to its fullest extent, the entire disc of the sun will easily come within the limits of the arrangement, which can be made any size and length.

It will be advisable to shut off all direct sunlight by either thrusting the object-glass end of the telescope through a pair of heavy window-curtains, should the sun be conveniently situated; or, if the observations are being made in the open air, by passing a fairly large piece of black card over the main tube of the instrument in order that the projection apparatus shall be as much as possible in shadow. By this means much interesting—even valuable—work can be done, and any astronomical society (if you belong to one) will be glad to have your sketches; or you might send them to the correspondence column of this paper for the benefit of fellow observers.

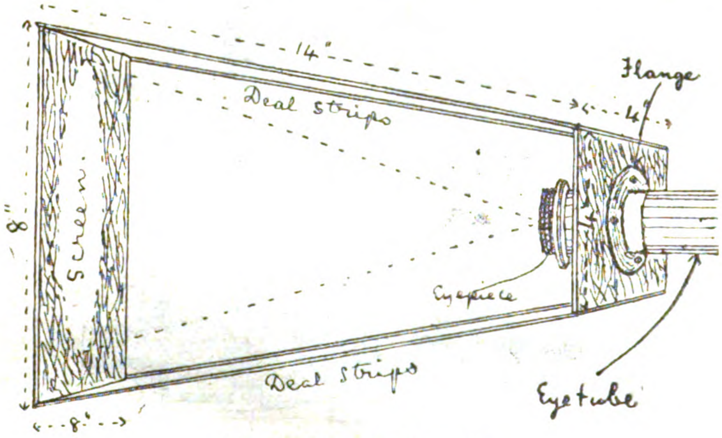


Fig. 4.—Projection Apparatus.

There are 112 towns in France outside of Paris which are provided with telephone exchanges.

PROF. W. R. SMITH ON DIPHTHERIA.

In the second of the Harben Lectures at the Royal College of Physicians, Prof. W. R. Smith, discussing the terms "infection" and "contagion," pointed out that formerly infectious diseases were considered to be those caused by certain poisons either entering the body from without or manufactured from within. To the latter the term "contagion" was applied, to the former a "miasma" was ascribed, the one arising within, the other outside, the diseased organism. In the present day only such diseases were considered infective as were produced by a living organism entering the body from without and capable of multiplication within. A diseased caused by a substance not capable of multiplication within was spoken of as an "intoxicative" process. In such infective diseases as diphtheria and anthrax there was a combination of these two causes—the mechanical presence of a specific organism and the metabolic products of the life of such. The difference between infection and intoxication, therefore, was that in the one the effects were immediate, while in the second there was an incubation period during which the poison was manufactured. In diphtheria the period was short—as a rule, not exceeding two or three days. Turning to the etiology of the disease, the lecturer alluded to an interesting fact, that the two sexes at the same age period were differently affected. In the first year of life boys were much more liable than girls to die of the disease; but this extra liability diminished year by year, and in the third or fourth year was transferred to the female side. Again, with regard to the incidence of diphtheria on children of various ages in London (apart from mortality) an examination of the figures for 1892-98 showed that the greatest attack rate was generally at the age of four to five; the rates were nearly equal for the three years of age, three to four, four to five, and five to six, while on each side of this three-year period they fell considerably. Infants under one year were remarkably exempt, and, if the notification returns might be trusted, liability to diphtheria was three times as great among children between one and two years old, and four times as great among those between two and three years old, as among infants in their first year. Direct infection from person to person was probably by far the most common cause of the disease. Milk was undoubtedly a vehicle of diphtheria, but whether the disease was transmitted by the cow through the milk or whether the latter was in all cases accidentally infected was a question by no means satisfactorily solved. The disease did not appear to have any direct relation to defective sanitary conditions, though these might lower the general power of resistance and give rise to throat complaints providing a favourable soil for the bacillus. Dr. Newsholme had suggested a relationship between the rainfall and outbreaks, but of all conditions exerting an influence on the spread of the disease that of school attendance was supposed by many to be by far the most powerful and far-reaching. This point was examined by the lecturer at considerable length. He mentioned that the medical officers of a large number of cities and towns, both in this country and in the Continent and America, whose opinions he had sought, considered that, on the whole, there was no important casual relation between schools and diphtheria. Dealing particularly with the figures for London, he found strong evidence that age-susceptibility was the main factor in the selection of the victims, and that, at the most, school-aggregation acted only as a slightly disturbing element. It was a fact that a child became more liable to be attacked year by year as it approached school-age, and less liable year by year after it had reached it. No special increase of liability could be traced to the beginning of school attendance, and there was nothing like constancy in the relationship of school holidays and a decrease in the notifications of diphtheria.

ALCOHOL INCANDESCENT LAMPS.

The success which has attended the introduction of the Auer incandescent mantle in connection with lighting by gas has led to various attempts to utilise the same principle with other heating media, especially with petroleum, alcohol, and various combined fluids. This matter formed the subject of a paper before the Société des Ingénieurs Civils de France by M. Denayrouze, who has himself contributed extensively to the improvements which have been made in lighting by incandescence, both in connection with gas and with liquid hydrocarbons.

It is well understood that the illuminating power of gas is entirely due to the incandescence of particles of carbon, and the wastefulness of this mode of lighting may be realised when it is understood, according to Saint-Claire Deville, that the hydrocarbons which form the illuminating portion of ordinary gas constitute but from 3 to 6 per cent. of the total volume, while the remaining portion is capable by its combustion of raising a much larger

mass to incandescence than is provided by the hydrocarbons present. It is its great richness in readily decomposed hydrocarbons which renders acetylene of such high illuminating power, while the introduction of an incandescent mantle composed of rare earths, as in the Auer burner, shows how great an advance may be made with ordinary gas.

It was a natural step to attempt to place such mantles over burners fed with liquid fuel, and in Germany various designs have been made, using methylated spirit, and even petroleum. Difficulties of various kinds were encountered, however, the principal one being an insufficient admixture of air to produce the high temperature necessary, and most of the devices are still in the experimental stage.

M. Denayrouze exhibited before the Société, however, a lamp containing the results of his latest researches, which seems to show that the difficulties have been surmounted in a practical manner.

An ordinary Welsbach mantle can be heated to incandescence over an alcohol burner, and thus be made to emit a brilliant light, but the cost is higher than desirable, and the illuminating power limited. M. Denayrouze has taken this idea, and supplemented it by charging the alcohol with hydrocarbons in solution to such an extent that the carbon in the flame and deposited upon the mantle also becomes incandescent, and adds greatly to the light without causing any increased consumption of alcohol.

While M. Denayrouze exhibited his lamps freely before the society, he did not give any very precise details as to the nature and quantity of the dissolved hydrocarbons which he used to reinforce the illuminating power of the mantle. The idea, however, is readily intelligible, and there should be little trouble in reproducing his results, now that the matter has been made public. The effect of the carburetted alcohol is clearly shown by the fact that when burned in specially designed lamps a very brilliant light is produced without the use of any mantle whatever, so that the combination of the two sources of light, especially when assisted by a slight blast of air, gives remarkable results.

The field of investigation which has thus been opened should lead to an active study and to the development of sources of illumination hitherto little used, and while electric lighting and incandescent gas-lighting will probably hold the larger portion of the field between them for a long while to come, yet for portable lighting, such as railway carriages, and similar service, some system such as offered by M. Denayrouze may be found decidely preferable.—*Engineering Magazine.*

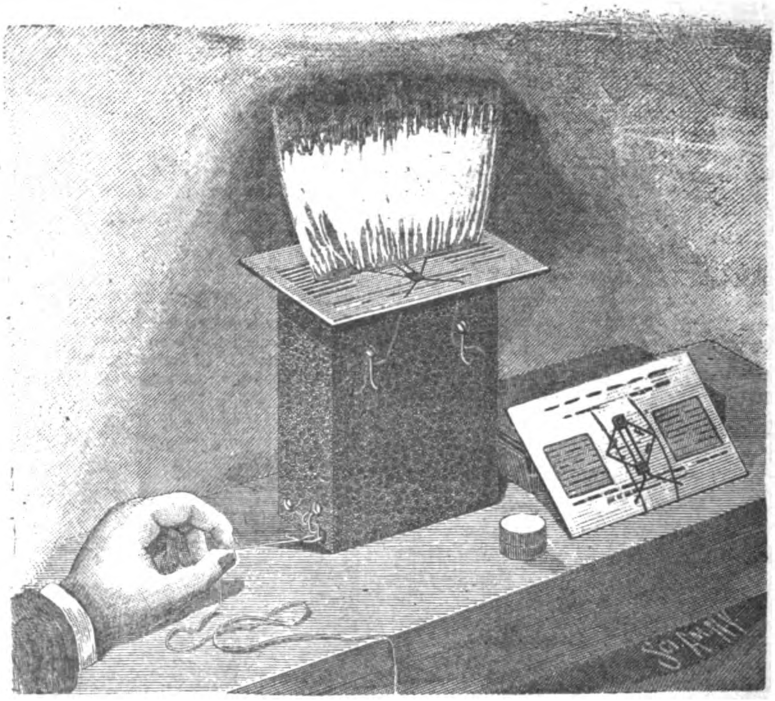
AN ELECTRIC FLASH-LIGHT DEVICE.

VARIOUS forms of lamps and devices for igniting flash-light magnesium compounds intended for photographic purposes have been invented during the past few years, several of which have been constructed in such a way as to promote the element of safety, for it is well known the setting off of a flash-powder is accompanied with more or less danger, and usually more than ordinary care is required.

The object of the electric flash-lamp shown in the accompanying engraving is to provide a perfectly safe lamp and one that is also effective, convenient to operate, and light to carry about.

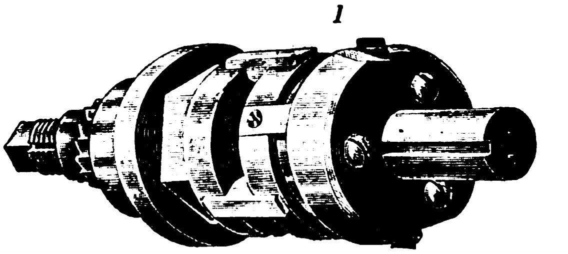
It consists of two cells of a powerful dry battery inclosed in a box suitably connected up in circuit, one part of the circuit being connected to two screws with spring fingers attached, as will be observed on the broad side, and similar screws at the bottom, at the narrow end. From one screw is a light spring wire, having a loop in its end, to which a spring is attached. From the other screw projects a hook-shaped shorter rigid wire. When the spring wire is pulled forward by the string, it brings both terminals into electrical contact. To the right of the box is a flash-card, having two fine wires on the surface arranged in a diamond form, and having in their circuit a minute platinum fuse. The card is placed on the box, and the wire terminals are slipped under the two spring wires, which completes the electrical circuit. The flash-powder, in a small, round box, is poured out on the card in the diamond-shaped space in such a way that some of it comes in contact with the platinum fuse. To ignite the powder it is only necessary to close the electrical circuit by pulling lightly on the string, which brings the two wire terminals at the bottom into contact, causing the electric current to heat the platinum fuse to redness and instantly fire the powder. The operation is extremely simply, and enables one to remain at some distance from the flash, and even to be included in the picture, as it is evident that the length of the string can be adjusted to suit the circumstances.

With a light of this kind it is any easy matter to take instantaneous interior daylight photographs of children and infants. Placing them near a window, e camera is adjusted on a stand and focussed. The flash-light may be located 6ft. or 8ft. from the subject, arranged to illuminate the shadow side of the face. The shutter of the camera may be set a very slow speed. Taking the operating bulb of the camera in one hand and the string of the flash-lamp in the other, the photographer can set off both at the same time, compressing the shutter bulb with the right and pulling the string with the left hand. The intensity of the shadow side may be varied by the distance of the light from the subject. Very soft and pleasing children's portraits may be made in this way. But flash-light pictures at night can be made perfectly, and in large rooms duplicate sets of light can be arranged to flash at once and thereby give proper illumination. The device has also the merit of being inexpensive, which will commend it to many. We are informed that Himmer and Potter, of No. 163, Greenwich-street, New York, are the manufacturers of this convenient article.—*Scientific American.*



KRUGER'S FLUE-CUTTER.

THE flue-cutter which we illustrate in perspective and section was invented by Mr. Philip J. Kruger, of Greenville, Ill., to fill a want for a device by means of which a flue could be cut at the inner side of the sheet without forming a burr, thus leaving the flue in perfect condition to have a piece welded on the end, so that it could be used again.



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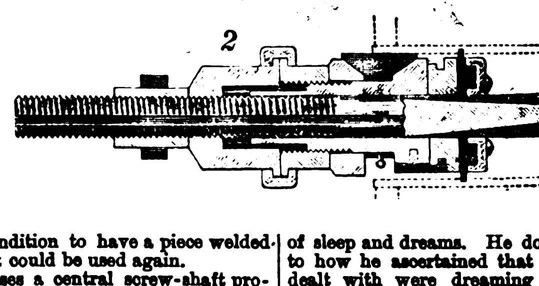

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The cutter comprises a central screw-shaft provided with inclined channels to receive the ribs of the cutter-carrying head. Owing to this arrangement the cutter-head is free to rotate with the shaft, and the shaft has longitudinal movement through the head. Cutters carried by the head are adapted to be moved outward by a longitudinal movement of the shaft and inward by a spring. The shaft is mounted to rotate in a sleeve on which clamping-blocks are supported by a spring ring. On the sleeve a ring is mounted for forcing the blocks outward, which ring is in turn forced longitudinally by a nut engaging a feed nut on the shaft. The abutting portions of both units are engaged by a locking collar. A second sleeve removably engaging the shaft, but rotating therewith, has ratchet-teeth on its outer side, which may engaged by a suitable tool to turn the shaft. This second sleeve brings the torsional strain upon the shaft nearer the cutters than in most similar devices.

In operation the cutter is placed sufficiently within the flue, as shown by dotted lines in Fig. 2. By rotating the sleeve nut, the sleeve ring is forced forward, causing the clamping-blocks so firmly to bind against the interior of the flue that the slightest movement of the sleeve and connected parts is impossible. Then by rotating the central shaft to move it inwardly, the inclined walls of the channels will gradually force the cutters outward, as they are carried round with the head.

The inventor has subjected his cutter to severe tests, and has found that flues can be cut with a gratifying despatch and facility.—*Scientific American.*

DREAMLESS SLEEP.

THERE is no such thing as "dreamless" sleep. So we are told by Prof. Baschide, a German man of science, who has been making investigations of sleep and dreams. He does not enlighten us as to how he ascertained that the thirty-six sleepers dealt with were dreaming when they were unconscious. It is stated in the *Daily News* that his subjects were of various ages, from one year to eighty years. In some cases his observations were continued during the whole night, and in others for a great part of the night. He watched and recorded every change of physiognomy, every movement of the limbs, and every speech or sound uttered by the unconscious dreamers. The depth of the sleep was also carefully measured, while from time to time the dreamers were awakened, but without their own perception that the awakening was intentional.

The Professor obtained, as he states at length, the following results:—(1) We dream throughout the whole of our sleep, even in that deepest sleep which we imagine to be "dreamless." (2) There is an intimate connection between the depth of our sleep and the character of our dreams. The deeper the sleep, the further back travels the retrospect into the past experiences of life, and also the more remote is the contents of dream from reality. In a light sleep, on the contrary, the subject of the dream relates to the experiences and excitements of the day, and has a character of probability. (3) In a comatose sleep, the Professor thinks there may, perhaps, be no dreaming. (4) Persons who assert that they do not dream "are the victims of a psychical delusion." (5) Dreams of a moderate character remain longest in the memory; the wilder the dream, the sooner it is forgotten.

THE LIMITING SIZE OF A TWIST-DRILL.

IS there a limit of size for twist-drills above which they should not be made or used; and, if so, what is that limit? asks the *American Machinist*.

There are those whose experience ought to qualify them to judge that think there is such a limit, and that it may be placed at about 1½in. diameter. Yet twist-drills are regularly made by at least one

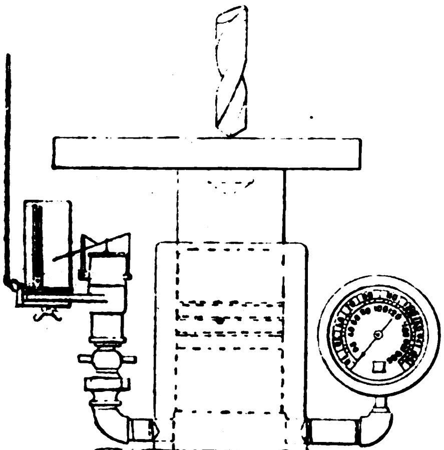
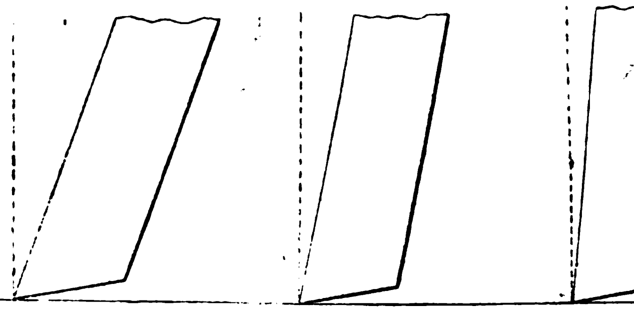


FIG. 1.—Apparatus for Making Drilling Diagram.

manufacturer up to 5in. diameter, and are regularly catalogued up to 3in., both straight and taper shank.

We all know that it takes considerable force to push a large twist-drill through solid steel, and lots of cast iron is put into radial and other forms of drilling-machines in order to keep the deflection of the arms within a reasonable limit when using large drills. At the same time we know that if we want to enlarge a hole already drilled, and attempt to do it with a twist-drill, it takes little or no force to do the feeding, and, indeed, the drill will feed itself (sometimes much too rapidly) if the first hole is nearly the size of the enlarged one. This proves that when drilling is being done the outer portions of the lips tend to draw in or feed themselves, while the central portion resists this drawing-in tendency; the machine and its feed mechanism having to supply the difference between the two forces. This was very beautifully shown by some experiments made by Prof. L. P. Breckenridge in 1888, and described in the *Journal* of the Engineering Society of the Lehigh University for October of that year.

Prof. Breckenridge asked himself the question, "What pressure comes on a drill-press table when drilling cast iron with a 1in. twist-drill?" and in order to answer this question he made the apparatus shown in Fig. 1. This consists of an upright cylinder, closed at the bottom and fitted with a plunger, the area of which is exactly 10sq in. In the cylinder, below the plunger, oil was placed, and grooves were turned near the bottom of the plunger to answer for packing. On top of this plunger the work to be drilled was placed, so that the downward pressure of the drill would produce a pressure per square inch upon the oil equal to one-tenth of the total drill pressure. At the bottom of the cylinder connections were made to a gauge and to an indicator as shown, and arrangements were made to have the downward motion of the drill-press spindle rotate the indicator drum, so that in this way an indicator diagram is made, its length corresponding to the downward movement of the drill and its height to the downward pressure exerted by it. The drill-press used was built by Prentice Bros., of Worcester, and had back gears and an automatic feed. The plates drilled were of cast iron, and were of various thicknesses—½in., 1in., 1½in., and



FIGS. 2, 3, 4.—Angles of Cutting Lips of a Drill at Various Points.

2in. Some were planed on one side, some on both, and some not at all. Morse taper-shank drills were used, ¼in., ½in., ¾in., 1in., and 1¼in. diameter; they were ground upon a twist-drill grinder, and the iron was of about ordinary hardness—not the softest, nor yet the hardest; 143 holes were drilled, and the last of a series of tables given by Prof. Breckenridge gives the following figures:—

Dia. of Drill. Inches.	Maximum Pressure on Drill while Drilling at Start.	Maximum Pressure on Drill while Drilling with Full Diameter of Drill.
¼	400lb.	350- 400lb.
½	900 ,,	800- 900 ,,
¾	1,100 ,,	800- 900 ,,
1	1,450 ,,	1,000-1,150 ,,
1¼	1,800 ,,	1,000-1,150 ,,

These figures speak eloquently of the force required to push the central part of a drill into cast iron, and when drilling steel the effort must, of course, be much more severe. They also show that in the case of the 1¼in. drill, for instance, as much as 800lb. drawing-in force was exerted by the outer portion of the lips of the drill, and the central portion not only used up this force, but required 1,000lb. more to be supplied to the feed mechanism. In other words, they show that when the outer portions of the lips of a drill begin cutting they tend to pull into a solid hole, the same as they do when we try to enlarge a hole with a twist-drill, and that this pulling-in simply relieves the feed motion of a part of the work of pushing the resisting central portion through.

We are in the habit of thinking of the angle of the spiral of a twist drill as being what we see when we look at the drill, i.e., the angle at the outer edge of the groove. This angle for medium-sized drills, say from ½in. up, is about 20 degrees, as shown in Fig. 2, which we may take to represent the outer surface of one side of a twist-drill with its spiral lines straightened out. But really most of the cutting edge has much less cutting angle, or rake, and if the lips were carried to the centre they would have none. Taking the central portion of a 5in. drill, for instance, equal to half the total diameter of the drill, and the angle of the spiral would be as in Fig. 3; and going down to 1in. diameter, the angle is as shown in Fig. 4. At the centre this drill is ⅛in. thick, and must be literally pushed through the work, or, if thinned on the point, as is sometimes done, and ought always to be done with large drills, the cutting angle is necessarily a negative one, and the stock is simply crushed or pushed off by that portion of the edge.

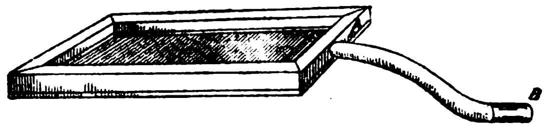
It is this central portion of the drill which must be forced through the work, while the outer portion must be held back to keep it from screwing itself through at a rate entirely too fast for the safety of the drill. This, of course, sets up two opposing forces within the drill itself, and if the centre of a drill be made too thin it splits lengthwise, while if it be made too thick, the resistance of that portion becomes enormous.

What is thought by many to be a better plan is to use ordinary drills up to about an inch diameter, and then follow with a tool which resembles the outer portion of the twist-drill, so far as its cutting action is concerned, but has twice as many cutting edges, and is more efficient as a cutting tool. Its centre is plenty thick enough for great strength, and it follows a drill of from 1in. to 1½in. diameter, according to circumstances. It is believed that holes above 1½in. diameter can be drilled faster by the use of a regular drill followed by this tool, and both of them pushed to the limit of their capacity, than is possible where the full diameter is drilled from the solid at a single operation, and with this tool the drilling-machine needs to supply only the rotating force; the tool will feed itself almost, if not quite.

If Prof. Breckenridge's experiments had extended far enough, so that the figures could have been given for a 5in. drill, the results would probably have been somewhat startling.

APPARATUS FOR REMOVING BUBBLES FROM MOUNTS.

IN the course of my peregrinations among the laboratories of the North of England, I have, upon several occasions, met with a small exhaust apparatus which is used for the removal of air-bubbles from mounts. It is simple in construction and effective in action, and a description of it may not, therefore, be without some interest to readers. It consists of a slip of plate-glass measuring 4in. by 1½in., to which a frame of wood has been cemented. The frame is of such a size as to allow of ordinary glass micro-slips being placed in it. In one side of the frame a hole is bored, and one



end of a piece of indiarubber tube, measuring 6in. long by $\frac{1}{16}$in. diameter, is cemented into it. A piece of glass tubing, B, 1in. in length, is closed at one end, and a small hole is bored through it at about a quarter of an inch from the closed end. The open end of the glass tube is then slipped into the free end of the rubber tube, and the two so arranged that the hole in the former shall be just covered by the indiarubber. To use the apparatus, place the mount containing the air-bubbles in the wooden cell, and cover it over with a second slip of glass measuring 4in. by 1½in., the edges of which have been previously greased with tallow. If the frame has been accurately made the cell will now be air-tight. Exhaust the cell by drawing the air through the tube. The valve formed by the hole will prevent the re-entrance of air, and any bubbles contained in the mount will quickly disappear.—J. H. COOKE, in the *Journal of Applied Microscopy*, N.Y.

FILM PHOTOGRAPHY: THE LATEST PROCESS.

THE latest process of film photography is due to Mr. Albert Hofmann, of Cologne, who gives the following description of it. Smooth, well-gummed, even baryta-weighted or similarly prepared papers, or woven materials, or other flexible bodies serving the purpose, are coated either on one side or both sides with substances soluble in alcohols, ethers, or benzines, such as resin alone or in combination, but at all events not made brittle, but softened through being dissolved in fatty oils or turpentines. The best results are obtained with simple solutions of shellac, gum sandrac, or mastic, with the addition of fatty or drying oils—e.g., castor oil—also with turpentine or the common pine-tree resin, with suitable additions to make and and to maintain the product soft and ductile. Just as good are the soluble albuminous bodies of cereal origin, such as vegetable gluten. After this film is taken up and is dried on, one applies a gelatine coating, to which is added a hardening medium, alum, chrome alum, or the like. With a suitable concentration, one can get a sufficiently thick coating in one operation, otherwise one must repeat the operation often enough to give the final product the requisite strength, in order that it may act as independent negative without any later strengthening. Under certain conditions, gelatine can be applied to both sides of the paper, and, after being dried, coated with a layer sensible to light, whereby it is rendered serviceable for using on both sides. In

this case the original paper must be blackened. The laying on of the sensitive sheet is accomplished in the well-known manner, as well as the development, fixing, and washing of the negative after exposure.

Before the negative is dried, it is placed for a few minutes in a spirit-bath, after which the paper easily loosens itself from the foundation. In order that the separated negative may be hardened and softened, it is now immersed in alcohol containing 5 per cent. of glycerine and 5 per cent. of formalin. The film coming out of this alcoholic glycerine bath is then dried, suitably pressed on to a scrupulously-clean glass plate, varnished, and copied, exactly like every other negative. It can, however, be used as an independent film, without transfer to a glass plate.—*British Journal of Photography.*

CASE-HARDENING.

THE following Report of Committee on Case-Hardening was submitted to the Annual Convention of National Railroad Master Blacksmiths' Association, Milwaukee, 1899, by John Bulkley:—

The process of case-hardening has not changed materially for the past few years. The principle materials used remain the same: granulated raw bone, hydro-carbonated bone black, black oxide of manganese, sal-soda, charcoal, and salt. These materials are commonly used in railroad shops, and give much satisfaction if they be carefully and properly handled. For pins and bushings and such light work as is required for immediate use, we use the "New York Specialty Case-Hardening Powder." This we found to be greatly superior to potash. Specimens of same will be found among samples of case-hardening submitted here for your inspection.

The work which is to be hardened can be packed in cast or wrought iron boxes, sealing with fireclay or mud so as to prevent the gases from escaping as much as possible. The pieces to be hardened should be placed about 2in. apart in box. The vacant spaces are well filled and packed with the material you are using for case-hardening purposes. Should your box be supplied with heavy work, as crank-pins, guides, &c., fifteen to twenty hours of steady heat is necessary in order to secure best results. If, on the other hand, you have light pieces, as links, link-blocks, and pins, eight to ten hours will be sufficient to subject them to a good heat. This class of work we place in the furnace about eight o'clock of a morning, and heat it all day. At night, close up the furnace, letting the box remain over night, and remove next morning. Reheat this work and cool in cold water.

We have secured good results by using granulated raw bone. If using hydro-carbonated bone black, pack pieces in box and seal same as before given. Furnaces for case-hardening should be so constructed that boxes would not have to be raised or lowered while being put into or taken from the furnace. The heating space is near the ground. The firebox and ash-pan are below the surface.

This refers to a furnace heated with soft coal. If the furnace is on outside of a building, a stack or chimney about 16ft. high will furnish draught enough to heat boxes without aid of blast.

Case-hardening furnaces which are heated with fuel oil are of a very different construction, the boxes being generally heated from the top; with coal, in most cases, it is from the bottom. The cooling tub is arranged so as to admit cold water from the end near the bottom, the cold stream thus running lengthwise along the bottom of tub. This cold stream forces the hot water to flow over top of tub. When cooling, guides or long pieces, strips or bars of iron, should be laid in the bottom of tub, in order to keep the work about 2in. or 3in. from the bottom of tub; in this way the cold stream flows under the work which is being cooled.

COLD AS AN APPETISER.

THE benefit of pure air as an appetiser, especially if taken in connection with outdoor pursuits, is well known to every Nature lover. Now it appears that air in liquid form is of benefit to the appetite from the results of lowering temperature.

The Bulletin of Pharmacy is responsibe for the statement that a Russian physician recently placed a dog in a room with the temperature lowered to 100° F. below zero by the use of liquid air. "After ten hours the dog was taken out alive, and with enormous appetite." The Bulletin does not state how much more "enormous" was the appetite after a ten hours' fast in the very cold room than it would have been at normal temperature.

However, the physician was so pleased with the manner in which that dog took to his food that he tried the test himself and reports this result: "After ten hours' confinement in an atmosphere of still, dry cold, his system was intensely stimulated. So much combustion had been required to keep the body warm that an intense appetite was created. The process was continued on the man and the dog, and both grew speedily fat and vigorous. It was like a visit to a bracing Northern climate."

If this theory is to be followed out, a reduction in price of coal and house furnaces may be expected. The reverse effect is true of cold-blooded animals. Prof. Smith, of Yale College, is authority for the statement that frogs may probably be kept alive for several years, possibly even as many as ten, without food in water of uniformly very low temperature.

AIRSHIP OR AËROPLANE—WHICH?

THE quest for a successful means of aërial navigation has been prosecuted along two different lines, according as the inventor aimed at the construction of a navigable balloon or airship, or a flying-machine or aëroplane. The early flying-machines, in which suspension and forward motion were attempted by imitating the flapping wings of a bird, were futile and wofully fatal. In later years they have given place to the scientifically-conceived soaring machine and motor-driven aëroplane. On the other hand, the old pear-shaped balloon, which depends entirely upon the wind for propulsion, has developed into the modern, cylindrical, screw-propelled airship. The progress of invention in aëronautics has been marked, sometimes by a preference for the aëroplane, sometimes for the airship type. To-day, it must be confessed, the latter is most in the public eye, chiefly because of the stupendous proportions of the Zeppelin airship, now nearing completion on its floating dock in Lake Constance.

The popularity of the aëroplane, and the widespread conviction which was noticeable a few years ago that this type would be the machine of the future, were based upon the fact that it was built upon the principles which govern the flight of birds. Since we now understand the laws of flight, and improved materials have enabled us to build flying-machines that are gradually, if very slowly, approaching the bird in their ratio of power to weight, it was argued that the production of a successful flying-machine was a matter of time merely. It is probable, however, that in coming to this conclusion, sufficient importance has been attached to the human element, upon which the successful operation of the aëroplane is absolutely dependent. It would no doubt be possible to build an aëroplane that would carry a person at a fairly rapid speed through the air, provided the occupant of the machine possessed that God-given faculty by which the bird is able to preserve its equilibrium, adjusting the position of its weight and the inclination of its wings to the ever-changing velocity and direction of the wind, and the varying speed and direction of its own flight.

This matter of equilibrium is determined, in the aëroplane, by the inter-relation of several factors, such as the speed, the inclination of the supporting planes, the position of the centre of gravity with regard to the centre of area of these planes, and the inclination of the guiding tail. It requires rare quickness of perception and judgment to keep all these factors in the harmonious equipoise necessary to equilibrium, even under the favourable conditions of a perfectly still atmosphere; but when we remember that every change in the direction and strength of the wind calls for an instant readjustment of the machine, and that a moment's hesitation might result in a sudden dive earthward, the perils of aëroplane navigation will be evident. The fatal mishaps to Lilienthal, Pilcher, and others were due to a failure to control the equilibrium, and the present indications are that as long as the balancing is dependent upon the sensations and voluntary control of the operator, aëroplane navigation will remain a very hazardous and fatal form of recreation.

It is evident that some method of automatic mechanical control is necessary, and the results achieved by Prof. Langley on the Potomac River indicate that such control is within the possibilities of the future. In perfectly still air the Langley steam-driven aërodrome achieved a steady flight of three-quarters of a mile at a speed of thirty miles an hour. But although this was a truly wonderful result, and speaks eloquently for the skill and unconquerable perseverance of the inventor, the aërodrome is to-day nothing more than a wonderfully ingenious toy. It is a far step from that to a machine of commercial or military utility, capable of carrying its freight in any direction in all possible conditions of wind and weather.

The airship (using that term to include all gas-inflated machines), though not by any means so attractive as a scientific problem, seems to be at present the more practicable. For in this type the question of suspension in mid-air has no necessary relation to the speed, as in the case of the aëroplane, and the efforts of the operator may be devoted entirely to steering and propulsion. Given a sufficient volume of gas and a containing cylinder of the proper strength, there is theoretically no limit to the weight which may be lifted. It is in providing a motor sufficiently powerful to propel the huge structure against a strong opposing wind that the difficulty lies. This has never been accomplished as yet, and there is no expectation that even the mammoth Zeppelin airship will be able to make headway against anything stronger than a moderate breeze. Its proposed speed is 22 miles an hour, and hence it will be helpless against a wind of that velocity. Nevertheless, if this distinguished German succeeds in achieving this speed with an airship capable of carrying a crew of several men, he will have placed the problem of aërial navigation on a practical basis which it has never hitherto reached.

The Zepplin airship is of unprecedented size. It consists of a conical-ended cylinder 39ft. in diameter and 410ft. long, carrying two parallel, boat-like cars below it, in which are placed two 15H.P., benzine motors for driving the propellers. The hull consists of an aluminium framework surrounded with a strong netting, within which will be 17 separate, independent, airtight gas balloons, the arrangement resembling that of the watertight compartments of a steamship. The ship will be trimmed by means of a weight sliding on a cable suspended below the cars. By sliding the weight aft, the bow will be thrown up, and the reaction of the air will cause the ship to rise; the contrary movement of the weight will depress the bow and cause the ship to sink. Unless some unforeseen difficulty arises, we may expect to learn the results of the trials of this Brobdingnagian at any moment, and their publication will go far to determ'n the possibilities of aërial navigation on a practical and commercially useful scale.—*Scientific American.*

THE EBONY OF THE ANCIENTS.

EBONY was known and highly-esteemed by the ancients as an article of luxury, and was used by them for a variety of purposes, says the *Jewellers' Weekly.* In India it is said that it was employed by kings for sceptres, and also for images. On account of its supposed antagonism to poisons, it was used largely for drinking cups. Its use has extended continuously down to the present time, and in England, as well as on the Continent, it has always been held in high esteem by the wealthy for toilet articles and boxes. In France particularly the manufacture of ebony goods has attained a high degree of perfection. Within a few years its use in the United States has increased remarkably, in a large measure, no doubt, on account of its combination with silver, which is believed to have originated in this country. The striking contrast of the dead black of the wood and the brilliant white of the silver has from the outset commended it to the American public. This combination, it is said, has now been introduced into England and other European countries. The silver mounting of the ebony gives scope for the taste and originality of the silversmith. The style of decoration most frequently used on the larger pieces consists of a border of scrolls, of flowers, or of a combination of scrolls and floral designs. The variety and degree of elaboration the borders shown are almost endless. Sometimes the border extends only half-way round the edge of the article. A silver shield, on which the initials of the owner may be engraved, is generally placed in the centre of the piece. This shield is occasionally replaced by a monogram, more or less elaborate, which may be the only mountings used. Large initials are also used instead of a monogram. Another style of decoration consists of a beaded edge of silver. While the border is occasionally used on smaller pieces, the decoration for these is generally confined to a shield or monogram. The shield may be combined with floral designs or scrolls. The name ebony is given to the wood of several varieties of trees. All kinds of ebony are distinguished for their great density and dark colour. The wood in all varieties is heavier than water; the heaviest varieties are the darkest. The other grades require a considerable amount of staining to make them black. Ebony is of a uniform colour throughout, and will not show any deterioration even from long-continued use. There are three varieties of ebony well known in commerce. The ebony from the Gaboon coast of Africa is the darkest; the Madagascar ebony is the densest; the Macassar ebony furnishes the largest pieces. Almost all ebony is sent in the form of logs to London, and from there shipped to the various countries in which it is used for manufacturing purposes; it is sold by weight. Imitations of ebony can always be distinguished by their lighter weight, and the cheaper imitations can be detected by merely scratching the surface.

THE most recent discovery of alluvial deposits is in Tasmania. The Mount Bischoff mine, the largest lode tin mine in the world, is situated in that colony. A more recent discovery has been the finding of huge alluvial deposits of great richness and depth. Perhaps the most famous of alluvial deposits referred to is that of the Briseis tin mine, situated at Derby, county Dorset, in the north-eastern tin field of Tasmania.

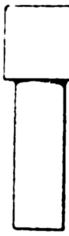


Fig. 1

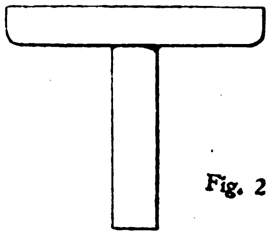


Fig. 2

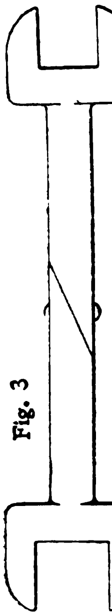


Fig. 3

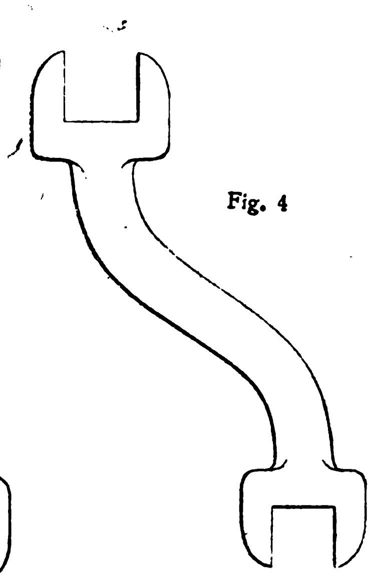


Fig. 4

MAKING AN "S" WRENCH.

THE following method of making a wrench of S shape is given by a correspondent of the *Blacksmith and Wheelwright*. Take a piece of cast steel bar, 1in. square; draw down end 2in. long to fit round hole in anvil. Then cut off, leaving 1in. of square head to the piece as in Fig. 1. Then work round part in hole in anvil, and draw square head each way, working it down to ⅝in. by ½in., or any size wanted, as shown in Fig. 2, and turn up each end to fit size nut wanted. Make two pieces exactly alike, scarf the ends and rivet them together (Fig. 3) and weld, then flatten round part or handle to one-fourth inch thick, leaving ends round. Fig. 4 shows the wrench completed.

PARISIAN INVENTORS' ACADEMY.

THE following curious letter is brought into the light of day by the *American Machinist*, with some appropriate comments. Our contemporary says:—There is in Paris an institution which awards medals to inventors. The inventor apparently has to do almost nothing to secure one of these medals, except to pay 10dol., and he thereby becomes the owner of a medal, the intrinsic value of which may be as much as 50 cents. Numbers of our American inventors have been elected to membership in this academy "unbeknownst" to them, and apparently on the simple announcement of their names and addresses in our *Patent Office Gazette*. This membership costs nothing, but it entitles the member to "the first-class diploma and the great gold medal" (gilded), and for these the 10dol. or "2 pounds St." are required. Naturally, doubts as to the value of this membership, so easily acquired, will arise in the mind of anyone who knows enough to pull on the end of a rope; but such doubts may (perhaps) be set at rest by the following letter, which is printed on the back of a circular letter announcing election to membership of a friend of ours, which friend thinks this is a matter that ought to interest or amuse our readers, especially Captain John's testimonial, which is as follows:—

"Captain John Uster, Paterson, New Jersey,
"U. St. of America, April 3d, 1899.

"Dear Sir: Almost respectfully, I beg you, kindly to accept the following Lines as a Testimony from me, in regard to you Self and the worthy 'Academie Parisienne des Inventeurs.'

"In 1891, I had the pleasure to git acquainted with your Academie;—And since, always was in friendly and often very business like Corespondence with you as President of the Academie;—I confirm here with Pleasure that the Academie have me, as Inventor, promoted to the Rank of a Honorary Member of said Institution.

"The Academie Parisienne des Inventeurs should be recognised as the almost worthy and best one in the whole World!—Indeed i dont testify so in acount of have geting acquainted to the Academie once, either is and in acount of having received Gold, Medal and diplom, o no, it is not the Goldmedal make me testify so, no matter how proud I am about'm, a great deal more was the Inspiration I have received there, I was in a short time quiet an other Man, as i was befor, I could say the Academie did (in 1891) lay the Corne-stone for my Luck afterwards for Lifetime Once a Member of the Academie, the friendly Acting of the Members towards any Inventors will make them improving from Day to Day, the wouldnt let any one doe like the Grandfathers did 50 years ago, o no the want to see any men smarter next morning as the was he Day before indeed exactly so was with myself, the so strickty and lawfull Acting of the Academie towards me was just licke a Spring put in to my whole Body, with nearly the same Effect like a Spur in the Priders Heel towards the Horse,—As i said before: It was the Inspiration, received from your Self and the Academie, that i git up to the point where i am now, only for this i might would not be in Possession of two other Gold, Medals from the Exhibition at Paris, in 1897, because i may was not able to have any Invention to place there - nothing to say about, that I am able to bring 4 other new Inventions to the Exhibition next year 1900.

"Now 3 Cheers for the Academie! And my Sincerely thank for all the Goodness of you all.

"Gentlemen, very respectfully, yours truly, Friend and College:

"Captain John Uster Paterson,
"New Jersey."

GRINDING SHOP TOOLS.

IN the old days every man ground his own tools, or rather the tools he used, and each had a peculiar turn or angle which, in his eyes, made them cut better than any other tool in the shop. This included everything, from drills to milling-cutters, and resulted in a great variety of shapes and sizes. It also took considerable of each man's time, and did not improve the condition of such tools as drills (flat or twist), milling-cutters, or reamers.

The drill-grinder has long been a part of nearly every tool-room, and no one will deny that drills are ground more uniformly and at less expense than by the old way. They also do better work, as the cutting-angle is correct, and, being even, they drill true to size.

The grinder for reamers and milling-cutters is also making its way, and the lathe and planer tool-grinder is the problem in many shops at present. Some have adopted it and are using it with success—others have tried it and are either using it in a half-hearted way, and are not getting all there is out of it, while some have abandoned it altogether and call it a failure.

Its success in large machine shops, however, shows that it can be made a paying investment, while the results obtained in some of the large railroad shops show that it is applicable to this work as well as to any other. The problem is in its application and in deciding when it will pay to introduce the new system. This decided, the next thing is to determine to use it successfully by adhering strictly to the suggestions of the makers.

It is sometimes objected that it takes longer to set the machine and grind a tool than to do it by hand, and the objection shows that the proper use of the tool-grinder is not understood in this case.

Having the grinder, get all the lathe and planer tools in the tool-room. Grind all the turning-tools to the form you select for that kind of tool, and carry this through them all. Have enough of each kind so you always have a supply, and keep them in the tool-room, subject to call. They should be ground in as large lots as possible, as it reduces cost by avoiding setting the machine so often.

When a tool is dull, let it be brought (or sent in a large shop) to the tool-room and exchanged for another—the dull ones can be ground when enough have collected. Two or three can be issued at once to avoid delay between tools, and the machines kept constantly at work.

The main difficulty in introducing this seems to be in not doing it entirely according to the ideas under which it was designed to work, or of trying to compromise the old with the new. With each man going to the grinder, setting it and grinding his tools, it becomes an expensive tool, although still having the although still having the advantage of uniformity. But with all the tools of the shop ground by one man—or more if necessary—there should be an increase in production. And unless the system is thoroughly carried out, there is little use in buying a grinder, for, like many other tools, they can save or lose money according to the way they are used.—*Locomotive Engineering*, N.Y.

A method of thawing water-pipes by electricity has been put to the test in Canada. Alternating current at a pressure of 20 volts to 50 volts is used, obtained from a portable transformer connected with the street mains; a current of 200 to 400 ampères is passed through the frozen pipe until the water flows freely, which usually takes place in a few minutes.

A Lobster in a Short Jacket.—"One must live," said the tramp. "No," replied the cynical alderman, "I don't see the necessity." So writes the Rev. Thos. R. R. Stebbing, F.R.S., in *Knowledge* for December. But, at all events, in order to live, one must breathe. This is indispensable alike to tramps and aldermen and crabs, and to every item of the animal world. Some minute organisms may be dessicated by heat or frozen by liquid air into a state of suspended animation, and a stuffed lion in a museum, or an embalmed Pharaoh in a pyramid, may out of courtesy still be called an animal, though each ceased to be one as soon as the breath was out of its body. Breath being so essential, respiration, like perspiration, all over the surface, wears the aspect of an advantage. It is, in fact, not to be despised, and, such as it is, this advantage is enjoyed by several animals, and among them by some of the crustacea. But with increasing complications of structure and existence, more than one consideration comes into play, as the greedy boy, who wished that he was all mouth, would speedily have discovered. Nature, in her more elaborate efforts, utilises division of labour, and allots special organs to special functions. Anyone who has used a hammer for cracking open the claw of a crab will understand how unsuitable a surface for respiration would be afforded by that stony, water-tight integument. In bringing to perfection her wonderful karkinokosm, Nature certainly did not begin by making crabs, but rather in that line of business produced them as the crown of her operations. To follow Nature, then, we must not begin by investigating the breathing apparatus of a crab, but follow down the line till we come to something simpler. Pause, then, at the amphipods. Specimens can be had without cost. An amphipod might be familiarly described as a lobster in a short jacket. It differs from the lobster in that its eyes are not movable on jointed stalks. With its whole body so small and nimble, separate ocular mobility could scarcely be needful to it. Otherwise, in the general inventory of its kit, this little campaigner agrees with the lordly lobster, thus:—Antennæ, two pairs; one upper lip, one lower; one pair of mandibles; maxillæ, two pairs; maxillipeds, three pairs; and five pair of trunk legs. By all means catch a *Gammarus pulex* in the rivulet that runs through your park, or a *Gammarus locusta* that slidders under weeds and stones on almost any sea-shore, to see whether I have counted right."

SCIENTIFIC NEWS.

THE eclipse of the moon seems to have been well observed from many districts, but the accounts of the colours vary. When the greatest phase was reached, the moon appeared of the dull copper colour so well known, and it was noted that the crescent at and near the greatest phase appeared to be part of a circle larger in diameter than the boundary of the eclipsed portion—the effect, probably, of irradiation. The late eclipse was very little short of being total; but it is very rarely that the moon entirely disappears in even a total eclipse.

Another small planet was, it is stated, discovered by M. Charlois, of Nice, on Dec. 4, and, if it is verified, it will increase his number of discoveries —already the largest—to ninety-five.

Prof. H. H. Turner, the Savilian professor of astronomy at Oxford University, has issued (London: Henry Frowde) "the Day Numbers of the *Nautical Almanac* for the years 1900, 1901, 1902," modified for use with the tables of the star constants arranged by the late E. J. Stone, M.A., F.R.S.

"Precession Tables adapted to Newcomb's Value of the Precessional Constant and reduced to the Epoch 1910·0" have been issued by Dr. A. M. W. Downing, M.A., F.R.S., through Neil and Co., Ltd., Edinburgh. The tables can be used from 1900 to 1920.

A course of eight lectures on the methods of spectroscopy, especially in connection with the photography of the spectrum, will be delivered at University College by Mr. E. C. C. Baly, commencing on Jan. 19, 1900, and continuing on following Friday evenings.

The date when the 20th century commences seems to still be a puzzle, and the following paragraph (the statements in which may not be true) is widely published:—"In Sweden the next century is to be considered as beginning with Jan. 1, 1900. According to a Dalziel's message there are many Swedes who hold the view that the next century will not be entered upon for another twelve months; but in order to overcome their objections and remove their scruples the bishops and clergy generally of Sweden have been requested to dwell specially upon this point in their sermons on the concluding Sunday of the year. Further, all the church bells will begin to ring at midnight on Sunday for half an hour to welcome not only the new year but the new century." It is not stated by whom the "bishops and clergy," &c., have been requested to dwell, &c.

The Christmas lectures at the Royal Institution will be delivered by Prof. C. V. Boys, F.R.S., on Dec. 28 and 30, and Jan. 2, 4, 6, 9. The subject will be "Fluids in Motion and at Rest."

The Friday evening meetings of the Royal Institution commence on Jan. 19, when Lord Rayleigh will deliver a discourse on "Flight."

Amongst the lectures already announced at the Royal Institution may be specially noted a course of three by Prof. H. H. Turner, M.A., F.R.S., the Savilian professor at Oxford, on "Modern Astronomy," to be delivered on Feb. 8, 15, 22.

A Congrès International des Sciences Ethnographiques is to be held in Paris on Aug. 26 – Sept. 1, 1900. There will be seven sections. The secretary is M. Greverath, rue d'Athènes 3 bis, Paris.

At the preliminary meeting in connection with the British Congress on Tuberculosis to be held in the spring of 1901, Sir Samuel Wilks, ex-President of the Royal College of Physicians, said they all knew that tuberculosis was a bacillus, a living organism peculiar to tubercle. In consequence of that discovery came the natural corollary—that that bacillus might be carried about by air or food, and was therefore infectious or contagious. One of the objects of that society was to appeal to the public to enable them to obtain new hospitals or sanatoria where patients might be cured of that disease. A pioneer in this subject, the late Dr. MacCormac, of Belfast, gave nearly all his time and his energy to advocating the treatment of consumption by fresh air breathed night and day, especially at night, with open bedroom windows. He said that this was the best way of curing the disease. The disease was especially prevalent in oxen and cows, and was propagated by the food which people ate and also by the milk they drank. These facts, which he had mentioned with reference to the disease of tuberculosis, were accepted now all over the world with perfect unanimity of opinion in the medical profession in every civilised country; but, inasmuch as we were so closely associated in the present day by travel and otherwise, it did seem desirable that they should meet together to discuss this matter in common, and that some common methods of action should be proposed.

The death is announced of Dr. John Frederick Hodges, Professor of Agriculture and Lecturer on Medical Jurisprudence in Queen's College, Belfast. Educated at Trinity College and the Royal College of Surgeons of Dublin, he became, in 1837, a licentiate of the Faculty of Physicians and Surgeons of Glasgow, and afterwards studied in Germany, where in 1843 he graduated doctor of medicine in the University of Giessen. He then applied himself to the study of analytical and agricultural chemistry; and subsequently filled the office of chemist to the Chemico-Agricultural Society of Ulster; analyst to the city of Belfast and to the counties of Antrim, Tyrone, and Donegal; Professor of Chemistry, Royal Belfast College; Examiner, Queen's University, Ireland; and president of the Natural History and Philosophical Society and of the Royal Academy Institute, Belfast. He was also an honorary member of the Academy of Agriculture of Sweden, and many other scientific societies. Dr. Hodges was nearly, if not quite, the oldest member of the Chemical Society of London, having been elected a Fellow in 1844—three years after the formation of the society. He was the author of the following works:—"First Book of Lessons in Chemistry for Farmers and Teachers" (a work which reached a 12th edition in 1862), "First Steps in Chemistry," "The Structure and Physiology of the Animals of the Farm," and contribution to the reports of the British Association, the *Medical Gazette*, and the *Journals* of the Chemical Society. He was also for some years editor of the *Journal* of the Chemico-Agricultural Society of Ulster.

Sir Richard Thorne Thorne, principal medical officer of the Local Government Board, is dead. He was born at Leamington in 1841, and was the son of a banker there. After passing through Mill Hill Grammar School and the Lycée St. Louis, Paris, he became a student at St. Bartholomew's Medical School. Sir Richard, who obtained his M.B. degree with double first-class honours, was the author of several important medical works. As a member of the General Medical Council, he has represented Great Britain at the principal international sanitary conferences at Venice, Berlin, and other cities.

Mr. Bernard Quaritch, the famous bibliophile, died on Sunday last at the age of eighty-one. During his long career he has bought and sold most of the rare books and MSS. which have come into the market, and of late years he has purchased all copies of the Mazarine or Gutenberg Bible which have come into the market. He was one of the founders of the "Ye Odde Volumes," a society of bibliophiles founded about twenty years ago.

Mr. James Robertson, who died recently in his seventy-ninth year, was one of the most prolific inventors of the day in the engineering world, more especially in connection with hydraulic machinery for the manufacture of tubes of various metals.

Mr. David Peebles is also dead in his seventy-third year. He, too, was an inventor, especially in connection with gas appliances—his needle burner and governors being widely known. He was a Fellow of the Royal Society of Edinburgh.

One of the greatest railway builders in America died the other day. Mr. John Insley Blair was born in New Jersey in 1802. He built more than 2,000 miles of railway in Iowa and Nebraska alone. When the Pacific railroad was proposed it was found that the cost of transporting the rails by river would be ruinous. Mr. Blair was therefore urged to complete his own connecting line across Iowa, which he did in less than a year, thus earning a million acres of land by way of premium, besides the great profits from carrying the rails, merely for finishing his own road. Beginning with 1860, he was connected with the construction of most of the great land-grant roads east of the Rocky Mountains. Though little heard of in the great railway combinations of recent years, there have been few of importance in which he did not have some part. He was a life-long Presbyterian, and gave about 500,000dol. to various institutions, mainly universities and colleges connected with that denomination.

M. Henri Becquerel has been recently investigating the phosphorescing properties of radium, and he discovered that the rays given off by chloride of barium containing the new (?) element radium produced luminosity in all the minerals which become luminous under the influence of X rays. Many differences were, however, noted, for ruby and calc spar remained unaffected by the radium, while diamond became brilliantly luminous. The subject will no doubt engage the attention of students of phosphoresence and radiation for some time. M. Becquerel has communicated his observations to the Paris Academy of Sciences.

M. Armand Gautier, in a memoir presented to the Paris Academy of Sciences on the presence of arsenic in certain organs of animals, says that it is present as a normal constituent of the thyroid gland in the herbivora, the carnivora, and in man. As it appears that it is also present in other organs the successful use of arsenic as a remedy in certain diseases — for example, anæmia and Basedow's disease (goitre, &c.)— would appear to be explained. The memoir will attract the attention of toxicologists, for arsenic-eating has been known as a habit for many years.

In a memoir presented to the Paris Academy of Sciences, M. Berthélot refers to the explosive properties of chlorate of potassium. He finds that if the chlorate is suddenly placed in a vessel at a higher temperature than that at which decomposition commences, the salt explodes, though if slowly heated the chlorate does not explode. The investigation was probably made in consequence of a comparatively recent disaster in Lancashire.

At a meeting of the Staffordshire Iron and Steel Institute, last Saturday, Mr. H. B. Toy read a paper on "Iron and Steel Works Plant," in the course of which he said that it was well established that for many purposes steel had superseded iron; but he firmly believed that if the heads of departments in ironworks would study more closely the question of economy of production, and improve their plants by judicious expenditure, the iron trade of the district would die a much more lingering death than was frequently predicted. The question of railway rates very seriously affected not only the development of any new industry in the Midland counties, but was gradually compelling manufacturers either to discontinue an old-fashioned business or seek, at a very great cost, some more convenient site at the coast or elsewhere. If the members of that Institute could in any way prevail upon the railway companies to make a concession in their rates from the Midlands to our shipping ports, they would not only benefit themselves, but confer a great blessing upon many other branches of industry. He did not recommend all owners of ironworks to dismantle their plants and replace them with something quite different, but to make the necessary modifications to those details which seriously affected the cost of production, and which in many cases could be done at a small expense. Mr. Toy condemned the practice of replacing old egg-ended cylindrical boilers with new ones of the same pattern. Several attempts, he said, were being made in Staffordshire to roll steel sheets in old iron mills; but, considering the many difficulties, he was afraid the trials would not be attended with very great success. The ultimate monopoly in the steel trade would be vested in those who had their own blast-furnaces, steel-smelting works, and sheet works. His impression was that in the near future steel sheet bars 18in. wide would be rolled direct from the ingot in a universal reversing two-high mill.

At the monthly meeting of the British Ornithologists' Club an agreeable surprise was in store for the members in the exhibition of a remarkably fine egg of the great auk, hitherto unrecorded and recently discovered. The specimen is said by the experts to be unsurpassed in beauty and preservation. The number of eggs of this extinct bird now known to be in existence is seventy-two, fifty-four examples being in England. The birds exhibited included several species new to science from the New Hebrides (from which islands Capt. Farquhar, R.N., has recently brought home a small but extremely interesting collection.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE ECLIPSE OF THE MOON.

[43118.]—THE lunar eclipse was well seen here, the atmospheric conditions being very favourable. The moon shining through the shadow was of a coppery red colour, more ruddy in the northern hemisphere. During the eclipse several stars were occulted, which could not have been observed unless the moon was undergoing eclipse. Of these occultations there were at least four, and possibly others beyond reach of my instrument; the disappearance was in all cases quite sudden. The eclipsed moon hanging over Orion, with the rich region of stars around Aldebaran on the right, and Sirius shining brightly low down on the left, formed a very impressive astronomical picture.

Earlsfield, S.W. **Silverplume.**

[43119.]—HAVING observed and reported on in "Our" pages a number of lunar eclipses within the last ten years, I may say, by way of preface to a more minute description of last Saturday's superb spectacle (astro. reckoning), that the peculiarities of the eclipse from my point of view were: The very marked evidence of penumbral shading over the "seas" between 11h. 25m. and 11h. 45m., and the curious way in which this shading seemed to avoid the Polar regions. The sharply defined advancing edge of the shadow, even when scrutinised by a power of 80 on 3in. refractor. The alternate transparency and opacity of the shadow itself, and the very close approximation to totality at the time of maximum phase.

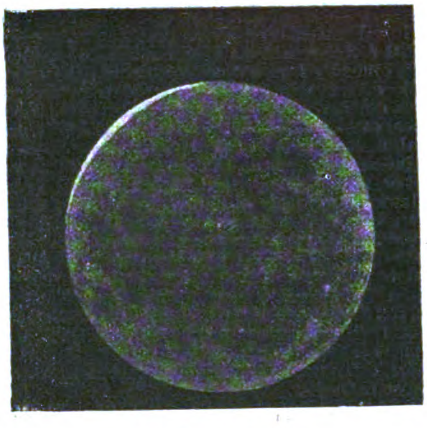
Employing throughout a power of 80 on 6in. o.g. and using a diagonal to avoid getting a permanent crick in the neck, the progress of the phenomenon could be very conveniently noted. At 11h. 25m. the penumbræ shading over the "seas" forcibly suggested the idea that a dilute specimen of London "peasouper" was paying its attention to the lunar lowlands. During the next five minutes this fog seemed to gain much in density, and the intense whiteness of the regions south of Tycho and north of Plato suggested a considerable elevation above the smother; by 11h. 40m. however, the "fog" seemed to have nearly forsaken the *Mare Serenitatis*. At 11h. 45m. a deep brown discoloration in the E.N.E. bespoke the close proximity of the shadow itself to that neighbourhood, and 90sec. later Aristarchus was immersed in it. For some time afterwards this object could be seen at intervals very conspicuously, while now and again it disappeared completely. The eclipsed limb of the moon became visible by 11hr. 50min., at which time the area in shade was very dark, and there was a very deep band following advancing edge of shadow. The South Polar regions were still intensely white. Five minutes later the eclipsed limb was lost to view in some places, but distinctly visible in others; whilst with the lapse of another ten minutes it reappeared in its entirety to remain on show. By midnight the area of the moon in shadow became visible, and so continued throughout the time I was watching; but the transparency of the shadow varied momentarily, so much so that one was tempted to think there must be heavy masses of cloud in the lower atmosphere about the margin of the earth seen from the moon.

Generally, the colour of the umbra seen in the telescope was a deep grey, but at times I suspected a greenish tinge in it; whilst one or twice it assumed quite a turquoise appearance. To unassisted vision the eclipsed area of the moon maintained a "coppery" look throughout; but the ruddy tinge sometimes so noticeable was to my vision entirely lacking. Near the time of middle eclipse the lunar disc strongly resembled an iron one at a dull red heat, with dark patches near the centre, and the lower edge raised to welding temperature. I quite expected to witness a rehearsal of "the old moon in the new moon's arms," but in this I was disappointed; for, until my last look at the progress of the phenomenon I could detect no "irradiation" effect. The said last look took place at 13h. 38m., at which time the result sought was easily obtained. Certainly 0 005 of the lunar disc is a very small portion; but at 12h. 30m. it seemed to me that all that was not involved in the actual umbra might have been more moderately described as equal to 0·0005, which, however, might easily be accounted for by the greater density of the penumbra contiguous with the shadow. I think that, on this occasion, at any rate, the visibility of the eclipsed limb of the moon might be fairly set down to "contrast" effect, for, although it was, as a rule, very clearly defined, it did not appear nearly so conspicuous to me as did the said limb on the occasion of the last lunar eclipse witnessed by myself—to wit, the small partial eclipse of Jan. 7, 1898. Altogether, it was a most fascinating spectacle—the eclipse of yesterday—and as we poor stay-at-homes are not likely to see anything of the sort again on so large a scale before April 22, 1902, and that only indifferently, it is worthy of remembrance.

William Godden.

West Hampstead, N.W., Dec. 17.

[43120.]—THE almost total eclipse of the moon last Saturday night afforded a pretty spectacle to possessors of small instruments. Even an aperture of 2in., with a low power, say, 30 diameters, was quite sufficient to yield an excellent view of the earth's shadow as it crept over the lunar hills and dales, and swept across brilliant sunlit plains, each shining peak stoutly resisting the obliterating effects of the smothering pall. Of course, the darkening was greatest in the moon's northern hemisphere, particularly to the eastward over the vast low-lying tracts constituting the Oceanus Procellarum and



1.15 a.m., Dec. 17.

the Mare Imbrium. Here the disc glowed with a dull blood-red hue as of heated iron, an effect due to the refractive power of the earth's atmosphere, which bends a small proportion of the solar rays into the cone of shadow, reddening the dim light in the process. Here is a sketch of the phenomenon as it appeared ten minutes before maximum, at which moment a curtain of clouds covered the sky, and precluded further observations.

Norman Lattey.

THE PERIODICITY OF SUNSPOTS.

[43121.]—(1) THREE years ago (Oct. 30, 1896) the "E.M." was good enough to publish a letter (39257) from me on the above subject containing an hypothesis or theory to account for the spots and the periodical variation. The theory was that the formation of sunspots is dependent upon the law of the conservation of energy and the law of gravitation. The orbits of the planets being elliptical, the moment a planet has passed its perihelion the sun's gravitation slackens its speed something after the fashion in which the speed of a railway train is slackened by putting on the brake when it runs into a station. And as action and reaction are equal, the law of conservation of energy steps in, and the planets react upon the sun, and this reaction produces sunspots. (I am fully aware that the preceding sentence may not be considered quite orthodox; but—"There are more things in heaven and earth, Horatio," &c.) Consequently, as the sun is attended by one giant planet, Jupiter, whose mass is more than double that of all the others added together, the average period of sunspots must be precisely equal to the period of Jupiter's revolution—namely, 11·86 years. But this is over or underlapped by the periods of the other planets. The theory was, in fact, that sunspots are only produced when planets are on the up side of their orbits—i.e., on that side on which a planet is rising from the sun towards its aphelion, and that when it is on the down side—i.e., on that side on which it is nearing the sun, no spots are produced. My letter further showed, or rather proved that out of thirteen recorded maxima and minima the last eleven precisely fitted the theory, and that the two non-coincident ones were the first two that Schwabe observed early in the present century.

(2) I read in the "E.M." on Oct. 27, in the article on "Astronomical Occurrences for November" that "as the sunspot minimum has now definitely arrived, and that as the last minimum was in 1889-6 so that 10·1 years only have elapsed since, the period of 11·11 years of certain textbooks has thus broken down entirely." Is not this opinion rather premature? What has the above theory to say upon the subject?

(3) A reference to the *Nautical Almanac* shows that from October 23 to December 6 five out of the six primary planets nearest the sun were, according to the theory, *hors de combat*, so far as producing sunspots is concerned. Saturn is near his aphelion, and Jupiter, Mars, Earth, and Mercury were on the down side of their orbits. The only one of the six on the up side of its orbit was Venus, whose orbit is so very nearly circular that it would not be likely to produce sunspots. Here, then, the theory fully accounts for the minimum, and at the same time indicates that the long average of 11·86 years has not "broken down entirely."

(4) On December 6 the above state of affairs came to an end. The planet Mercury, whose orbit is the most eccentric of all the above-mentioned six planets, passed its perihelion, and is now sweeping along the up side of its orbit, and by the time this letter is published will be 90° in longitude distant from its perihelion. Even as I write I notice that a fresh crop of small spots is breaking out on the solar disc, and this fully agrees with the theory.

Ryvecton. **W. A.**

SUNSPOT CYCLES.

[43122.]—WITH reference to the letter (43107) in your issue of yesterday, *re* the sunspot cycle, will you allow me, as having foreseen the great diminution in sunspots which occurred early in July last, and the subsequent dearth of spots, to say that I have as good reason to anticipate a resumption of sunspot activity between March 1 and July 1 next, and thereafter continuing without lengthy interruption until the autumn of 1903.

The bodies causing the spots move so slowly that I am unable to more closely fix the date of resumption of activity. **Alex. Hutt.**

Member British Astronomical Association.

THE SATELLITE OF NEPTUNE.

[43123.]—"ELL HAY" (in letter 43111, p. 406) states that his "N" Telescope (Newtonian) shows the satellite of Neptune, though very faint. In the same letter, when mentioning another observation, he gives the aperture as 5½in. As the satellite of Neptune has not been seen steadily with so small an aperture, so far as I have seen recorded, will "Ell Hay" kindly give your readers first the date of his observation and the hour; second the aperture employed and power used; third whether satellite was seen steadily or by glimpses; four the position angle and distance, either measured or estimated.

Dawes with 8in. Alvan Clark refractor, Ward with 4·3in. Wray refractor, and Sadler with 6½in. Calver reflector, have all seen the satellite, but not steadily. **Neptune.**

THE LOST LEONIDS.

[43124.]—THE conclusions to which Dr. Johnstone Stoney and Dr. Downing have been led regarding the non-appearance this year of the expected meteoric display must cause considerable surprise to those who, for so many years past, have been led by those in authority to anticipate with confidence their due return, inasmuch as the abnormal effect likely to be produced upon their orbit by the perturbations of the giant planets during their late revolution round the sun could scarcely fail to have been recognised by those who have given their attention to the matter, although, possibly, the exact allowance to be made on this account could only be determined by elaborate calculation. What strikes me as vary remarkable is, that during the many centuries that their history can be traced back, no such abnormal conditions should at any time previously have prevailed, or that during such interval the accumulated effect of the entire series of perturbations experienced has not been sufficient to produce a similar result.

Although that portion of the stream through which the earth passed in 1866, and to which the calculations have been specially directed, will not reach the node of its orbit until the middle of February next, the perturbing effect upon this portion would not, I presume, differ very materially from its action on that part which reached it in November, and which is probably situated near the front of the stream, and as the effect, according to Dr. Downing, would be still more apparent in that portion which will be nearest to the earth next November. I gather from his remarks at the B.A. meeting that, in his opinion, we have now lost the ortho-stream altogether, and the utmost that this or future generations can hope to see will be a few outlying stragglers of the system.

W. T. N.

THE GEMINIDS, 1899.

[43125.]—THE weather during the Geminid epoch was extremely poor. Clouds, rain, fog, snow, and frost all combined to make observation very arduous and difficult.

The watches were divided into two parts:—

1. December 1—10. On and between these dates observations were made in the evening. After the 10th the light of the moon was too strong to allow a profitable look-out to be kept.

2. December 11—13. The observations were now conducted in the early morning.

The following table gives a more detailed account:

1899.	From.	To.	Meteors Seen.	Meteors Rec'rd'd	Geminids Seen.	Geminids Recorded	Seeing.	Remarks.	Hours of obs.
	h. m.	h. m.							h. m.
Dec. 1	10 0	11 0	6	6	0	0	2	——	1 0
,, 2	—	—	—	—	—	—	-	Sky overclouded	—
,, 3	—	—	—	—	—	—	-	Rain falling	—
,, 4	—	—	—	—	—	—	-		—
,, 5	—	—	—	—	—	—	-	The state of sky rendered	—
,, 6	—	—	—	—	—	—	-	observations impossible..	—
,, 7	—	—	—	—	—	—	-		—
,, 8	9 35	11 10	9	8	2	2	2	Moon up during greater part of watch, but its light had little effect on observation.	1 35
,, 9	—	—	—	—	—	—	-	Sky cloudy	—
,, 10	—	—	—	—	—	—	-	Sky cloudy	—
,, 11	—	—	—	—	—	—	-	Early morning 12th snowing	—
,, 12	—	—	—	—	—	—	-	Snow falling	—
,, 13	17 10	18 30	5	5	0	0	3	——	12 20

In the above table "2" means good, "3" fair.

It will be seen that out of 13 days, observation was possible on only three occasions. The total time spent in watching the sky was 3h. 55m.; 20 shooting stars were seen, of which 19 were mapped. Two meteors were Geminids. This cannot be taken as a sign of paucity of meteors belonging to that shower, because the sky on nights and early mornings of the days of maximum was entirely overcast. On the early morning of the 14th not a single meteor from the shower was seen during a watch of nearly $1\frac{1}{4}$ hour.

On projecting the paths of the two Geminids seen on the 8th with another meteor from the same radiant observed earlier in the evening, I find a centre at α 105°, δ + 34°.

Of the minor showers, that of the α Orionids was prominent on December 1. During one hour three bright meteors from a fairly definite radiant at α $84\frac{1}{2}°$ δ + $9\frac{1}{2}°$ were seen. Their magnitudes were > 1, 1, 1.

On December 13 three υ Ursids from a radiant at 145° + 57° were recorded.

Other showers furnished less prominent displays; but observations were only possible on three widely separated occasions. This latter fact prevented a large number of meteors from any one shower being observed.

Leicester, Dec. 18. **A. King.**

METEOR.

[43126.]—IN letter 43075 Mr. N. Maclachlan raises the query as to whether the meteor he saw on the morning of Nov. 15 was the same as the one I saw near the radiant point on that same date. This meteor seemed to be coming straight at us both, although separated as we were by a distance of about 400 miles. I am sorry to say that I have not a record of the time the meteor appeared; but, as far as I can remember, it was about the time he mentions (4.50). Even if I had a note of the correct time, and it was similar to Mr. Maclachlan's, it would be difficult to believe that it was the same meteor. For, as he remarks, "it seems impossible, with the estimated depth of the atmosphere, that the same meteor should appear to be coming straight towards the eye of two persons at a distance of something like 400 miles apart." For such a state of things to be possible, we should have to have a depth of atmosphere of some thousands of miles, instead of less than a hundred, as it undoubtedly is.

Wm. H. Daw.

9, Belgrave-road, St. John's Wood, N.W.

HOROLOGICAL—STAR TRANSITS.

[43127.]—I HAVE recently come into possession of a long-cased clock, by "John Wilks, Evesham," and should be very grateful if any of your numerous correspondents could give me a little information about the old clock and its maker?

The mahogany case is about 7ft. high, with Corinthian pillars and gilt mountings; dial, silvered, 13in. diam., figures and maker's name finely engraved and waxed in. The hours and minutes circle is not concentric, but is placed at the bottom of the dial below the centre hole. The seconds-hand is much longer, working from the centre of the large dial, and marking seconds at each beat. (Am I correct in supposing it was originally intended for an astronomical regulator?) Escapement dead beat pallets worn; want renewing. I notice the seconds-hand moves farther one beat than the next one, marking, say, $\frac{3}{4}$sec. one beat, and $1\frac{1}{4}$ the next. Is this due to worn pallets? When the clock came into my hands it had two weights of 16lb. each, which was at once seen, owing to the rapid striking, to be much too heavy, and after some experimenting I found 6lb. on a double line, both for the going and striking part, was about correct. Would it be advisable to file out the worn pallets and fit some hard substance for the teeth to act on, or, better, to make new steel ones. Any information would be welcome, both as to the clock and its probable date.

Now I am writing about timekeepers, perhaps "F.R.A.S." would be kind enough to explain a little difficulty I cannot quite get over. In various books dealing with times of star transits, instructions are given for obtaining local mean time at places east or west of Greenwich; but I don't want local mean time, but Greenwich mean time at Maidstone, which is said to be 2 minutes 10 seconds east or fast of Greenwich. Am I correct in the following:—Suppose Sirius is stated to south at Greenwich on Jan. 1st at 2 minutes 10 seconds past 10 p.m. Greenwich mean time. Would that star south at Maidstone 2 minutes 10 seconds earlier—that is to say, at 10 p.m. exactly. It is easy to obtain time from Greenwich signal occasionally, and if the above is correct, I could easily check a clock that is keeping nearly correct Greenwich time. I have never seen this question answered before, and should feel much obliged for information on this point.

Maidstone. **E. P.**

FIRE-BALLS—THE DELUGE.

[43128.]—MR. WRIGHT'S account of the train of the Littlemore meteor is very interesting. It suggests to me that observers should make more careful observations on the trains of meteors which last for any appreciable time. Such meteors or fireballs are pretty certain to be seen from several stations, and their paths through the air can thus be approximately determined. We thus learn the original position of the train. If, then, we could also observe the angular rate of shifting as well as the direction of the shift, we should obtain important information as to currents in the upper region of the atmosphere. Some apparent shifting, however, might, I apprehend, be caused by the sinking or rising of the train—sinking being more probable than rising. For it would thus get into a region where the velocity of rotation was greater or less than before. This rising or sinking, however, ought to involve an apparent lengthening or shortening of the train.

Your correspondent "F.R.A.S." seems to forget that Mr. Garbett's deluge occurred in B.C. 3102, and is not therefore in the least affected by the Chinese observation referred to. But what of this observation itself? I find from Mr. Williams's book that a conjunction of planets is recorded as having occurred in the reign of Chuen Kuh, which lasted for 78 years (a rather startling incident to commence with). This 78 years is set down as lasting from B.C. 2513 to B.C. 2436. Mr. Williams adds that according to a modern computation (he believes by Bailly), the conjunction took place on February 29, B.C. 2449. He then says, "Should this, on further investigation, prove correct, it will afford a strong presumption of the authenticity of the early Chinese annals," because the Chinese astronomers had not sufficient knowledge to arrive at the date by computation.

I see that "F.R.A.S." gives the date of the conjunction as February 18, B.C. 2446, instead of February 29, B.C. 2449, so I suppose he has some new authority. He also speaks of a conjunction of four planets; but, according to Mr. Williams, the Chinese record relates to a conjunction of five—the entire number then known. Under these circumstances I do not feel confident that both Usher and Garbett may not survive the Chinaman's attack.

I find that "F.R.A.S." has followed Chambers's "Handbook of Practical and Descriptive Astronomy," Vol. I. p. 70, of the last edition, as regards the date of the Chinese conjunction of the planets. But Chambers mentions that another computation gives February 9, B.C. 2441, as the date, and in both cases the computed conjunction is one of four planets; whereas, according to Mr. Williams, the Chinese record is a conjunction of all five. I need hardly say that Jupiter or Saturn could not have been seen in the same part of the sky in February, B.C. 2441, 2446, and 2449. Some of the computations must therefore have been egregiously wrong.

W. H. S. Monck.

NEWTONIAN—GREGORIAN.

[43129.]—I READ the interesting letter of "Ell Hay" with much pleasure. Apparently he has managed to make his telescope serviceable under both forms. He must have a fine mirror and a good eye to divide Zeta Boötis and pick up the companion to Mu Andromedæ. Will he tell us if he notes any difference in the focal images under the two forms, such as "H." proved should occur? An American professor has shown incontestably that the Newtonian suffers from incurable defects. The images formed by the margin are larger than from the centre, and are at varying inclinations to the cube axes, and from these results the well-known defective definition of that form of telescope. "H." and others have shown that the Gregorian construction eliminates these errors, and it would be interesting to know if "Ell Hay" has noticed any practical difference in the focal planes and sharpness. If he has not, it rather indicates that he has failed to reach the highest perfection in his Gregorian. If he has, the fact should be noted, as it would tend to elucidate truth, and is of importance to both astronomers and telescopists.

The defects of telescopes and suggestions for removing them, or counteracting them, are of such great importance that too much discussion of them can hardly take place if conducted in the courteous manner so characteristic of "H." and "A. S. L.," and I read every line of theirs and of others who know anything about the instrument with the greatest attention.

"Ell Hay" possibly means John Bird, where he asks for information about John Buck. I fear the search is useless, as I also have gone through the *Leisure Hour* in vain. He may safely write down the account he refers to as a credit to the inventive faculties of the story-teller who took care to be absent when the romance was read, and thus avoided questionings.

I have contemplated trying to grind a mirror for experimental purposes, and shall be glad of advice from those who have experience as to whether a cast disc or a polished plate one will be best. A good many of each must be in use, but little has ever been said as to their merits, excepting, indeed, by a former writer who was interested in their sale. Is the defective annealing of the cast discs any detriment? Would not the internal strains tend to keep the mirror figure good, since they may be said to constitute springs to resist the effects of temperature and pressure? Which is softest and easiest to grind, and which takes the best polish? Is there any difference in freedom from air blebs? I suppose the discs are best cast; but while the polished ones are occasionally advertised in "Ours," I have not seen cast ones offered. I think it would pay the makers of such to advertise them.

In conclusion, I hope the truly delightful letters of "H." will be continued. I have learned very much from them. They are, as far as they have gone, a most perfect elucidation of telescopic optics, and much more interest one than the squabbles that formerly did duty for astronomy. **Hippalus.**

USSHER'S CHRONOLOGY.

[43130.]—THE "F.R.A.S." would seem to imply, on p. 405, that chronologists are "a brotherhood" worthy of no note whatever. We really owe to Archbishop Ussher all the dates in our popular Bible, and all of Abraham's time or later are trustworthy. But his following the modern Jews in all earlier dates was really the work of an ass. With no knowledge of any Chinese or Hindoo dates, anyone could easily find those of the Jews' Genesis were artfully doctored.

I have never questioned the Chinese conjunction of planets in 2446 B.C.; when, according to the Samaritan Genesis, Heber was near his death, and his son Phaleg, born in 2701, and so named because "in his days was the earth divided." The Chinese begin their history just about that year. The lengths of their six or seven first reigns harmonise very well with the generations in Genesis xi.; that is with the LXX. or Samaritan copy—not the Jewish.

Le Verrier's computation of 126 A.D. for the Leonids is not mentioned in G. F. Chambers's or any late astronomy that I can find. The period of the comet is given as 33·25 years, which would give for 15 periods 493·75 years. That is just a year less than the interval from October, 1366, to January, 1866. If Le Verrier reckoned from this 33·25 (and he certainly did from no *longer* one), he would be a

year short in five centuries, and three or four in the time since 126. I should like to see the mathematician who can make 33·25, or 33 29, or 33 28, or 33·27, or 33·26 each suit an encounter in the same year.

E. L. Garbett.

THE MOON AND THE WEATHER.

[43131.]—It is not easy to reply to an argument unless that is clearly stated, and I fail to see any in the quotation given by "A. B. M." (p. 405), from Prof. Angot's work. Nor do I see that the professor has even removed a little bit on one side that persistent "stumbling-block" which "A. B. M." says is "trotted out once more." Why not? That at least is a fact. How do the weather prophets propose to avoid it? Prof. Angot, judging from the quotation given by "A. M. B.," is at least treating the subject scientifically—that is, by research and investigation—work always worthy of respect, even if it leads to nothing; but I note that the professor says, "in the present state of our knowledge it cannot be affirmed that the moon has an influence on weather; but as little can it be denied that such influence may exist." Just so, it may exist; but, so far, I do not think anyone has found a particle of evidence of the existence.

Now, as to what "Glatton" says (p. 406), suppose the influence of the moon can produce "tides" in the atmosphere, how can that be compared with the "ocean tides," the rise and fall of which can be calculated with almost mathematical accuracy months before any given date? The one is a practical certainty, thoroughly ascertained, and even measured; the other has not a single fact to support it—a mere hypothesis. It seems to me that temperature, rainfall, winds, change of weather, &c., have everything to do with the subject when the influence of the moon on the weather is spoken of.

Has not Mr. G. J. Symons shown that for many years the average rainfall of Cumberland has been many times greater than that of Norfolk (for example); how many miles are they apart? Is it not common knowledge that a wind-storm may prevail in one part of this country and be unknown in another? And then what of the whole globe? There is no such vagary in connection with ocean tides. Then as to "aërial" tides, it would be interesting to have the views of balloonists. They often find considerable variety in the "tides" of the atmosphere. Of course, if temperature, rainfall, winds, &c., are not to be considered "weather," it is time that we arrived at what we mean by "weather." The late George Glenny, a well-known gardener, used to declare that changes of the weather generally came with changes of the moon; but when he was shown that the facts were against him, he retorted by saying that he did not mean the actual day set down in the almanac for the change of phase, but two days before and two days afterwards. The belief still hangs about in country districts, and because changes of weather do sometimes come with changes of the moon (so-called), I suppose the old belief will be preserved. By the way, should not the moon have greatest influence on the weather when she is eclipsed?

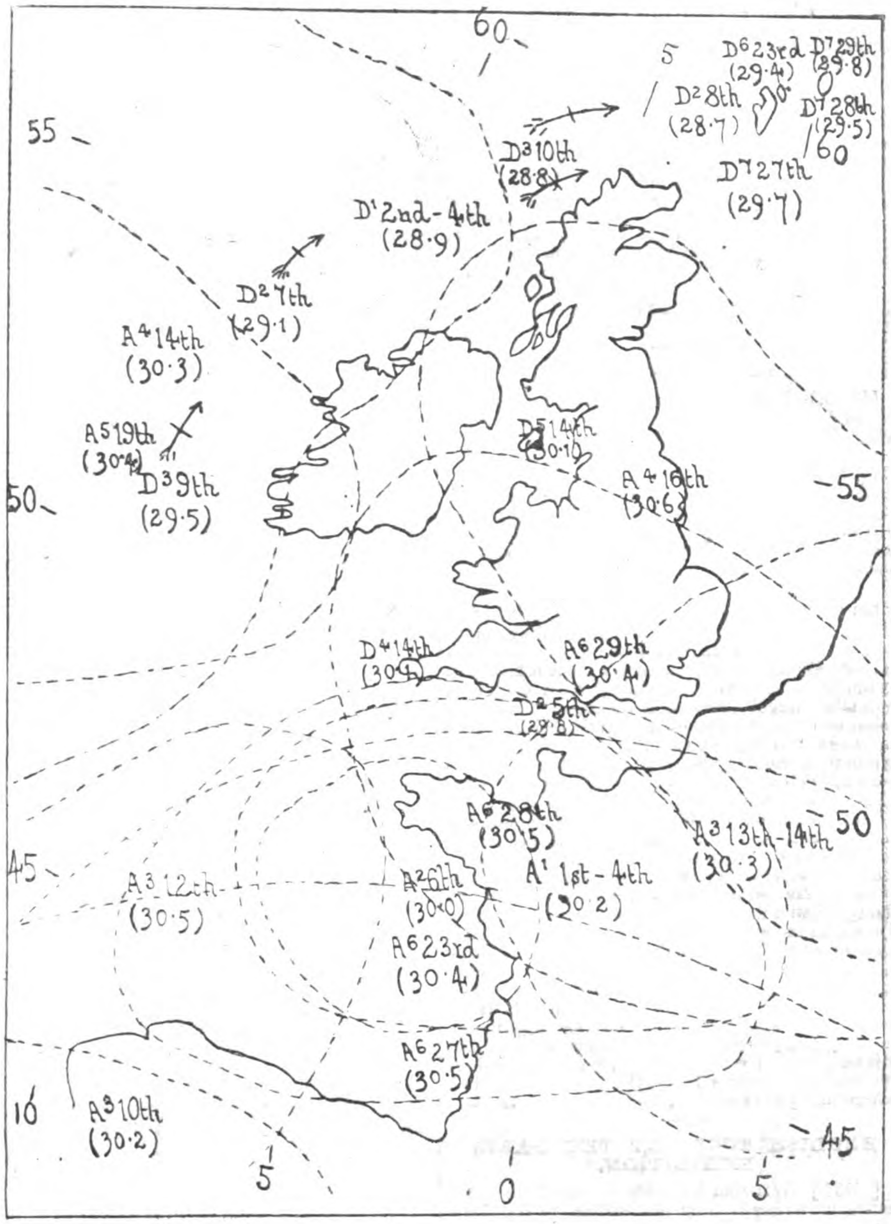
S. R.

THE WEATHER OF THE BRITISH ISLES IN NOVEMBER.

[43132.]—

Date.	Cause.	Effect.
Nov. 1 to 10	A continuous series of depressions passing to the N.W. High pressure to the Southward.	Westerly gales and rain. (Rain fell on every day but one from the 1st to 10th inclusive.)
11 to 15	High pressure to S.E. and S.W. Depression off the N. of Scotland. Shallow secondary disturbances in the Bristol and St. George's Channels.	Fair weather in the S., squally and rainy in the N., and showery in the W.
16 to 20	The anticyclone in the S.E. is joined by another from N.W.	Foggy, gloomy and dull weather generally.
21 to 24	The anticyclones remain stationary.	A continuance of dull weather.
25 to 27	Depression in the far N.E. High pressure to Southward.	Fair, but still rather dull.
28 to 30	Anticyclone covers the S. of England.	Fine in the S.E. of England. Dull elsewhere.

Explanation of Chart.—The anticyclones, or high-pressure systems, are inclosed by the dotted lines; the letter A and the index [5] demonstrate the point of greatest intensity, and the number of the system in relation to the others of the month respectively.



The figures in parenthesis just below show the highest point reached by the barometer in that region. Thus, for example:—A^{6} 27th, with (30·5) just beneath it, indicates that the sixth anticyclone of the month was in the position shown on the 27th, and the highest barometric pressure attained at its centre was 30·5in. The depressions are shown with the letter D, and indices, &c., as before—e.g., D^{3} 9th, with (29·5) below, shows that a depression was situated off the west coast of Ireland on November 9, that is was the third of its kind during the month, and the barometric pressure near the centre of the disturbance was 29·5in. The crossed arrows point the direction in which a depression is travelling.

It will be noticed on reference to the chart that during the first half of the month the depressions all passed to the north-westward of our islands, whilst a zone of continuous high-pressure lay to the southward. It was this which caused the chief peculiarity of the month, which was that the entire rainfall occurred during the first 11 days of the month, after which the high-pressure systems moved over our islands, pushing the depressions away to the far north. Hence, although the month had 1$\frac{3}{4}$in. more than the average rainfall in the South of England, yet it also developed an absolute drought extending over 18 days.

Meteor.

GRINDING AND POLISHING SPECULA.

[43133.]—The photograph of the machine used by Mr. Glass which was reproduced in this journal a week ago (43100) shows very clearly the general arrangement; but it fails to give one a clear idea of the way in which the motion is communicated from one wheel to another. I am familiar, like many others of your readers, I do not doubt, with the construction and details of the various machines used by Sir John Herschel, Lord Rosse, Mr. Lassell, Sir Howard Grubb, and Dr. Common; in fact, I have a machine somewhat similar to the Grubb machine, on a much smaller scale. I also knew something of the Wassell machine as formerly figured and described in this journal. There is one point, however, both in the Wassell machine and in that of Mr. Glass on which I think it would be very satisfactory if some little light were thrown. The point I refer to is what is termed in both cases the "oval wheel." If Mr. Smith, who sent you the photograph of Mr. Glass's machine, would be so good as to give a rough pen-and-ink sketch or drawing of the oval wheel, and the manner in which the various motions and speeds are communicated to it and the other wheels, I, for one, should be very much obliged. From the photograph, it is not possible to make out any of these.

Speculum.

SPLICING.

[43134.]—Mr. Hudson (letter 43113) hopes that I am not going to "slip through" (as he rather nastily puts it) the articles on "Millwright's Work" "without treating the matter of splicing in as exhaustive a manner as he has done the jointing of belts. The reason why I did not illustrate splicing was because I had done so in "Fitting," and had no wish to lay myself open to the charge of repeating myself. The usual method was given correctly in that series.

As regards "best practice," who would care to take the responsibility of deciding that, except in general terms? Mr. Hudson correctly quotes me to the effect that "the splice is carried over a length of 4ft. or 5ft." That was "good practice" in 1892, when the passage was written, and I wrote it because that length was adopted in 1in. ropes, which I then knew running rapidly, and wearing well. Then, in "Millwright's Work" I say: "Not less than 6ft. to 12ft.," which gives increase in length, the longer being, of course, for the larger ropes. That is true in 1899, because the growing

tendency since 1892 has been to increase the length of splice. Then, finally, I give "a firm's table, which runs from 9ft. to 20ft." That is the table of one of the leading firms in America, who have made a speciality of rope-driving, and whose "best practice" is, therefore, suitably compared with English. There is nothing inconsistent in recording these developments.

As regards wire ropes, the splices for these are usually and properly made at the manufacturers. Concerning the splices of cotton ropes, there is a great deal yet untouched in "Millwright's Work," without taking up space for splicing; and which, if it is necessary to treat and illustrate again, should be done in an article or letter devoted specially to it. I will, however, with the Editor's permission, promise Mr. Hudson to bear this in mind.

J. H.

POISON IN FISH.

[43135.]—I REGRET the mistake on my part pointed out by "Glatton." The fish was a haddock; otherwise all that was stated was strictly accurate, and it would be of interest to be favoured with some explanation, if any can be suggested. I did not think it necessary to take up more space by mentioning that the two members of the family who suffered had each eaten a portion of another fish before they each took a little of that which is believed to have caused the illness.

L. C.

[43136.]—THE question propounded by "L. C." (p. 383) can apparently only be answered by guessing; but fish do sometimes disagree with people—notably mackerel. If the suspected fish had been examined by an expert, probably some useful information might have been obtained. Whiting, soles, plaice, and haddock are invalids' fish, and as to what "Glatton" (p. 407) says about "one whiting is usually not more than enough for one person," it is well that he put "usually." I have frequently bought whiting during this past three years, several of which weighed two pounds and more when cleaned. The whiting (Merlangus vulgaris) is a very voracious fish, and sometimes reaches a weight of three or four pounds. On one occasion my wife bought a whiting which she thought had a fine roe; but that turned out to be a fish which the whiting had swallowed. The greater number of whiting brought to London have, like haddocks, been opened and the viscera removed; for, while they are a delicate-fleshed fish, they soon go wrong when sent to market "round." Haddocks are sometimes passed off for whiting by scraping and by removing the "thumb-mark," but it is easy to certify to a whiting, for it has a black spot on the upper side of the pectoral fin, just where that joins the body.

S. R.

ENGLISH TOOLS AT THE PARIS EXHIBITION.

[43137.]—WE wish to notify that we have sent a notice of withdrawal of our exhibit to the Commissioners of the Paris Exposition of next year, where we had intended to have made a fine display of English-made tools.

The present ill-feeling in France against anything English is being fostered, we have noticed, by some of the most respectable French papers, and exhibitors have unfortunately no guarantee that this discord will not become accentuated as the time for opening approaches. This may pass quietly away; but exhibitors who have an interest at stake have *not time to hesitate*, as exhibits should be now in active course of preparation.

The value of the Exposition to many English houses will depend largely upon a good British attendance, and we feel that such a conspicuous want of welcome will seriously interfere with the number of British visitors. It is possible to be too easily alarmed at the trend of circumstances that may seem to affect the success of this exhibition; but, although the proposed boycott at the time of the Dreyfus decision was properly considered to signify nothing but a newspaper scare, there is now an element of uncertainty that cannot be ignored by those who have relied upon a good British and Colonial attendance amongst the visitors.

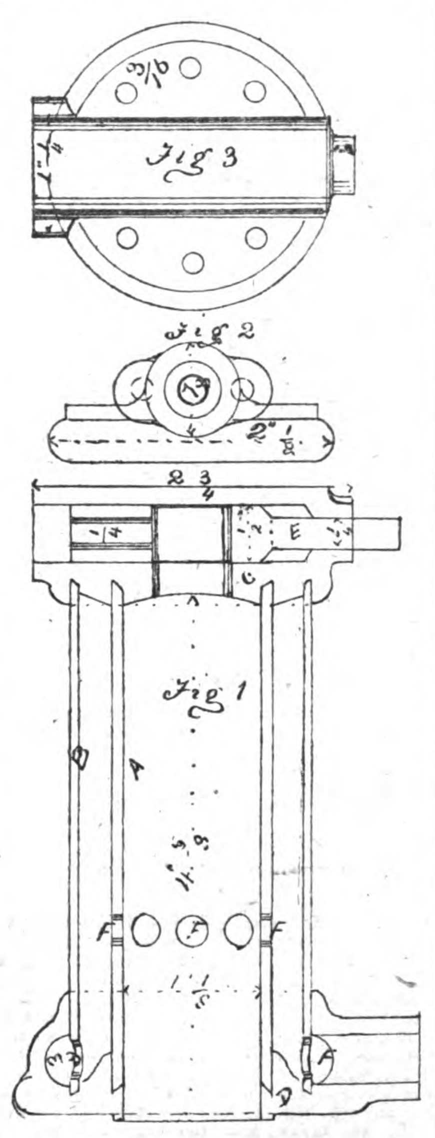
We mention this in extenuation of those whose interest in this matter is identical with our own, and anticipate that the same considerations will not influence those whose object it is to cultivate Continental sales, and extend the reputation of other English goods in this market.

R. Melhuish, Sons, and Co.

84, 85, and 87, Fetter-lane, E.C.

HOW TO BUILD A LIGHT ENGINE FOR VARIOUS PURPOSES.

[43138.]—IT is said that there is a time for everything if we will only wait. As I think, the time has arrived when a scheme I have had in my head may be turned to account. Take things all round, there is nothing new in it; but there are a few points thrown together that have been discarded in the past, but are now taken up to advantage, and, instead of retrograding, is practically an advance. In the small sixties I was called upon to manipulate upon a steam-hammer, and in overhauling it I came across an arrangement for rapid exhaust. A thought struck me at the time that it could be utilised for a single-acting engine. Well, of course, the steam-hammer was such in one sense. I committed it to paper, and intended to turn it to account for a relative of mine, who had been in the Crimean and China wars, and, as I thought, had come home to settle down. But there was no material that I knew of that would serve my purpose then. Some time after I was engaged upon the Palliser experiments, when I saw an account of guns—i.e., old cast-iron ordnance—being reinforced by the lining of them with solid drawn-steel tubes. I then said to myself, "The very thing for those engines; I would like to see a sample." Some



time after I was shown a sample by an old shipmate, and they far exceeded my expectations. They were very clean and bright inside and out, and true. He then told me that it was the outcome of an old shopmate of ours, I believe. At any rate, my relative was not happy at home, and we lost the run of him for some time, when we had news that he died at Aden, so the affair was shelved, but not to rest, because at different times I have worked out in rough sketches engines various. Now some of these, with the Editor's permission, I intend make presentable for your consideration, and I have not the least doubt but what some of you that can handle tools will find it an easy task to furnish you with what you have long desired. There is novelty in them, not a great deal of work, and not difficult work, and a useful little engine can be made in a 4in. centre lathe. The pattern making is very trifling—it is a trunk piston rotary valve, steam-jacketed or water-jacketed as the case may be, whether you fit it up for steam, gasoline, oil, or gas. You will see that the principle by alteration of valves can be turned to account for either. The trunk engines and rotary valves, as well as mushroom valves, are very old acquaintances, and single-acting engines trunk pistons I can recollect as long ago as 36 years when a three-cylinder trunk piston engine was at work at an alkali works, and I believe the maker's name was "Ramsden," "Ransome," "Ramsey," or some such name as that. It was driving a pair of large-edge runners, granite, and six stirrers in large vats; and although the cold shoulder has been given to single-acting engines, they have not only come to the fore, but, instead, we have the cycle of one in four strokes, doing good work, and quadruple expansion to the fore. The following sketch will represent a cylinder built of material now to be found in abundance. A is a piece of steel tube solid drawn, B brass triblet tube. The ends may be made of any of the bronzes or malleable cast iron—(that is, those marked C and D), E, the valve, of phosphor-bronze, brass, hard-drawn rod Delta metal, or any of the bronzes, but best made of the hard rod. F F F F are the exhaust; it is put together with six $\frac{3}{16}$ bolts—large ones between A and B.

Jack of All Trades.

VIBRATION OF ETHER.

[43139.]—THE matter pervading our Solar System, ether, is capable of transmitting the vibration which we know as light. Seeing the disturbances taking place on some of the planets, and their movements in that same medium, it is not unreasonable to imagine that these vibrations, quicker or slower than those producing light, may be transmitted to, and influence at least, the smaller bodies such as comets, Leonids, &c. They might be influenced either by being attracted, repulsed, forwarded, or retarded in their orbits. That would, of course, depend upon the form of the wave; crest forward and trough following would repulse; the reverse, attract. I should like the opinion of some of the readers of "Ours" on this subject.

J. H. Schucht.

PEAT.

[43140.]—I AM just now living almost upon a layer of that curious substance peat, which has made me want to find out just what it is, and how it is formed. This has led into the subject of coal, of which peat is a stage in the decomposition of cellulose. And thus a vast mine of information is worked on, and is still unworked. For the change of cellulose, or leaves and the like, into anthracite coal through peat is possible. They have been for two years opening out a park in Newark, New Jersey, and, as part of it is only a quarter of a mile from my house, I have visited it continually. I have thus been enabled to watch the digging, and to get some very nice fossils also. The wood is common, in the shape of logs over 6ft. long, cedar mostly, and these I have deposited in the collection of the Newark High School, where Prof. George Sonn, who has collected along with me, will have charge of them.

I find that the etymology of peat is doubtful. Skeat, we are told, considers the true form to be beat, from its being used to beet or mend the fire, from the middle English *belen*, to replenish the fire. At all events it must have been used to build fires where wood was scarce, and long before coal was used—for that is of comparatively modern use.

In most geological books it is said to be formed from sphagnum or similar water moss, is decomposed, and thus formed peat. But leaves also, not of water-moss, can form peat, when immersed in water and permitted to decay. And in this way coal is formed undoubtedly. And this peat, which I have examined in Newark, is formed of the roots of different water-plants, which, decomposing in standing water, undergo decomposition. On examination by means of the microscope, it is found to contain very little inorganic or mineral matter, this being made up of sponge spicules, the silicious spicules of *Spongia lacustris*, L. Mixed with these are now and then pustilles, or loricæ, as they are called, of fresh-water bacillaria; *Navicula major*, F. T. K., being by far the most common. In fact, this form is cosmopolitan and present everywhere, and in fresh, brackish, and even in salt-water. It is the most common of bacillaria when they are common. But the organic matter is present as a brown substance, without any definite form to indicate the plants from which it was derived; being without cellulose or any other substance which can make the form of the cell from which it was derived.

But the fossils that are the largest in the peat are trees, the stumps of which often are 6ft. long by 15in. across at the butt. Several of these have been taken out, and they are, for the most part, white cedar (*Cupressus thyoides*). There are branches of several other trees, and in one place a pestle of stone has been found. The wood is mostly very pliable, but can be cut into sections for the microscope.

And this brings me to speak of the so-called pine barrens which cover a large amount of the State in the Southern counties. They are made up of the remains of land plants, but often are now beneath the tide of salt water. They show the land is now going down rapidly, although it has been immersed before. The peat is now over 2ft. to 6ft. thick, though in Newark it is not a foot thick. Beneath

this is a layer of blue clay oftentimes very bacillarious, and in some places pure bacillarian, as at Weequackhic Lake; it is there 1ft. thick. Beneath all is the gravel of the Glacial moraine often markedly situated.

We can thus see the formation of the iceberg period, and trace the bacillaria, as well as at Mount St. Elias, on the Pacific coast. It is easy to see how the peat accummulated. At first the growth was higher than it is now, and colder weather prevailed; in fact, snow fell. This accumulated and packed to form ice. Then came the Glacial period, and the ice was heavy, and the ground sank beneath it until it became warmer. Then the ice broke up, and there came the Iceberg period, and bacillaria were common in the water. The icebergs floated off at the edge of the ice, and moved away from several points. One was in the north-west, and the icebergs floated away to the south-east, over New Jersey, bringing with it the logs of the forest, white cedar mostly, and deposited it in the valleys which run across the country, and one or more are in Newark. One of them is where they are laying out a park, and where they are digging Clark's pond 4ft. lower, and where the fossils were found. The water that formed was impregnated with vegetable matter. This formed the peat on the bottom, which was of clay—blue clay. At last this almost dried up, and left the mass of peat there. This is the way the peat came.

Arthur M. Edwards, M.D., F.L.S.

23, Belleville-ave., Newark, N.J.

FROM AN OLD FRIEND.

[43141.]—MY best thanks for the four Oct. numbers of the ENGLISH MECHANIC. Long before you get this, they will have given much pleasure to many of the soldiers in this lonely camp. I hope, also, that those which went to South Africa will give pleasure there, too. Oh, dear me, I believe I am one of your oldest subscribers. I began over thirty years ago. What changes! I wonder if you are the same? The next time I am on leave, and in town, I shall try and see you.

T. H. Foulkes, M.A.,
Chaplain to H.M. Forces.

British Camp, Kandia, Crete.

[Yes; just the same!—ED.]

SODOM DESTROYED BY THE LEONIDS.

[43142.]—MR. GARBETT again appears with his vapid assumptions. The above is not a suitable theme for discussion in a journal dealing with mechanical and scientific subjects. The observed facts of science show that a concentrated bombardment of Leonids in one isolated spot could never have taken place. The region of the Dead Sea, as it is now, has the same geological aspect and condition as it was countless thousands of years before the evolution of mankind upon the face of the Earth, so all chronological references are worthless, as they are mere suppositions and legends of men who knew nothing of such matters. Within the immense lapse of time after these geological disturbances there have been no cities or dwellings on the site of the Dead Sea, for no inhabitants could have existed there.

I have travelled on the borders of the Dead Sea, and it is quite apparent that the formation is due to a rupture and displacement before the crust of the earth had arrived at a state of quiescence and equilibrium. No living thing found a place on this desolate spot. So great was the upheaval that in one range on the east shore huge masses of rock have been tossed up. The well-defined stratifications of clear red and yellow streaks appear in perpendicular, inclined, or even inverted positions. We would have taken a photograph of the scene if we could have got our camera to bear upon it. The surface of the water was formerly at a higher level than at present, but has become lower by evaporation. This is now balanced by the constant inflow of the Jordan, the whole torrent of which is dissipated as vapour, for there is no outlet from the lake. In places the shore is so incrusted with salt as to resemble snow-drifts. Cakes of it were picked up by our mule-men for sale at our further destination. We found the waters of the Jordan so far salt that we had a difficulty in washing our negative-plates on account of a deposit of chloride of silver (these were in the wet-collodion days), which required an after-treatment to get rid of the fogging of the pictures, so the saltness of the lake is increasing. The level of the Dead Sea surface is over 1,300ft. below that of the Mediterranean, and the heat scarcely endurable. At sundown there are usually tremendous wind storms rushing down through the gorges of the hillsides, caused by the hot-air ascending, and the colder air from above taking its place. There is no vegetation for man or his flocks, and no community could ever have resided there. There is no tangible evidence by modern teaching to show that such anomalies in the definite conditions and order of this world's progress could ever have existed as miracles.

F. H. Wenham.

NATURAL HISTORY STORIES.

[43143.]—AMONGST the natural history stories recently published, I think this should find a place: "An employé of some timber merchants, while engaged in felling trees at Glen Roy, Lonan, Isle of Man, on striking a tree with his axe, was greatly surprised to find that he had hit upon a nest of bees. As soon as an opening was made, the bees issued forth, and the exodus continued for about two hours. Afterwards it was found that the nest contained an immense quantity of honey, and although some ran waste, over 70lb. weight was secured." I can understand that bees do make their "home" in the trunks of hollow trees; but I want to know what the bees did when they were disturbed by that axe, especially as they were two hours completing their "exodus"?

S. S.

STENCILS FOR SHADOWS.

[43144.]—THE plate inclosed is a copy from a paper one that has been in our family for a great number of years, and has been kept secret. I do

not know if ever you saw anything like it. You will see whom it represents on holding it against a white wall by gaslight. The shadow is good. I thought it could be put into print, for a great many people, I am sure, would like to have one. The drawing is half-size of the plate, which is simply cut out in thin sheet iron.

John Bywater.

3, Reedham-st., Choumert-rd., Peckham, S.E.

THE Russian Government are elaborating a scheme for the systematic colonisation of the northern coastlands of Siberia, and for the establishment in that region of an authoritative system of government control.

Classification of British Guns.—Generally speaking, all guns of classes used in the field are named from the weight of their projectile (approximately), the weight of the gun being also mentioned if further distinction is required. The one exception is the 2·5in. gun, which is made in two parts, to screw together, and is intended for mountain service. It is really a 7-pounder gun, but is distinguished by the diameter of its bore for a special reason. Thus, we have the 12-pounder of 6cwt., the gun with which the Royal Horse Artillery is generally armed, firing a shell $12\frac{1}{2}$lb. in weight, with a charge of 12oz. 7 drachms of cordite, and the 15-pounder, with which Field Batteries are equipped, weighing about 7cwt., and firing a shell of between 14lb. and 15lb., with a cordite charge of 15oz. 12 drachms. Howitzers (which are short pieces, relatively to the diameter of the bore, intended for firing heavy shells, with comparatively low velocities, for the destruction of buildings and field or other works) and guns over 3in. or 4in. in calibre are distinguished by their calibre or diameter of bore, with the addition, when necessary, of the weight of gun. Thus we have the 5in. howitzer (of which a battery has just reached South Africa), which weighs 9cwt., and throws a shell (filled with Lyddite) weighing 50lb., the firing charge being about $\frac{3}{4}$lb. of cordite. We have guns varying in calibre from 4in. up to 17·72in. Speaking generally, the weights of projectile for the following guns are about those stated against each, but they vary somewhat, according to the nature of the projectile, and, in some cases, the pattern of the gun: 4·7in., 20lb.; 6in. (gun), 100lb.; howitzer, 118lb.; 9·2in. (22 to 27 tons), 380lb.; 12in., varying from 45 to 47 tons (in very general use in the Navy), 714lb.; or a late pattern, 850lb.; 16·25in. (111-ton gun), 1,800lb.; 17·72in., 2,000lb. Except the last, all the guns mentioned are breechloaders.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

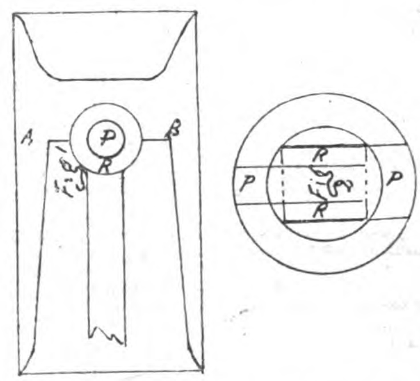
[96811.]—**Converting Objective.**—The water immersion would not give a sharp image when used with oil, without some correction. If made on modern lines, the front lens could be adjusted, or a new one formulated. For the objective to perform, the front lens might probably want to go closer to the correcting lenses than they would allow—that is, it would touch the next lens before a critical image could be formed. It should not cost much, but opticians capable of doing it are few and far between. Cedar oil is now used universally; its refractive index, 1·51 about, is very near many of the crowns used in objective making. We use ourselves glycerine, with a chemical salt dissolved to index of refraction whilst adjusting the front lens, until it is permanently fixed by running a minute ledge of metal over the edge of it, and then finally test for cedar oil.

Bognor. ENGLISH OBJECTIVE CO.

[96818.]—**Square Thread (U.Q.)**—I do not think that you will find anything better than taps. If you have a quantity of holes to tap, get three taps made, the diameter at the bottom of the thread in each case to be $\frac{1}{4}$in., while the largest diameter to be, say, $\frac{19}{64}$in., $\frac{11}{32}$in., and $\frac{3}{8}$in. respectively; the end of the taps to be tapered for about $\frac{3}{8}$in. Thus each tap will get a fair share of the work, and a little care will insure freedom from broken taps.

CLYTIE.

[96864.]—**Knocking in Gas-Engine.**—I do not know the construction of your piston, but it should be as sketch, and a good knuckle-joint made as shown. There is very little tug on your piston; it is all thrust. You have very little stuff to play with, and don't bore out to bush it, but lap it out true, and make a new pin, and either make a bush, as I have said, or get a piece of solid-drawn tube—i.e., steel—and make a bush, not forgetting the holes in



it. Fig. 1 is section through centre of length R, P pin. Fig. 2 is section of piston through A B, Fig. 1. R, eye of rod, and P P pin. That is as it should be fitted, a good butt knuckle-joint.

JACK OF ALL TRADES.

[96891.]—**Sun Views by Projection.**—My quotation from Proctor's "Half-Hours" was perfectly correct, it is from the 12th edition, p. 104. Will Mr. Wadsworth kindly tell me to what extent he stops his $8\frac{1}{2}$ mirror? My o.g. is 4in.

Masulipatam. E. G. R.

[96987.]—**Series (U.Q.)**—This query, on p 282, Nov. 3, has, I see, got into the "U.Q." column. The series is—

$$y = 1 + x + \frac{x^2}{1^2 . 2^2} + \frac{x^3}{1^2 . 2^2 . 3^2} + \frac{x^4}{1^2 . 2^2 . 3^2 . 4^2} + \&c.$$

It is required to find if there is any exact expression which will give y in terms of x. Referring to Boole's "Differential Equations," chapter xvii., where the symbolical method of working is explained, I find the differential equation of the above series is—

$$x \frac{d^2 y}{d x^2} + \frac{d y}{d x} - y = 0.$$

This can be tested by performing the operations indicated on a few terms of the series, which, when the results are added, gives the series—

$$y = 1 + \frac{(2 + 2) x}{1^2 . 2^2} + \frac{(3 + 2 . 3) x^2}{1^2 . 2^2 . 3^2} + \frac{(4 + 3 . 4) x^3}{1^2 . 2^2 . 3^2 . 4^2} + \&c.,$$

which is the same as the given series, as all the numerators are exact squares, and they cancel the

last square number in the denominators. Now, if there were an exact expression for y, the diff. equation given above would be integrable; but it can be proved that it is not exactly integrable, so that there is no exact expression for y.

Bath. M.I.C.E.

[97007.]—**Boat.**—What is meant by the "section of wood" for this boat? The kind of wood may be anything the querist likes, except elm, which will, however, do for the keel if the boat is kept in water always. He can use yellow pine or oak—the latter for preference. PUTNEY.

[97011.]—**Acetylene Generator.**—It seems to me that this querist should see the acetylene generators illustrated in back numbers, and, by the way, mostly patented. B. C.

[97023.]—**Engraving Tools.**—What is the meaning of "lead lessened about ¼in.," "pressed into cut," in the reply under this head on p. 324? A little explanation seems necessary. METOPS.

[97031.]—**Enamelling Oven.**—The querist should look up his back volumes for an enamelling oven. The iron may be only ⅛in. thick; but it is better to use ¼in. The burners (Bunsen) are usually underneath, and the oven, being surrounded by brickwork, the hot air passes all round it. A temperature of 300° to 350° Fahr. is required; but it depends on the enamel. V. P.

[97038.]—**Colouring Oil.**—Does it not occur to the querist that paraffin means "without affinity," and that therefore he will have some difficulty in colouring the oil? H. C.

[97044.]—**Accumulators.**—If the querist will turn up his back numbers he will find full instructions for making accumulators; but as to the rest of the query he must say what quantity of current will be required before sizes, &c., can be given. M. L. D.

[97050.]—**Electric Lighting.**—It is scarcely likely that the old-fashioned atmospheric gas-engine has ever been used to drive dynamos. It is not sufficiently steady in running. M. L. D.

[97149.]—**Manchester Dynamo.**—To MR. BOTTONE.—There is no mistake in the figures except 5½in. on each core ought to read 5½lb. on each core, and if Mr. Bottone reads my query again he will see that I have put my fields in parallel, and given him the result last week. Many thanks for his reply. TRY AGAIN.

[97198.]—**Screw Gear-Wheels.**—My inquiry last week has a mistake in it. I forgot to fill in the size of wheel where the printer has put the note of interrogation. It ought to be 4½in. diameter. J. A. C.

[97200.]—**Feed Pumps: Steam Launch.**—Best way to reduce speed of pumps would be to use spur gearing two to one ratio. Mount wheel in an eccentric bearing similar to back gear of lathe; it can then be thrown out of gear, and is convenient for examining pumps when running. If you want to adopt chain, then use Hans Renolds with inverted teeth, which will run on spur gear wheels, and forms a flexible rack; it works very sweetly. MONTY.

[97206.]—**Spokes.**—The construction of a cart-wheel is based on a sound scientific principle. When one wheel of a cart, through an uneven road, becomes lower than the other, it is obvious that this lower wheel has to bear a much greater weight than the higher one. To meet this it will be seen that the lower wheel becomes stronger than the higher wheel, simply from the fact of its spokes approaching nearer to the upright position; whilst in the normal position of a cart, the weight being equally divided, individual strength of wheel is not required. Were wheels built with the rims in the same plane as the nave, they would be weakest just at the time when the greatest individual strength was required, and strongest in the upright position when great individual strength of wheel was not required on account of there being two to bear the load. F. FITZPATRICK.

[97219.]—**Rope Drive.**—I should be obliged if "Monty," who kindly replied to my query, would let me know where I can obtain the Dick's belt? I advertise my address in this number. I should have thought a belt unsuitable when so short, there being only about 2½ft. from centre to centre of pulleys. The motor has a tension screw, however, to take up slack in belt. I cannot increase the length, as the apparatus is in a motor car.

Belfast. J. BROWN.

[97219.]—**Rope Drive.**—For "driver" read "drives." Typographical errors in many of the answers are apparent to a thinking reader. Read articles on "Millwright's Work" now appearing, which I had not read when replying. These give all the information required on rope driving, besides illustrating same. MONTY.

[97235.]—**Melting Old Brass.**—If you use all scrap brass, you will find the castings porous and defective; better use half-scrap and half-new metal. There should be no difficulty in melting in a smith's fire, as I have done it many times. You will get the best possible sand for casting brass at about 10s. per ton, plus carriage, so do not be tempted to pay fancy prices for doubtful compounds. CLYTIE.

[97235.]—**Melting Old Brass.**—If you think you can get 1,650°, the melting-point of brass, from a smithy fire, why, yes. You might try a small piece in a crucible first, but I think it doubtful; however, it is worth a trial. Otherwise, you will require a brass founder's furnace—no flux.

REGENT'S PARK.

[97235.]—**Melting Old Brass.**—There should be no difficulty in melting brass on an ordinary smith's fire. Get a proper crucible for the job, then make a fire with hard coke, and after it has blown up nice and bright bury the pot well down in the fire and heat up very gently, so as not to burn the bottom out of the pot. The metal will not require anything mixed with it to make it melt.

E. W. FRASER.

[97235.]—**Melting Old Brass.**—Old brass may be melted on a smith's fire in a small crucible, using coke. G. BOUSFIELD.

[97236.]—**Chimes for Clocks.**—Probably the correct note for the hour-bell of a Westminster chime is an octave below the third note of the quarters, No. 1 being the highest note, the chime reading B, A, G, D, and hour, G octave; but in most church clocks where a ringing peal of eight bells is used, the quarters are taken on the second, third, fourth, and seventh, and the hour on the eighth bell. In house quarter-chime clocks there is usually no musical relation at all between the chime bells and the hour bell, the matter is left purely to chance, and no one appears to notice any defect. "Cambridge" and "Westminster" chimes are the same. Eight-bell chimes are sometimes erroneously called "Cambridge" chimes, and these (eight-bell chimes) are taken on the octave anyhow, according to fancy, the hour being sometimes on the eighth bell, and sometimes on another having no musical relation to any of them. F. J. G.

[97236.]—**Chimes.**—The obvious note for the hour-bell is surely the tonic, or "key-note," of the scale in which the chimes have been playing. No other note can satisfy the ear as final. If the chimes were in G major, to end on C would be to end on the subdominant of the scale which the chimes had impressed on the ear; *that* would be extremely unsatisfying. At Croydon the chimes at the town-hall are in one key and the clock strikes on a note entirely out of it, or else utterly out of tune—the effect is enough to drive one frantic.

Farleigh Rectory. F. BENNETT.

[97237.]—**Jewish Calendar.**—The modern Jews always observe every feast on two successive days, to be certain of keeping the right day. Now, if this was already done in our Lord's time, it shows there is no contradiction between the last Gospel and the three earlier. Christ celebrated the supper on lamb the Thursday before ordering His own supper of bread and wine; but many, the following day, would not enter Pilate's hall, meaning to eat the lamb that Friday afternoon, when Christ was on the cross. The year was not, as "Studens" fancies, either 30 or 31 A.D., but 33. It was the fourth year of the 202nd Olympiad, in which Phlegon's book of "Phenomena," now lost, dated the wonderful eclipse of the sun at noon, and earthquakes. The same evening was an eclipse of the moon, visible at Jerusalem. The darkening of both sun and moon the same day had been foretold in Joel ii. 21, which St. Peter quoted in Acts ii. 20. Amos also had foretold that it should be a feast day, viii. 9; and Zechariah, xiv. 8, that it should be "one day which is known to the Lord, not day nor night, but at evening time it shall be light." The Jews, using a lunar calendar, must have known well that a natural solar eclipse could happen on no day but the last of their month, and that a solar and lunar one the same day must be miraculous. In old crucifixes we find the sun totally dark, and the moon partially dark, on each side. Gentiles, not keeping lunar months, were unaware of this. Seneca, who was born in Spain, was only a boy at the time, and those about him may have thought it a natural solar eclipse. But Pliny dishonestly ignored the darkness in Pilate's time, because of the use he knew Christians to make of it; and made a great wonder of that which was said to have followed Cæsar's death, near a century earlier. There were annals at Rome, like a modern newspaper, that told of the darkness in Pilate's time, and the Early Christian fathers directed inquirers to them. E. L. GARBETT.

[97237.]—**Jewish Calendar.**—"Studens" can obtain all the information he wants by writing to the Time Observatory, Wanstead, E. As B.C. and A.D. years are not made by the sun, they have no existence save by legislative enactments. The first day of Nisan in the Crucifixion year was Friday. The year was 4029 A.M. by solar and lunar motion. Hence the 14th was Thursday and the 15th (Passover Day) was Friday. J. B. DIMBLEBY.

[97238.]—**Truing Emery Wheels.**—As a rule, a bit of hard cast-iron will do, or an old file used edgeways; but if a certain face has to be given to the edge of the wheel a bort tool would probably be necessary. METOPS.

[97238.]—**Truing Emery Wheels.**—To G. BOUSFIELD.—Small emery wheels, or grinders, are commonly trued up by a piece of carbide, or black diamond, set in the end of a metal rod in the usual way. For the larger wheels I have used the following method:—Take a rod of some tough wood, about 10in. long and less than 1in. square, near one end drive in a common wire nail, nail transversely, with a stop behind, to prevent it from driving back. This is used like a small pickaxe. While rotating in the lathe mark the high places on the emery wheel with a piece of chalk, and break them down with the pick till they are effaced. Soft iron for the pick acts far more effectively than hard steel.

F. H. WENHAM.

[97238.]—**Truing Emery Wheels.**—The emery-wheels should be put upon a mandrel in the lathe, and very light cuts taken over them with a diamond mounted so as to be held in the slide-rest. Run slowly, or you will lose the diamond. If you have neither a diamond nor one of those hardened steel wheels which are sold for truing emery-wheels, the following may help:—A short time ago a friend of mine had the job to turn and bore out some 18in. by 2in. emery-wheels of good quality and coarse grain. He was told that the firm would not go to the expense of a diamond for boring them out, so he mounted one of the wheels on the face-plate of a 12in. lathe, ran the slowest possible speed (back gear in), and let a gas-flame play on the wheel till it was too hot to handle comfortably. Then he got some old three-cornered files, and put one in the slide-rest with one of the sides uppermost, thus making a cutting-edge of a sort. By this means he cut a recess 8in. by ⅜in. both sides of the wheel, breaking a bit off the file when it got ground away too badly to cut. It is a rather slow job. Last, but by no means least, is the terrific shriek the wheels set up when the cut comes on, and which, in the case referred to, defied all efforts to stop it. It was heard far and away above the rattle of nearly a hundred machine-tools, and was the cause of much profanity amongst those near the lathe. E. W. FRASER.

[97236.]—**Truing Emery Wheels.**—They are usually turned up with one of the numerous emery dressers, which consist of about six discs held in a holder, the edges of the discs being either serrated or wavy. They cost from 2s. 6d. to 5s. each, and must be used when the wheel is running at its usual speed. A piece of black diamond is much better, but the wheel should only run at a surface speed of about 100ft. per minute. CLYTIE.

[97241.]—**Small Spark Coil.**—To MR. BOTTONE.—Length of iron wire core 5in., diameter ⅝in., gauge No. 22; diameter of heads, 2in. Primary, two layers No. 24 silk, about 3oz.; secondary, 6oz. No. 36 silk; condenser, 50 sheets tinfoil, 2in. by 3in., interleaved with paraffined paper. Mica not much use. One-pint chromic-acid cell, or one single cell accumulator will work this coil well.

S. BOTTONE.

[97242.]—**Plating Dynamo.**—You must not expect to do much in the way of plating with so small a machine. Wire on armature, 3oz. No. 18; wire on field, 2lb. No. 20. Connect up in shunt.

S. BOTTONE.

[97244.]—**Grammaphone Experiment.**—I saw it stated in the "E.M." some two or three months ago that the same experiment which you describe in query had been successfully performed. Although you will get double the volume of sound, as far as regards the music or speech, I have no doubt but what the grating noise of the needle and record will also be increased in some proportion. I do not think any ear would be able to detect any undulations, with the needle at such a short distance as ¼in. apart, as the pitch of the note produced by each needle will be practically identical. If you are able to make your own records, you might try the following experiment:—Instead of placing the needles of each diaphragm one behind the other, fix them side by side, so that the line forming the two points coincides with a diameter of the disc, and fix them about one groove apart. Now, supposing you have a duet of voices or instruments to be reproduced, allow each voice or instrument to its own diaphragm. With quartettes, two of the parts might be allotted to each diaphragm, or, if experience taught otherwise, the melody part might be reproduced by the one diaphragm, and the remaining three parts by the other, also similarly with bands, &c. This arrangement of twin needles would shorten the performance of the songs, &c.; but, if necessary, larger discs and turn-tables could be made. I think this arrangement would not only double the volume of sound, but what is more important, would improve the quality or timbre. I beg respectfully to commend the above to the notice of the Gramophone Co. T. D.

Gateshead.

[97246.]—**Air-Heating.**—For churches and large public rooms allow 5ft., for schools and lecture rooms 7ft., for dwellings 14ft., and for greenhouses 35ft. of 4in. pipe per 1,000c.ft. of space, to maintain the temperatures required in such structures. If pipes are in, channels will require 20 per cent. more to give same result.
161, Albion-road, N. A. CLARKE.

[97246.]—**Air-Heating.**—I do not know of experiments on heating air by plates in actual contact with fire which would be necessary in order to get as much as 500° Fahr. Why is such an excessive temperature required? Rules for surfaces of steam and hot-water pipes to heat air to more moderate temperatures, say 70°, will be found on p. 337, Vol. LXIII. *Engineering*, together with tabulated results of experiments. GLATTON.

[97247.]—**Static Machines for X-Ray Work.**—To "SCALPEL."—Wimshurst machines of sizes up to 24 plates of 38in. diameter may very well be worked by hand. 24in. plates, if all is rightly designed, will give about 11in. spark. A machine with 8 plates of 24in. diameter will work almost any tube. Still a larger machine will naturally give more electricity, and require less time for an exposure. The machine which photographed the thorax had 12 plates of 2ft. 4in. diameter. The machines are made by many makers; but examine and satisfy yourself with the workmanship and the design before buying. J. W.

[97247.]—**Static Machines for X-ray Work.**—(1) Yes, easily. The length of spark depends on the number of sectors, and the height to which the jars are coated. The machine should give 10in. to 12in. sparks. (2) Procure a bianodic tube of 9in. length, exhausted to 2 millimeters on the gauge. (3) Dr. Monell's machine is an eight-plate 32in. machine. We supply these. (4) Yes; my "Radiography" and Dr. Monell's "Electro-therapeutics." S. BOTTONE.

[97248.]—**Compressed Gas.**—Probably Hurst and Lloyd, of High Holborn, W.C., engineers, would be a good firm to apply to. I take it, compressed air and gas are very much alike. If so, a perusal of F. Richards on compressed air may be handy reference—of Chapman and Hall, London.
REGENT'S PARK.

[97249.]—**Vertical Boiler.**—The practice in the British Navy is to fill the boilers to the top with distilled water when laid up. Another plan is to dry the boiler with a small fire, put an iron tray or box of quicklime inside and shut all valves, manholes, &c., airtight. GLATTON.

[97249.]—**Vertical Boiler.**—Corrosion may be prevented by adding about 5lb. of common soda to every 10c.ft. of feed-water used, or by metalically connecting rolled zinc to the inside of boiler. If a large one, the zinc must be connected in different places, so that the zinc is within 6ft. of any portion of boiler. In your case of a stationary boiler, both the above remedies should be tried.
G. BOUSFIELD.

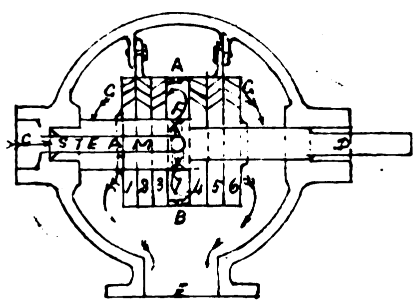
[97251.] — **Parrot Cage.** — Try as a solvent cleanser, strong alkali, or pure alcohol, and then coat over with so-called gold (or other tint) paint.
REGENT'S PARK.

[97252.]—**Telescope.**—Probably the inner curves of the flint and crown lenses are not coincident, and may be intentional. Then, when cemented, the balsam forms a third lens, which entirely alters the focal length of the pair. Remedy: remove the cement by soaking the lenses in benzoline or methylated spirit, clean carefully, and remount without cementing. Or you may have cemented the wrong surfaces together. S. BOTTONE.

[97253.]—**Crank-Shaft.** — In a general way, diameter of wrought-iron crank-shaft may be = diam. of cylinder multiplied by ·4. The diam. of steel crank-shaft may be = diam. of cylinder multiplied by 3·2; diam. of crank-pin = diam. of cylinder multiplied by ·20 to ·24. It is frequently = diam. of neck of crank-shaft multiplied by ·66. Diam. of piston-rod = diam. of cylinder in inches × ·02 × square root of initial pressure of steam. For one of steel use a multiplier of ·016 instead of ·02. Diam. of valve-spindle when of wrought-iron = diam. of cylinder in inches × ·0113 × square root of initial pressure of steam. For one of steel use ·009 as multiplier instead of ·0113.
REGENT'S PARK.

[97254.]—**Covering for Band-Saw Pulleys.**—I have put leather on pulleys thus:—A piece of good leather is cut the width and the length to just meet barely round pulley; then, having marked off the places where the fastenings are to be, I take a small centre-bit or twist-bit the size of the copper rivet-head, and make hole about $\frac{1}{16}$in. deep; then make the hole where point of centre-bit goes through the size of rivet. Drill the holes through rim of pulley the size of your rivets. The heads of rivets are on the hair side of leather, and the burrs of the rivets are, of course, underneath the rim of pulley. For years I have used pulleys treated so, and never had to repair them, or any trouble; in fact, I used to have slacker belts, which means less friction and some saving of power. MILLER.

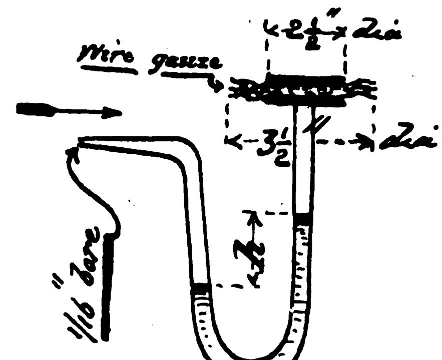
[97255.]—**Steam Turbine.**—There is nothing new about the steam turbine, or the principle on which it is constructed. I send you a sketch of one



upon the same principle as the Parson's, so much talked about. It appeared in *Engineering* about the "mid-sixties," and was said, I think, to have been driving a large engineering plant for about a twelvemonth, and giving out, I think, 100H.P. It was a spherical casing broken across the horizontal line in the centre—i.e., in two halves. It consisted of six discs, 1, 2, 3, 4, 5, 6, arranged as shown; 3 and 5 are fixed to lugs in the casing by their ears, as shown. Those are deflectors. The steam is taken one end of the spindle, C passes up steam, and makes its entry at chamber F, through the holes in spindle, passes right and left, and makes its exit at G G into casing, and exhausts at E. The driving end is D. JACK OF ALL TRADES.

[97256.] — **Windmills.** — "The Windmill as a Prime Mover," by A. R. Wolff, 2nd edition, 1894. Jno. Wiley and Sons, New York. Probably B. T. Batsford, High Holborn, could get it for you. He may have something on making wind pressure and velocity instruments. REGENT'S PARK.

[97256.] — **Windmills.** — An instrument is described on p. 376, Vol. LXV. *Engineering* which registers pressures of wind against buildings accurately. To measure velocity I suggest the apparatus shown in sketch. A glass "U" tube



with a little water in it has one end bent, as shown, and drawn out to a fine opening, the other being fitted with a sandwich, composed of two thin discs of metal with several layers of wire gauze between. The tube is in connection with the space containing the wire gauze. If the pointed end of tube is turned to face the wind, which is supposed to travel with the arrow, the water will show a difference of level = h. Then the velocity of the air in feet per second

$$= \sqrt{4370 \times h}$$
$$= 66\cdot1 \sqrt{h}.$$

"The Windmill as a Prime Mover," by Alfred R. Wolff (published by John Wiley and Sons), gives a lot of information about American wind-wheels. My copy is dated 1885; probably a later edition has been issued since. GLATTON.

[97258.]—**Annealing.**—Instead of annealing, you are case-hardening by the Harvey process—just like armour-plates are hardened in fact. Substitute fine ashes or mill scale for the charcoal, and you should have no further trouble. CLYTIE.

[97260.]—**Electric-Sparking Plug.**—Get some good pipeclay, work it up into a rather thin cream with water. When quite ready to use it, add about its own bulk of plaster of Paris, mix quickly, and apply to the portions to be cemented. Let it set quite hard before using. S. BOTTONE.

[97263.]—**Organ.**—The stops you have will make a very nice little two-manual organ; but I should advise a different distribution to that given by you, and also the continuation of the Gamba to Tenor C, with another bass. As you have mentioned my name in the matter, I shall be pleased to help you, and send specification which would be satisfactory, if you will advertise your address in the Address Column of "Ours." J. MATTHEWS.
(The writer of the articles.)

[97264.]—**Glass Harmonicon.**—I have made many of these, and can therefore advise to some purpose. The greatest useful compass is about two octaves, from C in the treble to C″. If you can get glass of absolutely the same thickness and texture throughout, then the lengths required (the width remaining the same) will be as follows:—

4 . $\frac{32}{9}$. $\frac{16}{5}$. 3 . $\frac{8}{3}$. $\frac{12}{5}$. $\frac{15}{8}$. 2 .
Do re mi fa sol la si do′
$\frac{16}{9}$. $\frac{8}{5}$. $\frac{3}{2}$. $\frac{4}{3}$. $\frac{6}{5}$. $\frac{8}{9}$. 1
re mi fa sol la si do″

Where do, re, &c., do not stand for any particular pitch, but only for the relative sequence of the notes in the octave, the numbers indicating the relative lengths of the glass strips required. A convenient width for the glass strips is $\frac{3}{4}$in. The glass should be thin and equal. As this is almost impossible to secure, a little "tuning" is often necessary, the thicker strips being made longer than indicated by the above rule, and the thinner ones somewhat shorter. To get good effects, the glass strips must not be fixed rigidly on their tapes. S. BOTTONE.

[97266.]—**Optical Lantern.**—If "C. W. C." refers to the "E. M." of March 24, 1899, p. 135, he will there find a full description, with diagrams, how to make a cheap enlarging box, which is nothing other than an optical lantern only made in wood, the light used being an incandescent burner of gas. I sent this description, and you will find it answer the double purpose of an enlarger of photographs as also a projector upon a screen. You can produce any size if you have only distance at your command. You require contact prints "positives" for projection. You cannot do without a condenser. You can obtain a 4in. one for about 6s. at an optician's. Your rectilinear will answer admirably; only do not stop it down too much. PHOTO.

[97266.]—**Optical Lantern.**—If "C. W. C." can procure or see Vols. LIII. to LVII. he will find a series of articles, which practically exhaust the construction of the optical lantern. If he procures No. 1378, August 21, 1891, No. 1381, Sept. 11, 1891, and No. 1383, Sept. 25, 1891, he will get an idea of the character of the articles, and probably all the information he wants.
SCORPIO.

[97268.]—**Hektographic Ink.**—If you make up an ink in the usual manner with glycerine, &c., and use as colouring matter only just sufficient fuchsine (hydrochlorate of rosaniline) to give a pale pink impression, you will find this easy enough to remove by the application of liquor ammoniæ and subsequent washing. S. BOTTONE.

[97268.]—**Hektograph Ink.** — If "Jersey" cares to communicate with me, I can put him in the way of doing what he wishes to do. See Address column. R. C. GILSON.

[97269.]—**Cloudy Lenses.**—J. J. Clarke is only one of thousands who have the same trouble with German work. The lens that generally goes on all Continental objectives is a single lens placed between the back and middle correcting lenses. It is constructed of one of the most perishable glasses made, though we have now scores with the front lens also "cloudy." We have had as many as thirty returned to us to be "fixed" in one week from large medical colleges. Apo. and achromatics, all with the disease. They last longer in different localities, according to climatic conditions. We had so many to do, and were tired of having them year after year, that we made a special rouge to polish them, which considerably lengthened their lives. We are afraid J. J. Clarke must send them to their respective makers, or to an optician who will undertake to put a suitable lens of a less perishable nature, which will only reduce the illuminating power somewhat. A well-known German maker was asked why he used such perishable glass, and couldn't he use glass that would last? He said: You buy a pair of shoes and do not expect them to last for ever. Why should my lenses do so?
Bognor. ENGLISH OBJECTIVE CO.

[97270.]—**American Organ.**—The best work I know of answering to the requirements of the querist is Spanswick's "Directions for Tuning and Regulating Mason and Hamlin's Cabinet Organs," published by Metzler and Co., Ltd., Great Marlborough-street, W., price 2s. It contains illustrations showing the mechanism and a description of the stops. "M." can also find a great deal about the American organ in back volumes. ORGANON.

[97271.]—**Dion Motor.**—Shut petrol taps completely off going down hill, also switch—to save petrol and battery. Note one thing, that is not generally mentioned in instructions; if hill is long the rapid rush through air, if going down with compression closed, sometimes causes specks of moisture to form, causing engine to miss first few shots, though only momentarily; therefore, if run-

ning down hill with compression closed—which is advisable for safety if the hill is steep—when nearing bottom open same, and leave it open till engine has fired three or four shots. "Never rush a hill till you can see the bottom" is a good maxim to bear in mind. The vapour-valve is merely an easy fitting round cylinder, and sometimes leaks slightly even when completely closed. A pint of petrol for 1¾ motor should carry you nine miles—less probably if the weather is damp. I could give you a sketch of carburator; but as you have one you can easily examine your own. Get a book of instructions from the British Motor Co., from whom (if you ride a Dion motor) you will receive every courtesy on application. Monty.

[97275.]—**Smoky Chimney.**—A supply of air brought from outside to the firegrate would have the same effect as the open door.
161, Albion-road, N. A. Clarke.

[97275.]—**Smoky Chimney.**—From what you state in regard to your old chimney, I suspect the grate stands too far out. In order to test this, let a small stone or plumb-line fall from inside of lintel, immediately over the fireplace. If the plumb-line falls inside of grate, the grate must be set back.
Rothesay. J. Kay.

[97276.]—**Boiler.**—Yes, ½in. is quite thick enough, providing the aluminium is alloyed with about 4 per cent. of copper. G. Bousfield.

[97277.]—**Condenser.**—Condensers, as a rule, are made with water circulating inside tubes—not outside. In your case you will require a chamber for the condensed steam to accumulate in (if there is not sufficient space left over ends of tubes), and the water is drawn from here by the air-pump.
G. Bousfield.

[97278.]—**Force Pump.**—The water must be pumped into boiler below the water-line.
G. Bousfield.

USEFUL AND SCIENTIFIC NOTES.

A daily Pullman express service between Berlin, Buda-Pesth, and Constantinople, will be established next summer, leaving Berlin at seven a.m., and arriving at Constantinople at ten minutes to ten a.m. on the third day.

According to the last annual report of the Japanese Railway Bureau, 472 miles of new line were opened during the year ended March 31st last. The total length of lines in operation was 3,421 miles. The number of railway companies incorporated under former charters was fifty-eight, with a total capital of 238,775,000 yen, with 2,652 miles of road in operation.

A project is said to be on foot which involves the raising of Loch Doon by 20ft., and converting the waters of Nees Glen into a source of energy for the driving of dynamos and the operating of electricity. The scheme consists in the construction of a light railway, which is to run into the heart of the mineral districts of Scotland. The scheme has been brought about chiefly by the finding of ironstone, lead, &c., round about the upper end of Loch Doon and elsewhere in the district.

Power of Dry Battery.—One way of defining a watt-hour is to say that the energy represented by it is equal to that expended in raising a pound to a height of 2,654ft., or two watt-hours correspond almost exactly to raising a pound to a height of one mile. Applying this to primary batteries gives results which at first sight are rather surprising, as they show how much energy is stored in them. A certain dry battery, for instance, weighing 6·38lb., yielded 130 watt-hours, which, if applied to raising the battery itself, would lift it to a height of over ten miles. In one hour the energy translated in an ordinary 16-candle power incandescent lamp weighing about an ounce would raise that lamp to a height of 400 miles at a velocity of nearly seven miles per minute.

Obesity Remedies.—Mme. Ameliere, who has tried many obesity cures without result, has succeeded in reducing her too solid flesh in a very simple way. Her usual diet is not modified; but everything taken into the mouth is masticated till it slides down the throat without the voluntary action of the person eating. Nothing is forcibly swallowed. This may seem impossible at the first thought, but a single trial will convince anyone of its practicability. Not only solid food is chewed in this way, but liquids of all kinds, tea, coffee, milk, beer, and so on. From the standpoint of economy this new method of eating is very satisfactory, because in following it one cannot take more than half the amount of food consumed in the ordinary way. When the food is thoroughly masticated, hunger is soon satisfied; and physicians have said for a long time that people eat very much more food than is necessary to keep them in health and strength. In the instance cited, at the end of twelve weeks the patient had reduced her weight 50lb.—*American Paper.*

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Clytie" has replied to 96818; "M.I.C.E." 96967.

QUERIES.

[97281.]—**Straight or Curly.**—Can any reader who has had his hair cut perfectly close to head or shaved, from other reasons than illness (fever, &c.), tell me from personal experience how the second crop has come out, as in cases of fever the hair previously straight always comes out curly? I have observed it in six cases to my personal knowledge.—Rose Thorn.

[97282.]—**Automatic Feed.**—Can any reader say if it is possible to make a pump or other arrangement feed a boiler automatically? and, if filling too quickly, to stop and start again? It would be needed for a still, and must not be got too full, or it would spoil the water.—J. A. C.

[97283.]—**Motor Tricycle.**—I am building a motor-cycle, and on purpose to shorten the process, I propose to bore crank-discs parallel and keyway them, and to turn shafts to suit, but a shade larger, and keyway also, and to shin the discs on to shafts, and to key up. Will "The Writer of the Articles" or "Monty" kindly say if there is any reason why this course should not be adopted? I may say I intend to finish the turning required after the discs are shrunk on. Advice will be greatly esteemed by—Electric Spark.

[97284.]—**Geometrical Progression.**—Will "M.I.C.E.," or others, look over this? The sum of six numbers in geometrical progression is 315, and the sum of the two extremes is 165. I find that this reduces to $\frac{315 - x}{150 + x} = r$ when x = first term and r = ratio. This divided gives $r = 2$ and remainder $15 - 8x$, or $15 - 3x = 0$, or $x = 5$, so that we at once get both the first term and the ratio. For information, I would be pleased if "M.I.C.E.," or other readers, would pronounce on this method, and if wrong, why? And also give another solution in quadratics. I have no use for the solutions, hitherto, of Mr. Burgess; in a former "G.P." he found out by guessing that, as it happened, the first term and the ratio were alike, so he proceeds: "Let x = the first term," "also let x = the ratio," then he gets along swimmingly; but it is rather too thin.—Ontario.

[97285.]—**Factory Clubs.**—I should be glad if any of our readers could afford me information regarding the formation and working of clubs and institutes in connection with factories. We are offered several rooms in a building in course of erection by our firm, which we propose to turn into a social club, with reading and recreation rooms, and to set aside one big room for "smokers," lectures, &c. We are wishful to arrange for the sale of tea and coffee, &c., as well as to provide for the sale of a limited quantity of beer to the members. Any hints or copies of rules would oblige.—M. I.

[97286.]—**Specula.**—I have tried ineffectually to grind by hand an 8in. speculum, but fear the curve must be radically incorrect, as it does not polish properly, and the cause of this irregularity seems to be the difficulty in giving a regular stroke when grinding by hand. I should like to try and work another with a machine, if such a thing could be done inexpensively, and would be glad of design for a simple and easily-constructed one. The recently-reproduced photo. of Mr. Glass's machine is too indistinct to make out the several parts, and I do not see any arrangement for the side movement mentioned. Could this be effected by setting the tool eccentrically on the spindle? I have tried to test the general figure by the shadow test, but the screen appears to hide mirror altogether when brought across the cone of rays near the eye. With the pinhole and eyepiece it shows a magnified image with low-power eyepiece, but with small pinhole the in-and-out of focus images are too small, faint, and indistinct to make anything of. How is this? This test seems very difficult to master. Is there not a simpler but effectual one.—Astor.

[97287.]—**Photography.**—I have copied some photos. stamp size, to go on Christmas cards, and wish to paste them in sheets, cutting out when dry, so that by laying on a damp pad they will adhere to the mounts with a little pressure. What paste or other adhesive can you recommend?—T. Richards.

[97288.]—**Optics.**—Is it proper to call a periscopic rectilinear lens a rapid rectilinear, seeing that they have to be stopped down to $f/12$ and $f/16$ before you get reasonable definition, which is slower than most single lenses? I have a weak biconcave monocle which changes my 8in. R.R. to about 12in. focus, but the definition suffers, though the supplementary lens is placed close behind the iris with its plane true in position. Is this the usual experience? If not, can I obtain a couple of well-made lenses to alter to 7in. and 12in. focus (the former, of course, a convex). I have a biunial with 8in. portrait lenses. Can I obtain lenses that will slip into the tubes that will alter to 6in. (the aperture, of course, being proportionately reduced) without impairing the definition?—T. Richards.

[97289.]—**Double Vision.**—I should be glad if my case might catch the eye of some one of your readers who could help me. I am 70 years of age, and have had good sight until about six months ago, when very suddenly I begun to see objects double or treble. At a distance of 3ft. or 4ft. I scarcely perceive it, but at three or four yards white or bright objects like a gas jet or the white letters on a shop window or sign appear double, about 1in. apart, and across the sheet the divergence is several inches, and is very confusing. My regular doctor says it is old age; but I have not begun to feel old yet, and have excellent health. A specialist, after a month's treatment, gives it up. As I am inclined to think that the failing may have been brought by overstraining my eyes, I have wondered if closing them entirely for a week or a fortnight might be tried without risk. Any suggestion from your numerous readers would be gladly received.—F. B.

[97290.]—**Galvanometer.**—Will some reader kindly inform me if I can alter a galvanometer used by the post-office to show the number of volts in an accumulator up to five volts, say? The galvanometer has a dead-beat needle and an arc graduated 70 on either side. It has three terminals—one "intensity" and one "quantity"; also a small switch marked "full on" and "shunt." It seems a well-made instrument, which I have used for testing bell-wires, &c.—Hyde Park.

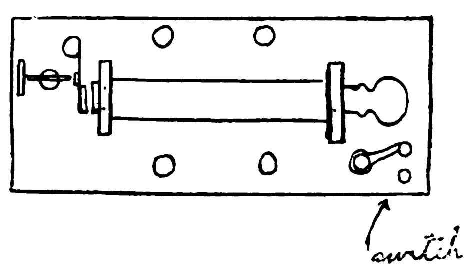
[97291.]—**Handicrafts for Working Lads.**—Some two years ago, as near as I can recollect, some gentleman gave an account in your columns of the success they had had in teaching some village lads the use of simple tools in the making of toys, &c., which were turned to profitable account. I am anxious to introduce such an idea to the manager of a working lads' club, and shall be very glad of information through your columns or to me direct.—Robert J. Parkes, Southport.

[97292.]—**Cycle Plating.**—I wish to construct an apparatus for coppering and plating cycle parts, &c. Will some reader give me a description of the most suitable and simplest kind of apparatus for cycle work? What voltage will be required from either dynamo or batteries, and which are the cheapest chemicals to use? A sketch will be most thankfully accepted by myself and many more.—G. B.

[97293.]—**Navigation.**—What moderate priced books on Practical Navigation can you recommend—i.e., with examples worked out?—T. Richards.

[97294.]—**Acetylene Gas.**—Would anyone oblige by assisting me out of a fix? I have been trying to adopt this gas for lantern work, and cannot get half enough of light. I have used 1, 2, 3 burners respectively in all positions, with a 4in. plated reflector. When you look in at the condenser the reflection has not the same brilliancy as the light has of itself, so I have got it into my head that the light is diminished. I have tried all distances from the screen. Hoping to get some encouragement—Rabbie Burns.

[97295.]—**Coil Connection.**—Would Mr. Bottone oblige by giving connections of coil, per sketch, to



terminals and switch, primary and secondary windings. Also what proportion of chemicals to charge battery with for same? Four layers of 20c.c. primary, 4oz. of 36 s c. secondary, are the amounts of wire on coil.—G. Dobbs.

[97296.]—**Gas-Engine.**—I am about to make a gas-engine, 3in. bore by 5in. stroke. I should be much obliged if any of our readers could inform as to size of compression space, valves, &c. I intend to use a liner of wrought-iron piping for cylinder, with cast-iron casing to form water-jacket. Are single-slotted crank-shafts in the rough suitable for above size obtainable? Is gas-bag necessary?—Gaseous.

[97297.]—**Lunar Volcanoes.**—Can "F.R.A.S.," or any other astronomer, give any explanation of the following, which I find in "Keith on the Globes," p. 152? Dr. Herschel on April 19, 1787, discovered three volcanoes in dark part of moon. First was nearly extinct, the third in actual eruption; the next night it burned with greater violence, and was computed to be three miles in diameter. The eruption resembled burning charcoal covered with a thin coating of white ashes. All adjacent parts of the mountain were faintly illuminated by the eruption. Is it not generally conceded that with the exception of the doubtful cases of Hyginus and Linné no well-authenticated movement has been observed on the moon? Most text-books seem to say so; but what about this observation?—Delphinus.

[97298.]—**Cements.**—I should be glad to know of cements suitable for the following purposes:—(1) For cementing silver or plate to glass—e.g., the plated rim of a glass biscuit barrel. (2) For cementing glass to brass or iron. The latter should be strong, as it is required for cementing the glass body of a large lamp to the stand.

Would dried and fused alum do for this purpose? I was at first advised to use plaster-of-paris, but have not found it satisfactory.—P. V.

[97299.]—**Budding Roses.**—What are "Manetti" stocks, on which roses are budded? Though referred to in almost every gardening book and price list that I have, the meaning is nowhere explained.—ROSA CANINA.

[97300.]—**Gas v. Petroleum.**—Will Mr. Fletcher or anyone familiar with the subject please state what quantity of good petroleum (such, for instance, as "Royal Daylight"—is equal in calorific effect to a cubic foot of ordinary (not "Cannel") gas?—the petroleum to be burnt in a central draught or other good stove, and the gas in an atmospheric burner or flat flame stove.—A. S. L.

[97301.]—**To Lanternists.**—I have a pair of oil-lanterns; but wish to change the light, as it is not powerful enough for large halls, &c. Before doing so, would like the opinion of readers. I thought of having the Rilford automatic oxygen generator, and should like to use a saturater with it; but, in looking over this month's *Lantern Journal*, I saw an explosion caused through using one. Now, I do not want my head found in a different place than my body, so if you could tell me of a really safe one I shall be very grateful, as some places that I may have to go to have not the gas laid on. Is there a good, inexpensive book on limelight?—LANTERNIST.

[97302.]—**Refracting Telescope.**—Would some reader kindly advise me what glasses to get for making a 3in. refracting telescope? I cannot afford to buy one, but I have a lathe and a fair knowledge of metalwork, and would very much like to follow the papers now appearing in the "E.M." by Norman Lattey. Probably a few hints would be acceptable to others like myself.—R. H.

[97303.]—**How to Solder.**—Will someone be kind enough to tell me the proper way to solder with the soldering-iron, stating all things needed for soldering tin, copper, and brass? Also how to make the solder?—R. H.

[97304.]—**Oxygen.**—Will some friend tell me if it is possible to make oxygen the same way as they do the new gas with carbide? If so, please say the quantity of material? Also, is there much danger in mixing it, and does it require much power to use it? Any hints on oxygen will greatly oblige.—F. ASQU.

[97305.]—**Small Milk Separator.**—Will one of "ours" kindly give particulars of how to make a small milk separator. I do not require it for dairy work, but for experimental purposes—therefore, one to hold from two to four pints of milk. Can the head, or vessel containing the milk, be made of stout tin-plate? Also, would the vertical spindle, if driven at 2,000 revolutions per minute, be too fast to be driven with light bevel wheels, the speed to be obtained from a counter spindle? Dimensions of vessel and height of spouts will greatly oblige.—MILKO.

[97306.]—**Thorite as an Explosive.**—Can anyone give me some information about the following? "Thorite is the name of a new high explosive adapted for the bursting charge of shells fired from ordinary guns. In a recent test it is said that a 7in. 182lb. shell was loaded with 4lb. of thorite, and then exploded by electricity in a 10ft. square steel inclosure. It was estimated that the fragments numbered 20,000. Thorite-charged 10in. shells have been fired through a 4½in. Harveyised steel plate without exploding." Where and when have experiments been made with thorite in 10in. shells?—F. E.

[97307.]—**Fireclay.**—What is the best method of blocking up some of the space in a common kitchener? At present the fire-space is simply a cube, more or less, a great portion of which might be blocked up to economise coals. There must be a front space and a side space next to the oven, and a top surface over the whole area; but certainly one-half of the space might be occupied with fireclay or firebrick with economy and advantage. How do you mix the clay?—KITCHEN.

[97308.]—**Soda and Uric Acid.**—I have suffered severely for years with headaches, and at times rheumatism, both caused, I believe, by excess of uric acid in the system, and I should be glad to learn from some of your capable readers if the consumption of food containing preparations of soda, such as baking-powder, &c., is likely to be injurious in my case. I think I have read that this is so, owing to the tendency of the soda to form an insoluble compound—i.e., urate of soda—which accumulates in the tissues, and causes many diseases, sometimes classed as "uric acid diseases," such as rheumatism, gout, Bright's disease, &c. In another medical work by an eminent authority, I find it asserted that bicarbonate of soda is a solvent of uric acid, and increases its excretion, thus aiding the cure of these diseases. I shall be grateful for any light upon these conflicting statements.—D. W. A.

[97309.]—**Fuller Porous Cells.**—Mr. Allop, in his book on "Electric Bells," p. 96, says: "The porous pots should be paraffined all over except a band of about 2in. at the bottom." Mr. Perren Maycock, on p. 182, Vol. XLVII. "E.M.," says: "I have had a good deal to do with this type of cell, and the base of the zinc is the more acted on because the bottom of the porous pot rests on the bichromate crystals; therefore paraffin the bottom well." And, on page 173 of the same volume, he adds: "The zincs may be short, but of large diameter, and suspended in the porous pot; the zinc is less acted on then, for when the bichromate diffuses into the porous pot it does so more at the bottom than the top, obviously." Suspending it in the pot raises another difficulty, for Mr. Sprague in his "Electricity," p. 394, says: "It will be dissolved mostly at the top, perforated with bobs or even cut through at the surface of the liquid." Here is a peculiar position of things. One authority says paraffin the bottom of the cell, the other says do not do it, and suspend your zincs; then another, equally clever, says if you suspend your zincs they will be eaten away for a certainty. Who is correct?—as so far I have had little or no success with Fuller cells.—SUBSCRIBER SINCE 1866.

[97310.]—**Armature.**—Will some reader of the "E.M." kindly inform me if the armature of an electromotor can be made to revolve in an opposite direction by means of a switch without having to change the position of the brushes? I want to change the direction of revolution at a distance from the motor. A sketch will be very thankfully received.—J. H. C.

[97311.]—**Soluble Sodium Silicate.**—Will some reader please say a word or two about soluble sodium silicate solution? What are it uses, nature, &c.?—MUM.

[97312.]—**Stereoscopic Transparencies.**—Will any reader kindly give me a little information on the production of glass stereo-photos? Are they similar to lantern slides? Is their production attended with any special difficulties for an amateur? What is the backing of opal glass intended for?—J. C.

[97313.]—**Screw Propellers.**—Would someone kindly tell me which will travel the faster of two model steamers—the one having a single screw propeller with 1in. blades, and the other having twin screws with ¾in. blades, in each case revolving at the same speed?—J. H. L. L.

[97314.]—**Wimshurst Machine.**—Will Mr. Bottone please help in the following matter? I want to make a Wimshurst machine for X-ray work, to be equal in effect to a 6in. spark coil? I have your book "Electrical Instrument Making." If I made the machine as there described, would it be efficient for the work? If not, please say where alterations are to be made, or give detailed instructions for making one. Would ebonite be better than glass for the discs?—WOULD-BE ELECTRICIAN.

[97315.]—**Increasing the Power of a Steam-Engine.**—Do any of your readers know anything about this, which I found in an American paper? "Prof. ——, of Berlin University, has invented a method of increasing the power of steam-engines, which promises to revolutionise steam-engineering. He conducts steam generated in an ordinary boiler into a cooling-tank, and then treats it with sulphuric acid, increasing its power from one-third to one-half. A factory at Charlottenburg has been using the invention for three months, and has obtained 56 per cent. above the indicated horse-power of its engines." How does sulphuric acid increase the power, and what is its effect on the metal?—D. T.

[97316.]—**Zinc Printing Blocks.**—What is the simplest process for making zinc cuts (no shading required), such as are used in catalogues, circulars, &c.?—H. WILSON, Toronto, Canada.

[97317.]—**Coaling Locomotives.**—Can any reader tell me which railway is adopting this "method" of coaling the loco.? It reads like an American yarn, but it is published in this country: "A new way to coal locomotives is being introduced by a prominent railway. All the engineer has to do is to run his engine on a trestle, touch a button, and a tenderful of coal drops into his tender, which is weighed as it drops in." Should like to know how it is done.—MIDLAND.

USEFUL AND SCIENTIFIC NOTES.

A RUN of five miles in three minutes, or at the rate of 100 miles per hour, is said to have been recorded lately on the Lake Shore and Michigan Southern Railway. Engine No. 601 hauled eight passenger and baggage cars; the train left Buffalo 59 minutes late, and ran into Cleveland two minutes ahead of time, thus making up 61 minutes lost time in 185 miles. Only three station stops were made, and the engine slowed down seven times for crossings.

THE pneumatic postal-tube service in New York includes one conduit connecting the General Post Office with Brooklyn, and the others lead to the Produce Exchange; to Madison-square; to Station D, at Bowery and Sixth-street; and to Station H, at Lexington-avenue and Forty-fourth-street. The latter line is employed for all mails going out from the Grand Central Station, and is the most used. It is estimated that 800,000 letters are sent daily through this conduit. They pass over a distance of 3½ miles in seven minutes, using about 2,000 "carriers" per day. These carriers are steel tubes, 28in. long by 6in. diameter, and hold about 300 letters each, or any package less than 6in. diameter.

AN unusually large fill has been made on the Burlington. On the Deadwood, S.D., branch is a gulch 700ft. wide, known as Sheeps Canyon. This was crossed, until recently, by a wooden bridge, 126ft. high, which took over 240,000ft. of lumber in the building. Recently this trestle was filled in. It took twenty weeks to accomplish the task. It was necessary to haul 2,880,000c.ft. of earth one and a half mile up a 2 per cent. grade, and unload off the high bridge. This required 1,486 trains of fifteen cars each—22,000 car-loads in all. The costly maintenance of the high trestle is saved and the serious danger of its destruction by fire avoided, thus warranting the expensive work.

Preserving Brasswork from Corrosion.—The use of the old lacquers where moisture or chemical fumes are absent is very effective in preserving the appearance of polished brasswork; but in the case of delicate articles used in a laboratory, such as brass weights, scale-beams, and so forth, it has been the custom to gild the surface in lieu of lacquering. Recently, however, Mr. W. A. Allen, of the State School of Mines, Rolla, Missouri, has made public a case in which a set of such gilt weights put away in a box, but evidently in a damp condition, in a safe for less than three months, were corroded and covered with a white incrustation, and he raises the question whether gold-plated weights are, under ordinary working conditions, preferable to brass.—*British Journal of Photography.*

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

CHRISTMAS WEEK.

The CHRISTMAS HOLIDAYS will practically necessitate our going to press with the number for Dec. 29 on SATURDAY, DEC. 23. The office will, of course, be open on Wednesday, Dec. 27, and advertisements and late communications will be taken up to the usual time of going to press on that day; but advertisers and others who want to make sure of their communications appearing in the issue of Dec. 29 had better see that they reach us on SATURDAY, DEC. 23.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 20, and unacknowledged elsewhere:—

STUBBS.—A Fellow of the Royal Astronomical Society.—Planter.—E. J. C.—L. L.—R. M.—T. Dyson.—Clara.—J. A. C.—Novice.—Perplexed.—At Last.—T. P.—P.—A. Fillmore.—Nest-Egg.—B. J.—R. Dixon.—W. L. D.—Balbus.—T. Jordan.—X.—Waiting.

NO SIBRAH.—The Morse system is the dot and dash, in which the signals vary in duration instead of in direction. Any of the small handbooks on the telegraph give the alphabet and the various methods of signalling with the sounder or the needle. Flag and flash signalling are generally the same as the needle. For full particulars see Culley's "Handbook of Practical Telegraphy," published by Longmans.

TANNER.—Young's "Navigation and Nautical Astronomy," published by Crosby Lockwood and Son, Stationers' Hall-court, E.C., will probably suit; or Raper's "Practice of Navigation and Nautical Astronomy," published by Potter, 16s. Apply to Norie and Wilson, Tower Hill, London, for a catalogue. See the Directory of the Science and Art Classes.

H. WILSON (Toronto).—The lines are photographed or transferred on to the zinc, and the other parts are eaten away by acid. There are several works on the subject. Procure a catalogue from Dawbarn and Ward, Farringdon-avenue, London, E.C.

W. D.—1. We must refer you to back vols. for information about the Star of Bethlehem. We have no space for more. 2. Cocoa nibs should be ground in an ordinary coffee-mill, and boiled.

R. JACKSON.—We send the set of Best Books free to any part of London for 30s. by our own carts, within a few hours of receipt of cheque or P.O.O. To country buyers we deliver free on rail in a substantial wooden packing-case strong enough to stand carriage round the world.

ENGINEER.—It is, as you say, unfortunate that you cannot spare eight shillings to try the *Weekly Times and Echo* cigars when you are not sure if you will like them. We are certain, however, that you will be satisfied; but for the benefit of you and others who cannot spare so large a sum we are sending a handsome leather case containing five *Weekly Times and Echo* Cigars, post free, to everyone who sends us a postal order for two shillings.

IN TYPE.—Arcturus, Arthur M. Edwards, Hugh Alexander, Gossip.

ACCORDING to the returns recently published by Lloyd's Register, the number of steam vessels for the whole world totally lost, condemned, &c., during the half-year ended June last was 51, of a net gross tonnage respectively of 43,203 and 67,553. The United Kingdom's loss amounted to 14 vessels, of 15,679 net tons and 25,215 gross tons.

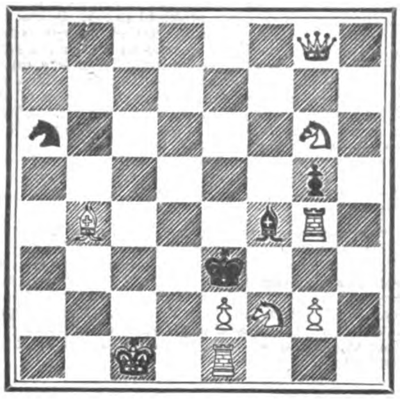
Accumulators.—A new method of accumulator construction has, it is stated, been devised in Germany. It resembles that used in the original Volta pile, the cells being piled one above the other. The battery consists of a series of shallow rectangular lead vessels with sloping sides, placed one above the other, with spherical insulators in the four corners of each vessel to prevent metallic contact. The bottom of each vessel is corrugated. From the crests of the corrugations project inwards the negative plates, while the positive plates are suspended from the lower or outer face of the corrugated bottom. When the vessels are in position the downwardly-projecting positives of any cell come between the upwardly-projecting negatives of the vessel immediately below it.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1706.—By K. KRAUSE.

Black. [4 pieces.



White. [9 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Jan. 1, 1900.*)

Solution of PROBLEM No. 1704.—By C. A. GILBERG.
Key-move, B-K B 6.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1704.—Correct solution has been received from T. Clark, N. M. Munro, Thos. Chipperfield, Rev. Dr. Quilter, A. Tupman, Richard Inwards, Whin-Hurst, J. B. Gore, F. B. (Oldham), Jas. Mason, Frank Gowing, Quizco.

ON the Boston and Albany Railroad in America 95lb. rails are used. The width of the base is 5¼in., and the height 15in. Fourteen ties to each 30ft. length are used.

IN round figures the world's production of petroleum is about 150,000,000 barrels per annum, and of that total 30,000,000 barrels are produced outside the United States and Russia. Thus Canada produced last year 758,000 barrels, but is capable of furnishing much more, as the oil area in the Dominion has been only partially exploited.

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, DECEMBER 29, 1899.

DARK-ROOM ILLUMINATION.

By REGINALD A. R. BENNETT, M.A.Oxon.

AT first sight, the above title may appear somewhat of a contradiction, seeing that if a room is "illuminated" it is not "dark." But to the photographic tiro to whom I am addressing myself it will be a well-understood combination. The problem of the illumination of the photographic dark-room is, indeed, one which meets the enthusiast at the outset of his career, and there is, perhaps, not one which is more fraught with the burden of his future success or failure, or on which his comfort in the manipulation of various processes more greatly depends. As an amateur myself, and dependent largely upon my own ideas for the solution of this problem in the way best suited to my circumstances, I have been through many periods of discomfort, which might have been avoided if I had had a knowledge of how to arrange matters in the best way at first. I therefore contribute this article to "Ours," in the hope of saving my readers unnecessary tribulation, the methods

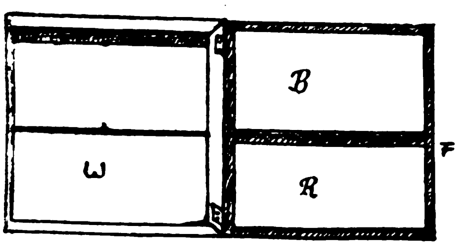


FIG. 1.—Method of Covering Window with Ruby Fabric temporarily. W, window; F, frame hinged to window frame; B, brown opaque paper; R, ruby fabric.

that I advocate being suitable to any circumstances.

Let us first consider the case of an ordinary room of which it is desired to darken the window for use in photographic work. In the first place, it is not desirable to darken the window itself; this would mean that the room had always to be lighted with a red light, which is most objectionable, as it is unnecessarily trying to the eyes. The original glass is, therefore, to be left clear, and the window should also be left free to open, the chemicals used in the work sometimes giving rise to objectionable fumes, so that free ventilation at intervals is important. The darkening arrangement has, therefore, to be independent of the window itself.

To effect this in the simplest manner, supposing the window is a small one, we can make a frame fitting tightly inside the sash, and supported on one side by hinges which allow it to be swung outwards inside the room when not wanted. Fig. 1 shows my idea of this arrangement. The top of the frame is covered with thick brown paper in which there is not a single pinhole, and the bottom with ruby fabric. This is best double, and I like to add a third covering of canary fabric, which gives a more pleasant light, and is an additional safeguard. The frame, as will be seen, has a bar across the middle between the different coverings. The wood is any suitable wood—deal will do—and the sides of the frame are about 1in. thick and 2in. broad. The outside measurements will, of course, be exactly such as to fit the sash of the window. It is best to cover round the outside of the frame with thick cloth or velvet to entirely exclude all light when the frame is pressed against the window-sash. It fastens on the opposite side to the hinges, either by a latchet or a wooden "stop" which moves down out of the way when not wanted, but presses the velvet against the woodwork

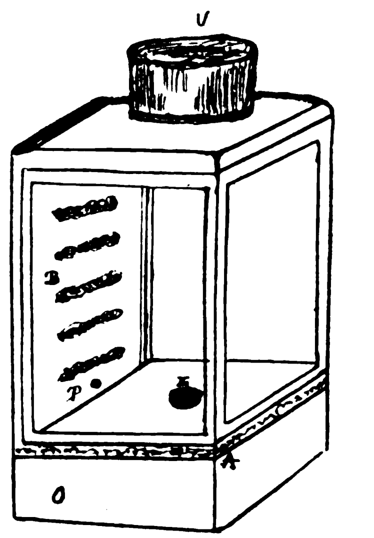


FIG. 2.—Lamp for Oil, complete. L, hole for lamp; V, top ventilator; A, ventilating chamber; B, holes for ventilation in back; O, vessel for oil.

of the window when it is placed horizontally, and at right angles to the frame.

Supposing the window is too large to be arranged in this way, or that there is an objection to the frame being moved out into the room when not wanted, it is necessary to so arrange matters that the frame can be removed entirely from the window-sash and deposited in any suitable place when not required. This I have achieved by the simple plan of constructing the frame in two portions, one of which fits on the top of the other, and when both are placed in their proper position their combined height is exactly that of the window-sash frame. Of course, the breadth of each frame is also such as to fit pretty tightly into the inside of the sash, so that when put together the whole window is covered. The top frame is covered with thick brown paper, and the bottom one

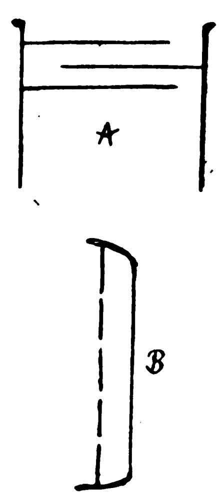


FIG. 3.—Tin Strips Forming Ventilators. A, strips inside top ventilator of lamp; B, strips on back or side of lamp, inner strip bored with holes—section as seen from top.

with the ruby and canary fabric, or if very large you can cover both with brown paper, cutting a smaller space in the bottom covering, over which the fabric can be glued. Care must be taken that no light can get in between the frames when inserted in their place in the window. To prevent this cloth or velvet should be glued between the bottom and top edges, and an overlapping piece of wood provided, which will project over the join when one is on top of the other.

For extra sensitive plates it is a good plan to have a small extra frame covered with ruby medium, which can be placed in front of the larger one, thus diminishing the light till development is far advanced, when it can be removed and the light increased for the remainder of the time.

An alternative method of darkening a small window is by means of a blind which traverses the outside of a window-sash frame, the edges being held in deep grooves down the side, so as to exclude light at the sides. The blind is made of opaque black material, and has a space cut in the bottom part which is covered with ruby and canary fabric. This rolls up with the blind when drawn up. This is about the most simple plan of all, but it necessitates a good deal of care in fixing the blind top and bottom to exclude the light at these points.

These methods will serve for those who work by daylight, but many workers cannot do this, and in their case some sort of artificial light is a necessity. In the case of the work under consideration artificial light resolves itself into one of four methods—either (1) candles, (2) oil, (3) gas, or (4) electricity. Of these, 1 is the worst, the wax being objectionable, while 4 is the

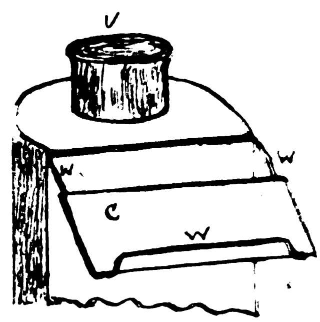


FIG. 4.—Shade for Lamp. W, W, W, wire to hold shade; C, cardboard strip forming shade; V, top ventilator of lamp.

best if there is electricity laid on in the house; but if it has to be made by the amateur it probably means too great an expense to be worth while to employ it. Gas can only be employed by the worker in towns, so that for general use the most frequently serviceable is 2—viz., oil.

As the illumination of the entire dark-room is very desirable, I prefer a lamp which has all its sides of glass rather than one which has only its front transparent. The construction of a lamp in this style is a simple matter. It can take the form shown in Fig. 2, the sides being deep ruby glass, and the corners formed of metal or wood grooved to hold the glass. The important point to be considered in this, as in all other lamps, is the ventilation. This is provided either at the back (if this is opaque) by means of holes covered with metal strips fitting across one another in such a way as to allow of the free passage of air while excluding light, or if all the sides are of glass, by a metal frame at the bottom containing similar holes. In either case a similar arrangement has to be made at the top by means of more tin strips, the simplest arrangement of which is shown in Fig. 3. As the top invariably becomes very dirty and incrusted with soot when candles or oil are used, this should be made easily removable when required for cleaning purposes. It also can have a ventilating chamber at the bottom, as shown at A in Fig. 2.

I have always found the light cast by a flame inside a lantern of which the front is plain ruby glass to be uneven, a shadow of the flame being usually visible on the surface of the plate if this is placed close to the lamp during development. As this interferes with

an accurate examination of the image as it appears, I always fasten a piece of ruby fabric before the glass in front of the lamp.

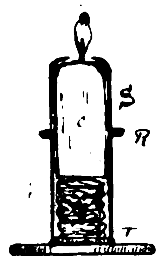


FIG. 5.—Holder for Candle of Candle Lamp. C, candle; S, socket for candle; T, spring forcing up candle inside socket; R, rim to prevent top of lamp from descending too low.

That at the sides of the lamp is not of importance. The ruby fabric gives an even illumination, and may also add to the safety of the light given by the lamp. Another addition that I have found useful is an eye-shade to protect the eyes from the light while developing. This can be simply a piece of white cardboard supported on a wire support

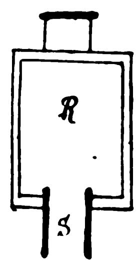


FIG. 6.—Top of Candle Lamp. R, ruby window; S, socket for candle-holder.

in front of the lamp at such an angle as to protect the eyes and yet allow the plate to be brightly lighted up. Fig. 4 shows the method of doing this.

If lighting by means of candles is the method adopted, the candle should be contained in a socket, through the top of which the candle is slowly forced by means of a spring as it burns. This avoids the production of large quantities of melted grease, which frequently takes place if the candle burns unequally,

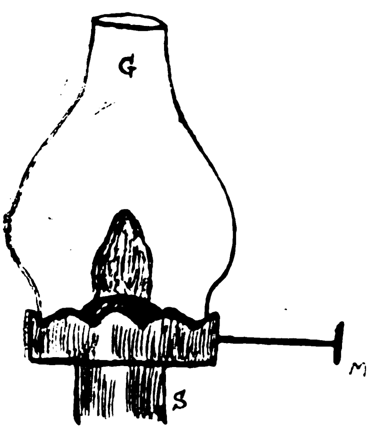


FIG. 7.—Method of Constructing Top of Oil Lamp. S, socket of wick-holder; M, milled head to turn up wick; G, glass.

and this is apt to occur if the lamp gets hot. The socket is shown in Fig. 5, where may be seen the spring S, which is kept in its place by a stand which screws to the bottom of the socket after the spring has been inserted beneath the candle. This socket and candle enter beneath the bottom of the lamp, being contained in another socket (just large enough for the tube containing the candle to fit it rather tightly) attached to the bottom of the lamp (see Fig. 6); it is prevented from descending too low by a rim round the candle-socket, which supports it at the right point (R, Fig. 5).

The oil-lamp is provided with a glass chimney in the better class of lamp.

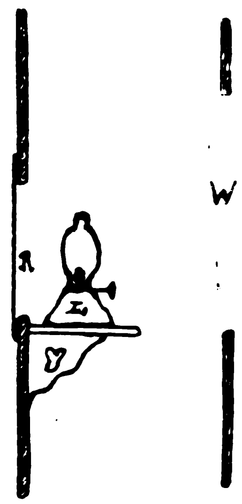


FIG. 8.—Method of Lighting Cupboard Inside a Room by Day or Night. W, window of room; R, ruby window of cupboard; L, lamp to light cupboard by night.

Whether this is so or not, I strongly advise you never to use a lamp without an arrangement for turning up or lowering the flame from the outside. This takes the form of a long axle which projects outside the lamp, and has a milled-head screw at the exterior extremity, and the usual wheel to rack the wick up and down at the other end (see M, Fig. 7). Lamps without this arrangement are exceedingly apt to get the operator into an awkward fix, for as the lamp gets hotter the flame is sure to rise, and if it cannot be turned down will smoke, or in bad cases may crack the ruby glass. As it is impossible to turn down the flame without opening the lamp, which is fatal to the negative if being developed, it is obvious that this is an unpleasant predicament in which to be placed. Of course, lamps lighted with gas should have a tap outside the lamp by which it can be turned up and down if required. Similarly, the electric lamps can be turned on and off by means of a switch, but in the case of electric lamps it is best to use a bulb of a ruby colour to contain the filament, and it is not at all necessary to inclose the lamp in a larger erection surrounded with ruby glass. This causes the electric arrangement to take up very considerably the least space of the three methods of lighting.

In the case of the lamp illustrated in Fig. 2, it is necessary if oil is employed to have some arrangement whereby air can enter freely, either at the bottom or the back. Some holes can be drilled in the back, which are covered with a plate outside which allows air to enter, but not light to escape, the system is shown in Fig. 2 at B, and in Fig. 3 at B, as seen from the top outside the lamp.

If a cupboard inside the house is used for developing, an excellent arrangement is not to have any lamp in the cupboard, but to light it by a ruby window which can be illuminated either by daylight, or by a gas jet placed just outside it, and which can be turned up or down from inside the cupboard. The plan of thus lighting the room is shown in Fig. 8. Failing gas, a lamp can be placed on a bracket just outside the window, as shown. These methods have the advantage that they entirely avoid all smell inside the cupboard from the gas or oil, which is a considerable advantage if the space in the cupboard is somewhat restricted. It is also a good thing to be relieved from the fear of an upset—a serious calamity if paraffin is used.

If electricity is used, and there is no main in the house, the most adequate method of producing the current will be by means of a small accumulator; but unfortunately they require recharging, and will not last for a long time, even if not used. There are some primary batteries of the bichromate type which may be used, but all are apt to polarise, and the light thus gradually fails. The best

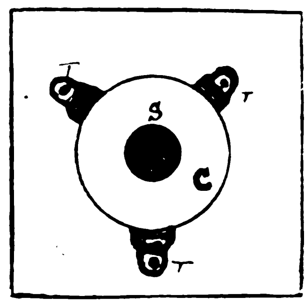


FIG. 10.—Inside of Bottom of Lamp. S, socket for candle or night-light; C, circle of tin over air-hole; T, T, T, tin supports to hold up tin circle.

I have found to be that known as the "chloride" battery, which lasts longer than the ordinary bichromate. The inner cell of this contains solution of chloride of zinc, and the outer cell saturated solution of bichromate of potash two parts, common hydrochloric acid one part. To keep the zinc in the inner cell amalgamated, a little metallic mercury (about ½oz. to 1oz.) can be placed in the inner cell. The outer cell contains the usual plate of carbon.

When travelling about one great source of difficulty is the illumination of the dark-room, which is usually a small ordinary apartment or cupboard, and unprovided with a proper window of ruby glass. In many cases it can be made temporarily suitable by placing a sheet of ruby fabric over it; but if this is impossible, one can block out the window and use a lamp. Under these circumstances a lamp is required which will fold into a small compass, and is easily carried about.

The construction of such a lamp is shown in Fig. 9, where there are seen four sides of tin, in which are cut square holes to allow

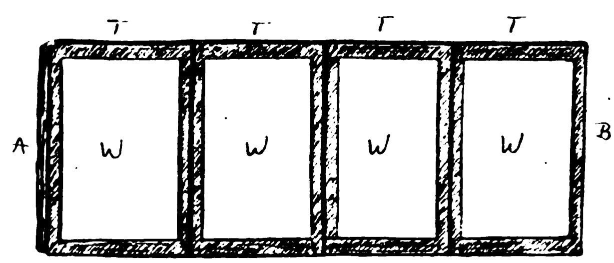


FIG. 9.—Method of Constructing Folding Lantern. T, T, T, T, tin framework; W, W, W, W, holes forming windows, covered with ruby fabric. The end B fastens to the end A, which is turned over to form a catch.

the light to pass out. I recommend that the lamp should be of a tolerable size. Those usually sold are far too small, and there are few things more disastrous than to have the lamp suddenly set on fire while you are developing, thus flooding the room with actinic light. I should construct each side of the lamp at least 5in. by 7in. The hole in the centre can then be about 4in. broad by 6in. high. The four plates are simply joined together by the ruby fabric, which is secured to them by turning over the ends of

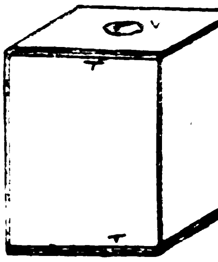


FIG. 11.—Folding Lamp complete. V, hole for air exit; T, T, top and bottom of tin.

the tin, or otherwise, and thus form a framework which will easily fold at the joins. The end pieces are arranged to lock together when the framework is set up by bending the end A of the left-hand piece in Fig. 9 into a spring, which fastens over the other end, when it is placed against a ledge forming a stop, which is soldered to the interior of the strip, and against which the edge B of the opposite end rests. When thus set up, the whole framework is inserted in a square of tin, forming the bottom, the edges being turned up to hold it. There is a similar square at the top. In both these squares are cut central holes, about ¾in. in diameter, for the purpose of ventilation, and over each hole on the inside is fastened a larger circular plate of tin, which keeps the light from issuing from the hole. The top needs no support; but the bottom should be supported upon four legs at the corners to allow the free entrance of air into the interior. The inner plate is shown in Fig. 10. In the case of the bottom, the circle supported above the hole is surmounted by a socket, in which is placed the candle which lights the lamp; the light, of course, issues from the ruby medium where it crosses the

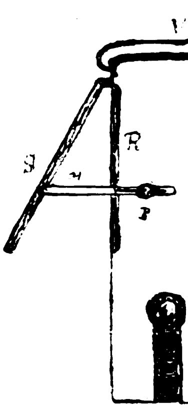


FIG. 12.—Travelling Lamp to Burn Oil.—V, ventilator; S, shade, which protects glass when folded down; H, holder for shade; R ruby glass; P, screw for fixing shade-adjuster in any desired position, which passes through slit in side of lamp; M, head of screw turning up wick from outside.

holes in the tin, which thus form windows for the lamp. The lamp outside, when complete, is shown in Fig. 11.

If an oil-lamp for carrying about is required, I prefer one which has a "vapour" lamp attached; that is, one which contains cotton-wool or wadding, which is saturated with paraffin, and not the oil itself in much quantity. Also it is most desirable that it should have a lamp which can be turned up from the outside. It is easy to construct a small lamp, the ruby-glass of which is protected by a metal shutter which forms an eye-shade when turned up to uncover the glass. Such a lamp is shown in Fig. 12.

MILLWRIGHT'S WORK.—XXII.

WE have now to consider rather briefly the transmission of power by toothed gearing, as an alternative to that by belting and ropes. That is, we cannot enter so much into questions of wheel design, but rather into the broad features of this method of driving, and into some practical hints for the millwright. One point in its favour is that it is positive. But as the slip of belting when properly fitted does not exceed about 2 per cent., this is hardly worth consideration. Objections to slip are however of weight in spinning-mills; and well-governed engines, and transmission from the prime mover by toothed-gearing is then often adopted.

Although numerous instances have occurred in which toothed wheels have been taken out of mills and rope drives substituted, yet it is necessary to remember the limitations of the latter. Very many cases occur in which shafts are so situated that there is no choice open, because toothed wheels alone will meet the conditions.

The principal advantage in toothed gearing lies in this: that power can be transmitted by it to adjacent shafts which are too close to be driven by belting or ropes, excepting by the return methods illustrated in a previous article. Also, that it can be transmitted to shafts at right angles, which can only be done with belts or ropes having twisted drives. Although the services of toothed gearing have been lessened in this field, yet there are many drives having the characteristics indicated, for which it still affords the best, and in some instances the only available, method.

It is at high speeds chiefly that the objections to toothed gearing become greatest. Wheels are noisy, and knock themselves and their bearings to pieces. But there is another side to the question. The reputation of toothed gearing has suffered largely from the sins of bad design in the past, teeth having been incorrectly designed and badly proportioned, and wheels hung on shafting with bearings of the rigid type. The mortise-wheel is invaluable in mill drives, in diminishing noise and conducing to smooth running. Even supposing, which is a wild supposition yet, that cut gears should be used in mills, they would not be so good as the wood and iron combination. There is no backlash in these when new, and the elasticity of the wooden teeth absorbs most of the vibration, so that high speeds are practicable as long as the bearings and general fittings remain in alignment, and but little worn.

When shafts run parallel with each other, too close together for a direct belt drive, then there is no alternative but to drive by gearing, or by an indirect belt drive. As a general rule, gearing is then the better mode of transmission. In such cases spur-wheels are used, made of the relative proportions to transmit the required velocity ratios.

When shafts have to run at right-angles with each other, then bevel-wheels are employed. Practically the only alternative and rival to this is the rope drive taken off to separate floors. Speaking generally, this is to be preferred, and obtains more favour in modern mills than bevel wheel main drives. But numerous subsidiary details of arrangement occur, in which the rope drive cannot well be utilised, as in transmitting power by short lengths of shafting, and here the great value of the indispensable bevel wheels is seen, by means of which any velocity ratios can be transmitted. Besides this, the bevel wheels are adaptable to driving at many angles other than the right angles, for which very awkward twisted drives with belting or ropes would otherwise be necessary. There are some types of gearing used in machinery which are rarely employed in mills—namely, the worm and screw gears, for the reason that they are too wasteful of power for heavy transmissions.

There are some important differences in the old and in modern gearing, which tells in favour of the latter, and which must be noticed. One relates to proportions of teeth, the second to other proportions.

During a period covered roughly by the last ten years, much improvement in tooth forms has been apparent. The principal difference lies in tooth lengths, which have been shortened in the best practice. Changes of this kind cause inconvenience in the mating of new wheels to old ones, and should not be adopted without substantial reasons. The fact that tooth lengths have exceeded their best limits had been suggested long ago, but little improvement has been noticeable until Mr. Michael Longridge made a special study of the subject, and demonstrated that a large number of tooth fractures in mill-wheels were clearly traceable to their long teeth. He advised, in consequence, a length of tooth equal to about one-half the pitch.

This seems very short to those accustomed to the old teeth, the length of which measured generally twelve-fifteenths of the pitch, and some certainly exceeded that length. But that the old were wrong, and that the new proportion is correct is clear from the following considerations. (Compare with Fig. 144.)

The length of a tooth is merely a matter of convenience—that is, it has no relation to the radius or leverage of the wheel. The strength of a tooth is governed by the width or thickness a, which is determined by the pitch. From one point of view, the shorter a tooth is made the better, since it would be really better to drive by frictional contact than by teeth at all. The shorter the teeth are the less is there of sliding action, and the less trouble is experienced in consequence of the extremes of thickness at point and root. These are points in favour of the short tooth, shown by full lines in Fig. 144.

On the other side, little can be said in favour of the long tooth indicated by the dotted line in Fig. 144, except its antiquity and an increased

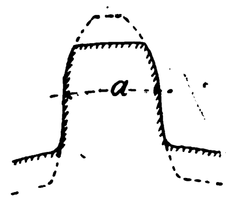


FIG. 144.

wearing surface. It is clearly a relic of the times when exact dimensions in the sizes of wheels and the centring of shafts were difficult of attainment, and when the length of tooth was made to a considerable extent the means of adjustment, being put closer into, or farther out of gear to suit the shafts, or to allow for wear. Another point was, perhaps, that a long tooth pleased the eye better than a shorter one. It looked noble, shapely, and capable of doing some work. As a cantilever, however, the longer a tooth is, the weaker it is.

With short teeth, these evils are reduced to a minimum. The limit to this shortening seems to be only that at which wheels will remain in mutual gear without possibility of jumping and overriding. This opens up the question of the degree of accuracy attainable in mill work, and that of good design. It presupposes stiff shafting, good bearings, and due provision for taking-up wear.

Better results are now observable in the general proportioning of wheels which has followed upon their moulding by machine. It is common practice now to make nearly all heavy and medium-sized wheels by machine, instead of from patterns, or by means of sweeps and core-boxes. The latter was never, except in the hands of very careful men, a satisfactory method; but it was practically the only way before the use of wheel-moulding machines became general. Firms possessed so-called "standard" patterns, which might, however, be good, bad, or indifferent, and there was a good deal of making up and stopping-off done. The consequence was that the gearing in a good many shops and mills was such that it would have puzzled a mathematician to deduce a common formula for any detail of the same. Some wheels were proportioned much too light, others much too heavy, with the inevitable results. The wheel machines, too, have rendered possible the cheap moulding of helical gears, which could not be made economically from entire patterns, and these conduce to smooth running.

Much of the trouble of toothed wheels is due to back-lash, which is the play of the wheel-teeth

in relation to each other by the amount of flank clearance allowed. With a longer tooth it is generally found desirable and safer to allow rather more clearance than with a short one, due to increased inaccuracies in the lengthened tooth profiles. On machine-moulded wheels less clearance would be allowed than on pattern wheels. On cut gears none at all is allowed. Neither is there any on mortise-wheels, which is one reason why they run so sweetly when new.

In reference to the methods of striking out wheel-teeth, the cycloidal forms still rule, and are likely to do so, because they are better adapted to a wide range of interchangeability than the involute shape. If it were not for the frequent occurrence of small pinions, then the involute basis would in some respects be preferable. In practice no trouble occurs with well-made cycloidal teeth, while it is easy on that system to get perfect gears in all wheels ranging from 11 to 12 teeth, up to 150 to a rack.

Cast iron, as heretofore, holds its own as a material for heavy gearing. For pinions subject to much stress and wear, phosphor-bronze and steel are employed in an increasing degree. Latterly the raw hide gears seem to be coming into favour. The practice of casting wheels in halves is adopted more frequently than of old, a practice which is easy on the wheel-moulding machine, though rather expensive when full patterns are in question. But the advantages are great, and there need be no sacrifice of strength. It is on a par with casting pulleys in halves. You have not to pull down a whole length of shafting to take off or put on a wheel, and there is no bother with driving the wheel endwise to get it on or off. Though wheels in halves cost a little more than solid ones, the cost is often more than saved in time in erecting, &c. J. H.

ASTRONOMICAL NOTES FOR JANUARY, 1900.

WITH the imminent advent of the last year of the present century, we commence yet another series of our Astronomical Notes, which will, however, differ in no respect from their predecessors, either in subject or arrangement. Inasmuch, though, as many of our younger readers may well commence their use of them with this monthly instalment, we shall follow our annual practice of explaining every table which may seem to require it, and supplementing such explanation, when requisite, with numerical examples fully worked out.

Turning now to Table I., that headed "The Sun." The second column gives, for every fifth day of the month, the instant which should be shown by a clock regulated to keep Mean Time, when the Sun is on the Meridian of Greenwich, and a sundial there marks 0h. 0m. 0s. What is called in the almanacs "The Equation of Time," or the amount to be added to—or subtracted from—this instant of apparent Solar Noon is calculated for the Meridian of Greenwich, but may, for practical purposes, be employed for any station in the United Kingdom, since the most westerly point in Ireland, Valentia, is only 41m. 23s. west of Greenwich (less than 0·69 hour), and the hourly variation in the equation, which is only 1·189sec. on the 1st, diminishes to 0·375sec. by the last day in January—a quantity which the most gigantic sundial ever constructed is wholly incapable of showing. Columns three and four give the Right Ascension and Declination of the Sun, to the nearest second of time and of arc respectively, at Greenwich Mean Noon on the days specified. The quantity which appears in the last column, under the heading of "Sidereal Time at Greenwich Mean Noon," is one which is very frequently required by the observer, that he may thence deduce the instant of Sidereal Time at *local* Mean Noon at his own station. This he effects by adding 9·8565 seconds for every hour (and proportional parts for minutes and seconds) when the place of observation is to the west of Greenwich, and by their subtraction when it is to the east of it. A couple of examples will make this clearer. Suppose, then, that an observer at Milford Haven wishes to find the Sidereal Time at his local Mean Noon on Jan. 1. We see below that the Sidereal Time at Greenwich Mean Noon on that day is 18h. 42m. 43·51s. Now, Milford Haven is 20 minutes west of Greenwich, so we say 60m. : 20m. : : 9·8565s. : what we shall find to be 3·2855s. If, then, according to the precept, Milford Haven being west, we add 3·29 seconds to 18h. 42m. 43·51s., we obtain 18h. 42m. 46·60s. as the Sidereal Time at Milford Haven at Local Mean Noon on New Year's Day. Or, suppose that we want to ascertain what will be the Sidereal Time at Yarmouth Mean Noon on January 26th. Turning to our table, we find that the Sidereal Time at Greenwich Mean Noon on the day specified is 20h. 21m. 17·43s. Now, Yarmouth is 6m. 52s. East of Greenwich, so we say, as before, 60m. : 6m. 52s. : : 9·8565s. : 1·12802s. If, then, from 20h. 21m. 17·43s. we subtract 1·13s., we finally get 20h. 21m. 16·30s. as the Sidereal Time at Yarmouth Mean Noon on the day in question.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 3 40·23 P.M.	18 46 24	23 1 23	18 42 43·51
6	0 5 58·18 ,,	19 8 24	22 31 12	19 2 26·30
11	0 8 4·02 ,,	19 30 13	21 49 57	19 22 9·08
16	0 9 54·75 ,,	19 51 46	20 58 6	19 41 51·89
21	0 11 28·29 ,,	20 13 3	19 56 16	20 1 34·65
26	0 12 43·17 ,,	20 34 0	18 45 7	20 21 17·43
31	0 13 38·34 ,,	20 54 38	17 25 25	20 41 0 23

As the sunspot minimum continues, the observer of the Sun's disc will find but little indeed to reward his scrutiny, long periods elapsing between faint exhibitions of Solar activity.

At 6h. a.m. on January 2nd the Sun will be in Perigee. In other words, the Earth will be in that point in her orbit at which she approaches most closely to him. At this instant an interval of only 91,338,416 miles will separate us from the mighty centre of the Solar System.

The Moon.

New Moon....	Jan.	1	1h. 51·9m. p.m.
First Quarter..	,,	8	5h. 39·9m. a.m.
Full Moon....	,,	15	7h. 7·6m. p.m.
Last Quarter..	,,	23	11h. 52·9m. ,,
New Moon....	,,	31	1h. 22·6m. a.m.
Perigee	,,	3	4h. 54·0m. p.m.
Apogee	,,	19	4h. 54·0m. ,,

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	Sun.
	Days.	h. m.	°	
1	29·47	11 58·5 a.m.	3·0 W.	S.
6	4·92	4 32·8 p.m.	23·9 W.	R.
11	9·92	8 52·2 p.m.	39·1 E.	R.
16	14·92	12 17·2 a.m.	89·2 E.	R.
21	19·92	3 49·3 ,,	28·1 W.	S.
26	24·92	7 42·9 ,,	34·7 E.	S.
31	0·44	0 34·6 p.m.	81·9 W.	R.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

The only columns in the above table that require any explanation are those headed "Moon's Terminator," which are intended to show the angular distance east or west of the Terminator (or line dividing the light and darkness) from the central Lunar Meridian at the instant of the moon's southing at Greenwich. The letters R and S in the column headed "Sun," indicate whether the sun is rising or setting on the moon at the time indicated. The use of this is to show whether the Lunar Phase is favourable for viewing any particular crater or other formation at or about the time of the moon's passage over the Meridian.

The Moon will be in Conjunction with

——	Day of Month.	Hour.	Planet.
			°
Mars	1	9 p.m.	3 8 S.
Venus	3	4 ,,	6 0 ,,
Jupiter	26	1 ,,	2 3 N.
Saturn	28	8 a.m.	0 2 S.
Mercury	30	3 p.m.	5 44 ,,
Mars	30	10 ,,	5 6 ,,

At Noon, on January 1, the Moon is n Sagittarius. She enters—

——	Day of Month.	Hour.
		h. m.
Capricornus	2	8 0 p.m
Aquarius	3	1 0 p.m.
Pisces	5	10 0 p.m.
Aries	9	2 0 a.m.
Taurus	10	8 0 p.m.
Gemini	13	4 0 p.m.
Cancer	15	9 0 p.m.
Leo	17	4 0 p.m.
Sextans	18	1 0 p.m.
Leo	19	4 0 p.m.
Virgo	20	8 0 p.m.
Libra	24	5 0 a.m.
Scorpio	26	1 0 a.m.
Ophiuchus	26	1 0 p.m.
Sagittarius	28	2 0 a.m.
Capricornus	30	7 0 a.m.
Aquarius	30	11 0 p.m.

This table gives, to the nearest hour, the times at which the Moon will enter the various Zodiacal Constellations during her monthly journey through the sky. Among other possible uses to the student, it may help him to acquire a naked-eye acquaintance with the constellations.

In the table given below, the column headed "Moon's Limb" indicate whether it is at the bright or the dark limb of the Moon that a star disappears (or reappears). From New Moon to Full Moon disappearances occur at the dark limb, and reappearances, of course, at the bright one,

Occultations of (and near approaches to) Fixed Stars by the Moon, visible at Greenwich

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
6	19 Piscium	5·2	7 12 p.m.	Dark	91	63	8 10 p.m.	Bright	215	182
9	27 Arietis	6·5	9 16 ,,	Dark	139	110	9 48 ,,	Bright	191	158
10	τ^2 Arietis	5·2	7 1 ,,	Dark	33	49	7 59 ,,	Bright	295	295
10	65 Arietis	5·6	7 55 ,,	Dark	45	47	9 1 ,,	Bright	288	271
11	DM + 20°602	6·2	3 10 a.m.	Dark	108	70	3 58 a.m.	Bright	246	212
11	κ^1 Tauri	4·6	10 27 p.m.	Dark	115	90	11 34 p.m.	Bright	241	205
11	κ^2 Tauri	5·5	10 40 ,,	Dark	143	115	11 23 ,,	Bright	213	178
13	B.A.C. 1970	6·5	6 32 ,,	Dark	24	65	6 59 ,,	Bright	336	17
15	5 Cancri	6·4	†11 44 ,,	S.S.W.	200	209				
17	α Cancri	4·3	5 17 a.m.	Bright	174	136	5 50 a.m.	Dark	236	196
19	p^2 Leonis	6·2	10 0 p.m.	Bright	110	148	11 6 p m.	Dark	301	336
21	B.A.C. 4006	5·7	12 46 a.m.	Bright	157	185	1 46 a.m.	Dark	263	284
21	q Virginis	5·7	11 22 p.m.	Bright	122	160	12 26 ,,	Dark	291	324
23	75 Virginis	5·7	8 33 a.m.	Bright	174	145	9 5 ,,	Dark	225	194
24	B.A.C. 4722	5·5	3 35 ,,	Bright	136	158	4 45 ,,	Dark	273	285
24	DM – 17°4053	6·5	†5 29 ,,	S.S.W.	204	209				
24	B.A.C. 4739	6 2	†6 31 ,,	S.S.W.	202	196				

† Near approaches.

and *vice versâ* from Full Moon to New. It may occasionally happen that an occultation occurs so very nearly at the actual time of the Moon being full that both disappearance and reappearance seem to take place at the opposite bright limbs of the Moon. In the columns headed "Angle from N. Point" and "Angle from Vertex," the North Point is that point in the Moon's limb cut by a great circle passing through her North Pole of the heavens and through her centre; while the vertex is that point in her limb similarly intersected by a great circle passing through the zenith and through her centre; being, in short, the top of the Moon as seen with the naked eye.

It will be seen at once that the North point of the Moon and her vertex can only coincide when she is actually on the meridian. Angles are measured from these points in the direction N., E., S., and W., or in an opposite direction to that in which the hands of a clock or watch move. As, however, an astronomical telescope, of course, inverts, the north or initial point must quite obviously be at the bottom of the field. In the case of near approaches (marked † in the column headed "Disappearance") as seen from Greenwich, we give, in terms of the points of the compass, in the column under "Moon's Limb," that part of the limb which most nearly approaches the star, because it often happens that a star which the Moon just clears as viewed from Greenwich, is actually occulted as seen from another station. Take, for example, the near approach of the 6·4 magnitude star 5 Cancri on the night of the 15th. As it is just S.S.W. of the Moon's limb as seen from Greenwich, it quite obviously must be actually occulted as observed from a station situated at any considerable distance to the N.N.E. of the National Observatory.

Mercury

is a Morning Star; but, owing to his very considerable South Declination, is badly placed for the observer. The angular diameter of his little disc shrinks from 5·8″ on January 1 to 4·8″ at the end of it.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	17	14·9	21	58·8	10	32·5	a.m.
6	17	43·8	23	1·6	10	41·6	,,
11	18	14·9	23	40·8	10	52·9	,,
16	18	47·3	23	51·2	11	5·6	,,
21	19	20·8	23	29·8	11	19·4	,,
26	19	55·0	22	34·1	11	33·8	,,
31	20	29·7	21	2·5	11	48·7	,,

It will be seen from the above ephemeris that Mercury, starting in Ophiuchus, will cross the whole width of Sagittarius, and be found at the end of the month in Capricornus. The majority of the stars in these constellations are small, and the planet will not approach a single conspicuous one during his journey through them. He will be in conjunction with Saturn (0° 51′ south of that planet) at 1 a.m. on the 8th.

Venus

is an Evening Star throughout the month, and as her South Declination is daily decreasing, she may be seen, especially towards the end of the month, glittering over the south-west horizon. Her disc, whose angular diameter increases from 11·4″ on Jan. 1st to 12·8″ by the 31st, is perceptibly gibbous, but she scarcely yet presents an object of much interest in the telescope.

Day of Month.	Right Ascension		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
1	20	39·8	20	8·3	1	56·8	p.m.
6	21	5·2	18	27·8	2	2·4	,,
11	21	30·0	16	34·5	2	7·5	,,
16	21	54·2	14	30·0	2	11·9	,,
21	22	17·8	12	15·9	2	15·9	,,
26	22	41·0	9	53·9	2	19·3	,,
31	23	3·7	7	25·6	2	22·3	,,

The path thus indicated begins in Sagittarius, crosses the entire width of Capricornus and Aquarius, and terminates in the confines of the last-named constellation and Pisces. The brightest star she will approach is the 3rd-magnitude one, ζ Capricorni, less than 1° to the north of which she will be found on the evening of the 13th. It is, however, doubtful if this star is of sufficient size to be visible in the twilight.

Mars

is quite invisible—a remark equally applicable to **Saturn.**

Jupiter

does not rise until just before 5h. a.m., and Uranus even later still; but

Neptune

continues in an excellent position for the observer, and is visible throughout the working hours of the ordinary amateur's night.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	5	39·3	22	4·0	10	54·7	p.m.
6	5	38·7	22	3·8	10	34·6	,,
11	5	38·1	22	3·7	10	14·3	,,
16	5	37·6	22	3·5	9	54·1	,,
21	5	37·1	22	3·4	9	34·0	,,
26	5	36·7	22	3·4	9	13·9	,,
31	5	36·3	22	3·4	8	53·8	,,

This little arc will be described somewhat to the east and a little to the north of the 3rd magnitude star, ζ Tauri.

Minima of the Variable Star Algol.

Day of Month.	——		
	h.	m.	
5	7	35	a.m.
8	4	24	,,
11	1	13	,,
13	10	1	p.m.
16	6	50	,,
26	6	16	a.m.
31	2	55	,,

And on other occasions when daylight will render the phenomenon invisible.

Shooting Stars

are not very abundant in January. The principal shower during the month may be looked for on the night of the 2nd, fortunately moonless. It is that of the so-called Quadrantids, whose radiant point in the sky is situated in R.A. 15h. 20m., and in 53° Declination North—i.e., between 6° and 7° South of the 3·4 magnitude star ι Draconis. Other and less conspicuous displays from various radiants are predicted for the nights of the 3rd, 11th, 17th, 22nd, 25th, and 29th.

Greenwich Mean Time of Southing of Twenty-four of the Principal Fixed Stars on the Night of January 1st, 1900.

Star.	Magnitude.	Souths.			
		h.	m.	s.	
α Andromedæ ..	2·1	5	19	37·88	p.m.
α Cassiopeiæ ..	2·2 to 2·8	5	49	36·33	,,
β Andromedæ ..	2·2	6	20	23·25	,,
Polaris	2·2	6	39	11·27	,,
α Arietis	2·0	7	17	38·37	,,
γ^2 Ceti	3·0	7	54	7·38	,,
α Ceti	2·7	8	13	0·38	,,
Algol	2·2 to 3·7	8	17	36·73	,,
α Persei	1·9	8	33	5·89	,,
η Tauri	3·0	8	57	22·82	,,
γ^1 Eridani	3·0	9	9	10·02	,,
Aldebaran	1·0	9	45	53·49	,,
Capella	0·2	10	24	55·19	,,
Rigel........	0·3	10	25	29·89	,,
β Tauri........	1·9	10	35	33·05	,,
α Leporis	2·7	10	43	52·13	,,
ζ Tauri........	3·0	10	47	12·85	,,
α Orionis	1·0 to 1·4	11	5	15·12	,,
β Aurigæ	2·1	11	7	41·80	,,
γ Geminorum ..	2·0	11	47	18·99	,,
Sirius..........	−1·4	11	56	5·68	,,
Castor	2·0	*12	44	27·01	a.m.
Procyon	0·5	*12	49	16·67	,,
Pollux	1·1	*12	54	23·90	,,

* Early morning of the 2nd.

We speak of the "Fixed Stars," and were it true that this was a rigorous description of them, then would each one South 3m. 55·9s. (i.e., 235·9 seconds) sooner every day, as shown by a clock regulated to keep ordinary or Mean Time. But although this is not absolutely accurately the case, it is quite sufficiently so for our present purpose, as regards by far the greater number of the stars, for us to assume that it is so; so that to find very approximately the Greenwich Mean Time of Transit of either of the stars in the above list on any other night in January, we have only to multiply 235·9 seconds by the number of days which have elapsed since January 1st (i.e., by the day of the month—1), and subtract the product from the time given in our table. For example: At what time will α Orionis cross the meridian of Greenwich on the night of January 21st? On that of the 1st we learn from our table that its transit will occur at 11h. 5m. 15·12s. G.M.T. Multiplying now 235·9 seconds by 20 we get 4,718 seconds, or 1h. 18m. 38s.; and if we subtract this from 11h. 5m. 15·12s. we get 9h. 46m. 37·12s. Actually, and as matter of fact by rigid computation, the star will South at 9h. 46m. 36·91s., or 0·21 second sooner than our rough-and-ready method of calculation would indicate that it will do. But it must be a very marvellous ordinary clock or watch that could indicate 0·2sec. The discrepancy would have been slightly more noticeable had we employed Polaris; or, in fact, any fairly close circumpolar star; but such stars cross the meridian so very slowly, and hang, so to speak, so on the transit wires, that for the purpose of rating a watch or clock, it would, as in the former case, be in practice inappreciable. We do not, however, all live on the meridian of Greenwich, and we may, and often do, require to find the local time of transit of the stars in the above list at our own station. This we obtain by subtracting 9·8296sec. for every hour of longitude (and proportional parts for minutes and seconds) when such station is West of Greenwich, and by the addition of that quantity when it is to the East of it. Thus: At what time will α Arietis South at Falmouth on the night of January 1, 1900? Falmouth is 20m. 8s. West of Greenwich, so we say 60m.: 20m. 8s. : : 9·8296s. : 3·29838s. Falmouth being west, we subtract this result from our tabular time, and say 7h. 17m. 38·37s. − 3·30s. = 7h. 17m. 35·07s. the Falmouth Mean Time of southing of α Arietis on the first night of the New Year. Or suppose we require the Norwich Mean Time at which Capella will cross that Meridian on the same night. Norwich is 5m. 12s. East of Greenwich, so, as before, we say 60m. : 5m. 12s. : : 9·8296s. : 0·8519s. As Norwich is east, we now add the quantity just obtained to the Greenwich Mean Time of transit. Thus: 10h. 24m. 55·19s. + 0·85s. = 10h. 24m. 56·04s. : and this is the local mean time at Norwich at which Capella will be due south on the night of January 1, 1900.

TEACHING THE LAWS OF BINOCULAR VISION.

THE movement and various changes that take place in the human eyes when looking from one plane to another, are exceedingly complex. Beside the actual turning of the eyes under muscular control, each separate eye undergoes that change known as accommodation, which may be taken to mean focussing upon the retina the image of the object to which the eye is directed.

By many direct experiments I have found the following changes to take place in binocular vision when directing the eyes from a distant object to a nearer one:—1. Both eyes turn inwards, until their axes cross exactly at the point where the object of attention is situated. 2. The iris of each eye contracts. 3. The ciliary muscles acting upon the crystalline lenses cause them to become more convex, and, consequently, of a shorter focus.

The reason for such changes could be easily accounted for; but as the object of this article is to describe an instrument with which these changes may be demonstrated, I shall not attempt their explanation here.

The accompanying illustration, Fig. 1, shows the plan of an instrument which I venture to think would prove of some service in science schools for the purpose of teaching the laws of binocular vision.

I will first describe the instrument itself, and then refer to its teaching capabilities. The base on which the model is mounted consists of a polished mahogany board about ¼in. thick, and

bevelled off at the edges. Four brass balls screwed to the underside form the legs (one of these is shown at S, Fig. 3). Two discs of thin brass, L and R, Fig. 1, represent the two eyes, and these revolve on centre screws, P P, fixed to the board. Six wires are then employed to represent oblique and direct rays of light entering the eyes; these wires also turn on the centre screws P P. To each of the outer wires—i.e., those representing the oblique rays, a metal arm,

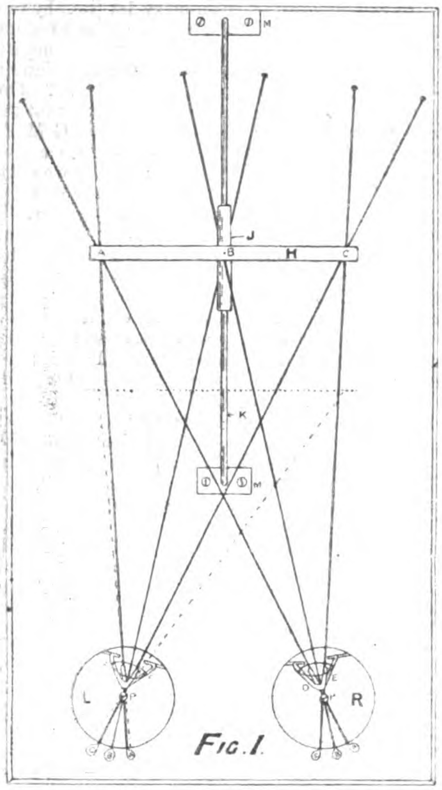


FIG. 1.

as shown at D, is soldered, the object of which is to represent the inner portion of the iris in each case—viz., in the right eye R, the metal arm D is soldered to, and works in unison with, the wire representing the oblique rays emanating from C, whilst the arm E works in conjunction with the oblique ray proceeding from A. The other portions of the iris extending to the circumference of the discs is painted upon the metal. The crystalline lens is represented by thin steel wire, fixed at F F, left eye L. It will be seen that the wires forming the rays extend, in both cases, to the circumference of the discs at the

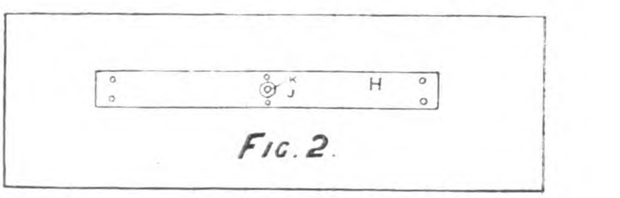


FIG. 2.

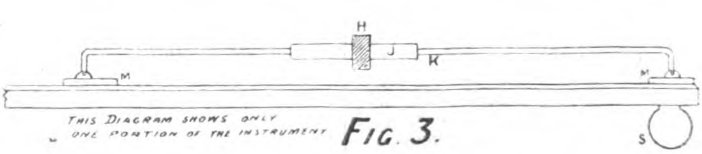


FIG. 3.

back, after being once wound around the centre screws P P.

The object to be examined by the eyes is shown at H, and consists of a beam of hard wood pierced with six holes (see Fig. 2) and fitted with a tube, J, at the centre. The movement of this beam is controlled by a steel rod, K, Fig. 1, passing through the centre tube J, and supported in the manner shown in the side view, Fig. 3. As will be seen by reference to Fig. 3, this arch-shaped steel support acts as a guide for the beam of wood, and keeps it from touching the surface of the board. Such an instrument may be called an automatic instructor, for we may slide the object H to any distance within the range of the instrument, and the mechanical changes that take place have a fair correspondence with those which the human eyes undergo during their movement and accommodation called for in binocular vision.

Now in reference to its teaching capabilities. Let the student suppose the observer to be looking at an object situated at A, the axes of both eyes will meet at that point, as indicated by the present adjustment of the instrument. On bringing the object A nearer to the eyes until it reaches the dotted line, the following changes will take place. Both eyes will turn inwards, revolving on P P. The oblique wires will diverge, and the size of the supposed image upon the retina will become larger, as indicated by the dotted lines in the left eye L. The irises will have contracted, whilst the crystalline lenses will have become more convex. On shifting the object H to the end of the slide, so that it is further from the eyes, the order of these changes will be reversed. The eyes will diverge their axes, the image space upon the retina will become considerably smaller, whilst the irises will be dilated and the crystalline lenses flattened. Hence the apparatus will demonstrate to the student axial movement and accommodation, such as binocular vision demands.

Theodore Brown.

THROUGH A SMALL TELESCOPE.—III.

By Norman Lattey.

The most striking constellation in the Northern heavens is, of course, Ursa Major (The Great Bear) and as it happens also to be circumpolar—i.e., continually above the horizon in these latitudes, it will be as suitable a group as any with which to begin our examination of stellar objects. At present it hangs immediately over the northern sky line like a great note of interrogation, its two "pointers" directing the eye to Polaris the polar star, situated in Ursa Minor (the Little Bear). A reference to the star atlas and planisphere recommended in our first paper will enable the reader to easily identify these constellations by their principal gems. In the formation in Ursa Major known as "Charles' Wain," is to be found the star ζ Mizar, the most beautiful double in the heavens. The primary is of second magnitude and greenish-white with a brilliant companion 4½ magnitude. At some little distance—on the margin of the field of view with a power of 60 diameters—will be noticed another star, Alkor, and several fainter ones, the whole assemblage on a dark clear night presenting a glorious spectacle. The visibility of Alkor without optical assistance is considered a test of eyesight.

Around the star β Ursæ Majoris are scattered several interesting planetary nebulæ, so called on account of the planet-like discs they exhibit. The largest (number 2343 in Klein's Atlas, and commonly known as the "Owl Nebula") is 2′ 40″ in diameter. A low-power e p. shows it best; but the sky must be dark, clear, and free from veiling mists. Spectroscopic analysis pronounces it to be a globular mass of glowing gas, within the limits of which probably thousands of solar systems could be comfortably accommodated.

Following the line of the "Pointers" in Ursa Major (see first illustration), the Polar star will be soon met with. It is the most important unit in Ursa Minor (the Little Bear), for around this twinkling point of light the entire vault of Heaven appears to circulate in stately revolution. The effect is, however, merely optical, being due to the circumstance of Polaris being situated almost vertically over the terrestrial North Pole. As will be explained further on, the unique position occupied by the present Polar star is of comparatively recent occurrence—at least, as far as this particular object is concerned, and even now the star does not *exactly* mark the celestial pole, its actual position being about a degree and a half from it. A good 3in. will discover the tiny companion. Keen-sighted observers have glimpsed it with a 2in., and even less. The spectroscope has lately revealed a triple system, but so exceedingly faint are the components that even the mammoth Lick refractor fails to show them. It is calculated that the light of Polaris, travelling at 186,000 miles a second, takes sixty-three years to reach us.

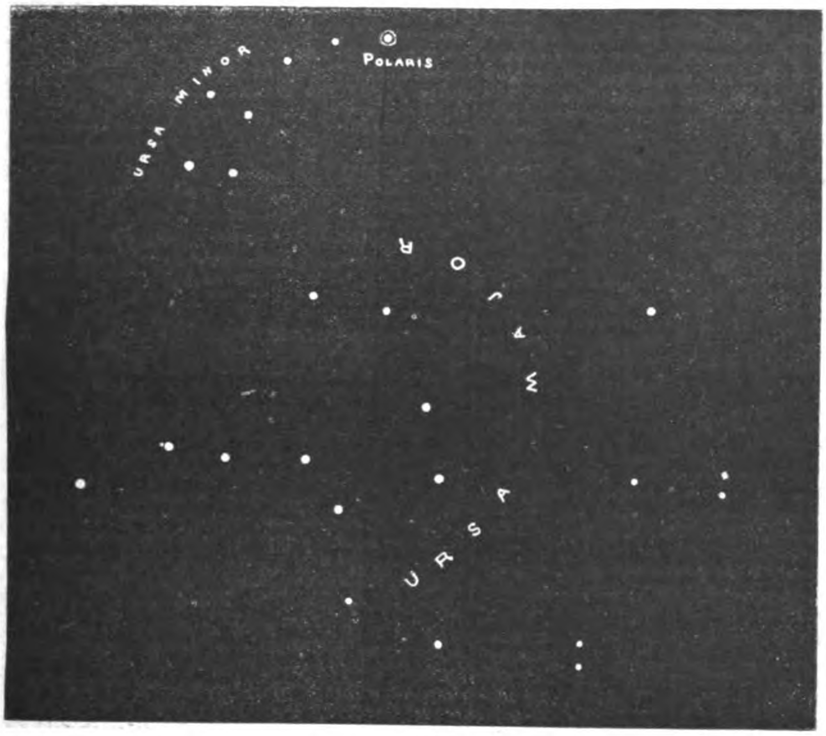
Towards the north-west lies Hercules, preparing to set. Between the stars η and ζ is situated the celebrated Cluster—a magnificent agglomeration of glowing suns. On a clear night it is just visible to the naked eye as a light cloud, and of course easily discernible in the smallest telescope. A 4in. will readily show its stellar nature, and in larger instruments it presents an amazing spectacle, especially when it is remembered that the luminous ball the observer is gazing at is composed of over two thousand blazing suns, each far exceeding the brilliancy of our own luminary.

α Herculis is a fine variable star of the 3rd mag., orange-red in colour, with an emerald-green companion. δ Herculis, another pretty double, has a greenish-white primary and bluish companion, farther off than in the last case. As it is rather late in the season to see Hercules at its best, observations should be commenced as soon as possible after dark.

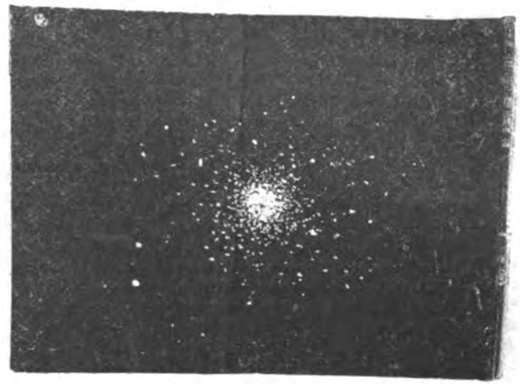
Almost due west, glittering rather higher up, will be noticed a particularly bright star flashing its scintillating rays of steely blue, like a miniature arc lamp. This is Vega, the chief star in Lyra (the Harp). Many thousands of years ago it enjoyed the post of honour now held by Polaris; but, owing to the wobbling of the earth's axis in a slow and steady gyration, like the peg of a spinning-top, Vega has been compelled in its turn to make way for all the other stars which lie on the imaginary circle traced out by the earth's pole upon the sky. Any elementary work on astronomy will quickly make this rather abstruse subject more intelligible. The distance of Vega from the Solar System is placed at 93 light years; in other words, the star may have ceased to exist nearly a century ago, but the last ray of light that left it cannot yet have completed its journey across the inconceivable gulf that separates us. Vega is surrounded by a number of smaller stars, but their connection is purely optical. They are obviously not members of a multiple system.

Close to Vega is an exceedingly interesting pair of twin stars, ε^1 and ε^2 Lyræ, known as the "Double-double." Here we have a duplicate system of four suns, the individual members of each couple revolving round one another, as well as each of the pairs round a common centre of gravity. β Lyra, a yellowish-white variable, is well worth scrutiny. It waxes and wanes at intervals of nearly thirteen days, the diminution ranging over an entire magnitude. It has three tiny companions visible in a small telescope, but only under specially favourable conditions. Between β and γ Lyræ can be detected the famous Ring Nebula. It is, however, a disappointing object in all but instruments of large aperture. Still, it can be caught with a 2¾in.—probably less—as a circular collar of faint luminosity somewhat resembling a ship's lifebuoy. In giant telescopes this curious ring of brightness sparkles as if composed of stellar points.

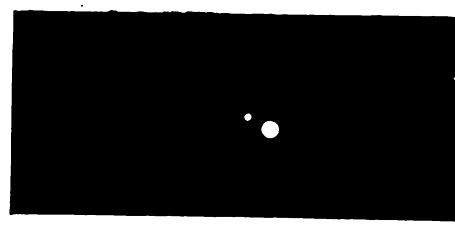
In the direction of the west, about midway between the horizon and the zenith, stands the constellation Cygnus (the Swan), its principal stars in the form of a great upright cross. Amongst the most interesting objects contained in it is β Cygni, a reddish-yellow star of the 3rd mag., with a small blue companion. It is one of the loveliest pairs in the starry heavens. The star numbered 61 Cygni, though comparatively small and otherwise scarcely worth attention in a small telescope, has a decided claim to the student's notice. As far as can be ascertained, this, with the exception of α Centauri, in the Southern hemisphere, is our nearest stellar neighbour, one of the first outposts of an infinite universe of suns. Yet so remote is it that its light takes seven years to travel to us. It is likewise double, with two golden-yellow components of 5th and 6th mag. Between α and δ Cygni is situated a



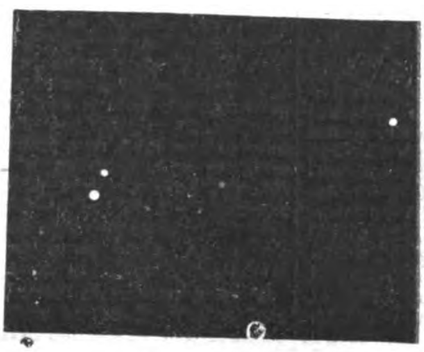
The Constellations *Ursa Major* and *Ursa Minor*, showing the Position of the Pole-Star.



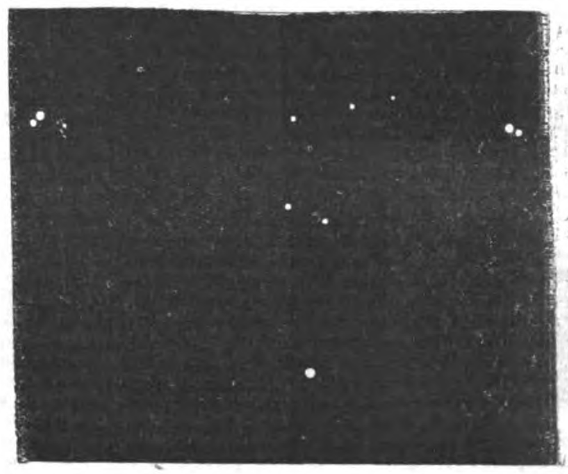
The Great Cluster in Hercules.



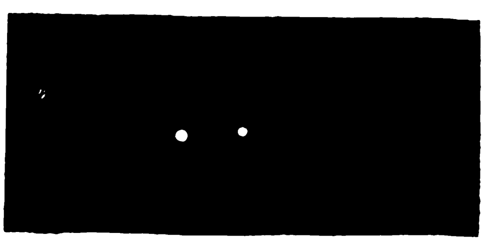
α Herculis.



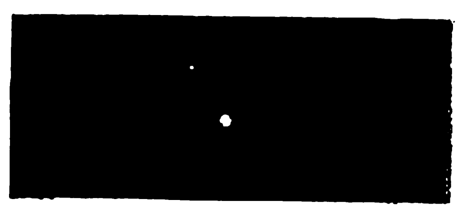
ζ *Ursæ Majoris* (Mizar).



ϵ^1 and ϵ^2 *Lyræ*. The Double-double.



β Cygni.



α *Ursæ Minoris*, the Polar Star.

rich star cluster; and two more, rather fainter groups, lying further north.

Immediately below Cygnus is the minor constellation Vulpecula (the Little Fox), containing the well-known "Dumb-bell Nebula." A 4in. shows this object tolerably well, but it can be discerned with a much smaller instrument, although by no means easy to pick up. Spectroscopic analysis reveals it to be composed of vast clouds of incandescent gas.

Below Vulpecula glitters Altair, the major brilliant in Aquila (the Eagle), a splendid star of the 1st mag., with a minute companion of the 10th mag. The latter is, however, far beyond the reach of anything under 5in. or 6in. aperture. β Aquilæ, the lowest of the three stars lying in an almost straight line (of which Altair is the middle), is of the 4th mag. and pale red, surrounded by several fainter specs; but none of them are of special interest.

Space now compels us to suspend operations. After next week, if the weather permits, we will commence our examination of the moon's wonderful surface; but it will be impossible to deal with more than a few of the most striking features on the "terminator," that sharp line of demarcation between night and day on the lunar disc. Several sketches will be made throughout the entire lunation, chiefly for the purpose of identification, in order to enable the student to more closely scrutinise them for himself when the corresponding phases occur again subsequent to the next "new." The writer cannot, however, hope to portray more than a tithe of the delicate and intricate detail revealed by the perfect 4in. photo-visual refractor by Messrs. T. Cooke and Sons, of York, which is being used stopped down to 3in. When the full aperture or less than 3in., is employed, the fact will invariably stated.

In the mean time the student cannot be strongly urged to carefully note and report any changes he may detect in star tints, or evidence of varying brightness. Comparisons with neighbouring stars will facilitate work in the latter department, and when the case appears beyond doubt it can be submitted to more powerful optical assistance for confirmation.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—X.

INTERESTING as it is to know how much rain has fallen during the day, month, or year, it is of no less importance to know the quantity that falls in an hour or portion of an hour. As already remarked, it does not entail a great deal of labour on the part of an observer to procure a daily record of the rainfall; but an hourly visit to the rain-gauge is out of the question, and if it be desired to secure a continuous record it therefore becomes necessary to obtain instrumental aid. As regards yearly averages of rainfall, not the least of the advantages gained by a perusal of such figures is that it enables much to be learnt concerning the suitableness or unsuitableness of certain parts of the world for agriculture and such-like operations. Thus it has been concluded that when the mean annual rainfall is less than 18in. agriculture can only be carried on by means of irrigation, and when the fall is below 12in. cultivation of the soil becomes extremely difficult, if not altogether impossible. Such figures also indicate that mankind has been most successful in agriculture in those localities where the rainfall is distributed evenly throughout the year, the most profitable results being associated with those areas over which the annual rainfall is from 50in. to 80in. It is probable also that had more complete information been forthcoming concerning the regimen of the rainfall in certain distant parts of the world, speculators would have been restrained from embarking on enterprises in localities having unfavourable characteristics as regards their rainfall. The rain gauge therefore may be made to point out the most suitable routes to be taken by an onward-moving empire. Many similar questions to the foregoing may be discussed in the light of rainfall observation, while more detailed records such as are obtained from self-recording rain-gauges admit of the daily history of the rain-fall being more minutely examined and given a long series of observations; it is possible to discover what hours of the day are most rainy, and to learn much concerning the duration of heavy showers, and the times and seasons when unusual falls are most frequent. So many people and occupations are affected by rain that there will be no necessity to enlarge upon the many benefits to be derived from a knowledge of the most suitable hours for taking one's walks abroad and for engaging in outdoor pursuits. For the agriculturists, engineers, and sanitary authorities, such information is of obvious interest. A self-recording rain-gauge, therefore, will give a great deal of interesting detail, and there are few meteorological instruments which so well repay attention.

Seeing that self-recording rain-gauges must necessarily be in the open air, considerable skill is required to adjust the working parts of them so that they shall not be thrown out of gear by changes in the weather. The clock, for instance, which drives the cylinder upon which is put the paper carrying the automatic record, requires to be of good workmanship, and demands considerable attention to preserve it from being affected by the dampness by which it is surrounded. In these instruments the collector, or outer portion of the gauge into which the rain first falls is very similar to that of other gauges, and similar precautions have to be taken to avoid insplashing of rain drops, and to keep snow from blowing out once it has fallen into the gauge. Now, in order that the amount of rain which falls from hour to hour may be determined, it is necessary to allow it to run out of the collector into a smaller vessel, sometimes called a receiver, so that the rate at which this latter fills and empties itself may be made to indicate the heaviness of the showers. In very many of these gauges the receiver is emptied by a small siphon of the kind commonly called intermittent. As the water flows from the outer part of the gauge into the receiver, it ascends the short leg of the siphon and drives the air before it and down the longer leg until, as the water rises, it presently reaches the bend in the tube, which is somewhat flattened, and falls over into the longer leg, and brings the siphon into play. By this simple contrivance the receiver is rapidly emptied immediately the water arrives at a definite height, and with it there is no interruption of the record by air bubbles lodging in the bend of the siphon, and the flow of water is not retarded.

Supposing, now, that the area of the collector is 100in.; the rain, as it falls, may be led by a funnel into a small glass or copper receiver having a capacity of 20c.in., so that, every time the receiver is filled, it indicates that two-tenths of an inch of rain have fallen. Moreover, if this receiver be supported by a small column running between small friction rollers and floating in a cistern of mercury, it will descend as the weight of water in it increases, and as soon as the water is discharged by the siphon it will quickly float upwards again. All, therefore, that has to be done to secure a continuous record is to attach a pencil to the outside of this moving receiver or float, which may be so adjusted that a mark or trace may be impressed upon the strip of paper wrapped round the revolving cylinder. Commonly, this strip of paper, which needs to be waterproof, contains the record for one day only, although it may be arranged for a longer period; and since it is ruled into hour spaces, it is easy to learn how many times the float fell and rose during the day, and so determine the amount of rain for the whole period. Occasionally, during heavy showers, the float may descend several times during the hour, and the full particulars of the rate at which the shower came down will be clearly shown by the perpendicular lines traced by the float and the pencil as they rose and fell together.

The water which is discharged from the receiver is, of course, carried off by a suitable pipe, and has no further interest after it has depressed the float. There are, however, other forms of receivers and other methods of discharging them, a very common variety taking the form of what is termed a "gravity bucket." These gravity buckets consist of a small vessel divided into two portions by a slip of metal or other material, which is so placed upon an axis as not to be exactly balanced, and in such a way that one end or the other is uppermost. The rainwater is conducted alternately into the two halves of the gravity or tilt bucket, and as one side is being depressed by the weight of water flowing into it, the other is turning upwards and getting into position to receive its load of water. As soon as the bucket reaches a certain point in its downward course it tips completely over, and the water is at once discharged and flows away down a small waste-pipe. Each division of the bucket holds a known quantity of water, which is proportional to the collecting area of the gauge, so that each discharge represents a certain depth of rain, and supposing the collecting area to be 200in., and the capacity of the division in the bucket 50c.in., the indication is that a ¼in. of rain has been collected. In some forms of this rain-gauge the water first passes into a receiver and flows thence into the gravity bucket, and the tilting of this latter, which is adjusted in a glass globe, creates a partial vacuum every time it tips out the water, and in this way a small siphon is put in action, and the flow of water from the glass globe to the bucket maintained. Having thus succeeded in putting the bucket in motion, it is a comparatively easy matter to harness a pen or pencil to it, by means of a spring or pulley, and register the rate and time of its movements on a strip of paper in the usual way.

These self-recording rain-gauges require constant attention to keep them going, and considerable skill is necessary so to construct them that the float, siphon, gravity bucket, pen or pencil, and the clockwork shall all work smoothly and continuously, and not get out of order during heavy rains, when the strain upon the resources of the instrument are greatest. There are, however, simpler methods of construction, and, although they are not quite so suitable for strictly scientific purposes, they nevertheless admit of very useful instruments being made by their aid. One such method consists in having a series of bottles or receivers arranged to hold the rain which runs from the outer portion of the gauge, each bottle representing a certain hour of the day. By this method of construction the collecting portion of the gauge is connected with a clock and revolved, so that if a pipe runs from the lower portion or funnel of the gauge it may be made to pass over the bottles in succession, and at an even rate. The bottles are arranged, of course, in a circle, and if the gauge is visited twice a day a series of twelve could be made to represent the twenty-four hours of the day. If, therefore, each bottle is properly graduated, all that needs to be done to ascertain the amount of rain that fell during each hour of the day is to measure the contents of each bottle, while the different amounts added together give the total value of the catch for the day. Now in such an arrangement as this, there is always a danger that some of the rain may be lost, owing to faulty construction of the small pipes that are required to distribute the water; and there is further always a possibility of outside moisture finding its way into the various bottles. The greatest source of loss is, however, commonly by evaporation, and in all gauges special devices are necessary to prevent water escaping by this facile road. Possibly, if the bottles were constructed after the manner of certain ink-pots, which have a cone-shaped depression for a mouth, and are designed to prevent loss of ink by evaporation and other untoward circumstances, deterioration of the rainfall records would be decreased.

During times of frost also the bottles would need watching lest the water within them should freeze, and they be destroyed. But the most troublesome circumstance to deal with is snow, for it not only chokes up the gauge, but since it can only be melted at certain times of the day, it becomes impossible at times to say when the snow fell, and how much of it should be apportioned to the individual bottles. All that can be done at such seasons is to melt the snow by pouring hot water upon it, and determine the amount for the whole day and take no regard for the hourly values. In measuring this melted snow care must, of course, be taken to deduct the hot water that has been added, which should always be a known quantity. In some gauges the attempt is made to melt the snow at once as it falls, this being done by keeping a jet of gas burning beneath the gauge; but, as a rule, this adjustment entails more attention than most observers are willing to bestow. Under ordinary conditions, however, the arrangement of bottles should be managed without much trouble, and since the construction of the necessary apparatus does not require more than ordinary mechanical skill it is to be recommended. It may also be observed in passing that this arrangement of bottles may be made to secure a continuous series of observations concerning the wind and the rain, and the points of the compass from which the rain comes. In this case the gauge is put in connection with a wind vane, and turns about with it, and the bottles are arranged to represent the points of the compass. As before, the rain would be led from the collecting surface of the gauge to the various bottles by a small protuding pipe, and measurements once a day would, when added together, not only tell how much rain had fallen, but also how much was to be set down to the credit of each direction of the wind. Now although such a gauge as this could not be expected to have the precision of registration attained by more elaborate instruments, there is a simplicity about its parts which urges the mechanically-minded to attempt its construction.

From a continuous record of rainfall many combinations of means and averages may be obtained, and, in addition to learning the time of the duration, beginning and ending of individual showers, hourly, daily, monthly, and yearly averages are to be worked out. Unfortunately, the compilation of such averages entails considerable arithmetical drudgery, and observers who are willing enough to set up rain-gauges and attend to them regularly, are inclined to shirk this part of the business. Before also this part of the work can be attacked, the curves or traces obtained from self-recording instruments have to be measured, or tabulated as the term is, with appropriate scales, and this operation also demands a large amount of enthusiasm for its successful accomplishment; but until this measuring and adding up is performed, the records remain meaningless, and the only safe method in this, as in other mundane affairs where work quickly accumulates, is to do a little each day; and if, as each rain-record is removed from the instrument it is at once tabulated, there need be no fear of a rising tide of arrears. Now, as regards the number of years' observations required to give a good average representation of the rainfall in any locality, it is probable that to obtain a yearly average at least ten years are necessary, and if it be desired to obtain dependable monthly averages at least thirty years are advisable, for the fluctuation in the monthly rainfall is often very large. A note of the maximum amount of rain which fell during the individual months and years is of interest, and these figures are, of course, picked out from the records without much difficulty. Further, the number of rainy days should also be extracted for each month, and in this connection it may be remarked that meteorologists call a rainy day one on which ·01in. or more of

rain was measured, and, as already mentioned, no regard is taken of the form of the precipitation —hail, snow, and moisture from dew, hoar-frost, and fog being all counted as rain. Having obtained these figures, it is then possible, if the series of observations is long enough, to calculate the average number of rainy days for any desired period, and, in estimating the probabilities as regards the future supply of rain-water, these and similar figures will greatly assist the observer to arrive at right conclusions.

NOTICES OF BOOKS.

The Prevention of Factory Accidents. By JOHN CALDER. London, New York, and Bombay: Longmans, Green, and Co.

THE author of this work has been for some time an inspector of factories, and being also a Whitworth scholar, it may be presumed that he has both knowledge and experience of the subject on which he writes. The first portion deals with the statistics of casualties, and the third part with the law on accident and safety in factories, both of which may be studied with advantage by both employers and employed. The second and more useful portion of the work is devoted to the prevention of accidents. Some of the statistical tables will be studied with attention by, amongst others, the friendly societies and assurance offices, and those portions which deal with the law on the subject of compensation will attract the attention of trade-union and other societies. The author gives some cases of accidents due to ignorance on the part of the workers; but the principal causes are carelessness, insufficient lighting, defects in machinery, and unsuitable clothing. There are parts of machines which cannot be fenced, because it is necessary for the operator to approach them closely, and then ragged sleeves, loose jackets, slipping neckties, and in the case of females, long hair unconfined, are prolific sources of accident. The chief cause of accidents in factories (an inclusive term) is, however, the absence of safeguards; but, thanks to recent legislation, and the vigilance of factory inspectors, that risk is being gradually diminished. The illustrations (124) are natural, confined to the sections which deal with the prevention of accidents, and they should be specially useful to owners of factories wherein many persons are employed.

Steam-Engine, Theory and Practice. By WILLIAM RIPPER. London, New York, and Bombay: Longmans, Green, and Co.

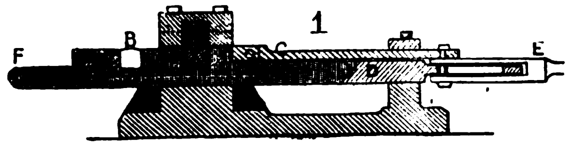
THE author of this work is the Professor of Engineering in the University College of Sheffield, and has issued this book as a sequel to his elementary treatise on "Steam." Special attention has been given to the subjects connected with the heat quantities in the generation and use of steam, and the temperature-entropy chart of Capt. Sankey forms the frontispiece. Mr. Ripper has brought his work up to date, and has included notes on all the modern types of steam-engines, on compounding, superheating, valve-gears, governors, &c. The chapters on friction, balancing, and on the modern "quick-revolution engine" are worth attention, and the work may be commended to all students of steam and the methods of its utilisation through mechanical apparatus.

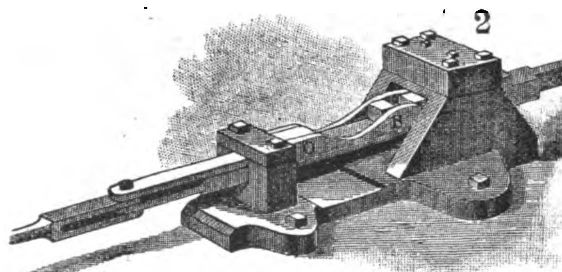
The Modern Safety Bicycle. By H. A. GARRATT. London: Whittaker and Co.

THE author says his work is intended to help riders to understand their machines rather than to assist manufacturers, and although some of the latter may be mentioned rather frequently, it must not be supposed that those firms whose names are not mentioned are really less important. Referring to the "free wheel," Mr. Garratt says he uses the word "pedals" instead of "wheel," which term he says many people do not understand—as a matter of fact it is not correct. The frontispiece is an illustration of part of the workshops of the Northern Polytechnic Institute in the Holloway-road, of which Mr. Garratt is the head in the engineering department. The volume is freely illustrated, and there are five working drawings. The "safety" type is the subject, but there is a great deal of information in this work which will be especially useful to riders and those who wish to thoroughly understand the construction of modern cycles. All cyclists will read this book with pleasure, for even if they do not always agree with the author in his criticisms, they will at least find food for thought in them.

We have also received *Practical Cycle Repairing* (London: Office of *Ironmongery*), a collection of articles which have appeared in that serial, and which are intended to help those who may be called upon to repair cycles.——*The Wonders of Modern Mechanism*, by CHARLES HENRY COCHRANE (London: J. B. Lippincott Company), is the third edition of a freely illustrated work in which the author has endeavoured to present to the public in popular language the results obtained with modern mechanical devices in all branches of science. It is a very interesting work.——*Practical Engraving on Metal*, by G. A. BANNER (London: Hampton and Co.), is intended for amateurs who occupy their leisure in carving, saw-piercing, inlaying, &c. It is a practical work, and will be found useful by all interested in "engraving"—a term which covers a great deal.—— *Wood-Carving for Beginners* and *Decorated Wood-Work* (London: Dawbarn and Ward, Ltd.), by CHARLES GODFREY LELAND and C. E. DAWSON, belong to the "Useful Arts and Handicrafts Series" issued by the publishers. They are freely illustrated, and will be found instructive by those who wish to do work of the kind.——*The Elements of Co-ordinates Geometry*, by J. H. GRACE, B.A., and F. ROSENBERG, M.A., B.Sc. (London: W. B. Clive), is one of the works published in the University Tutorial Series. It is Part II., and deals with "The Conic," a subject of interest to mathematicians. It is of value to students and to candidates for the London B.A. examination, more particularly those who have to study at home.——*Euclid's Elements of Geometry*, edited by CHARLES SMITH, M.A., and SOPHIE BRYANT, D.Sc. (London: Macmillan and Co., Ltd.), is a well arranged school edition of Euclid.——*Monthly Star Maps for the Year* 1900, by WALTER B. BLACKIE (The Scottish Provident Institution), is a series of star maps for the northern and southern aspects of the heavens in these islands. The charts are hemispherical on plan, and printed in blue with the stars in gilt. The time selected is 10 p.m. on the first of each month. Star maps of this sort are very useful in teaching the observation of the sky.

HANEY'S SAFETY SWITCH-LOCKING MECHANISM FOR RAILWAYS.





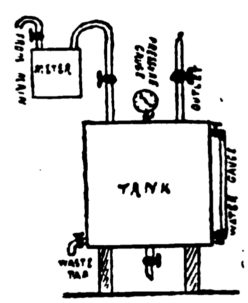
AN invention has been patented by William Haney, of Lexington, Kentucky, which provides an ingenious means for opening and closing railway switches and for locking the switch tongue in its adjusted position, to prevent possible accidents.

The switch-operating mechanism comprises a shifting-bar, F, formed with two transverse notches, in which a spring-pressed locking-bar, A, is designed to engage. At opposite sides of the shifting-bar, cam-plates, B, are arranged, which are curved so that their highest points are on a plane with the top of the shifting-bar. The cam-plates, are connected by means of a link, C, with an operating rod, E, leading to a switch-tower, and can be moved independently, and with the shifting-bar. The link C is connected with the rod E by means of a bolt passing through a longitudinal slot in the shifting-bar.

When the locking-bar A is in the first notch, as shown in Fig. 1, and it is desired to shift the switch-tongue in an opposite direction, the rod E is pulled outward, thus drawing the cam-plates, B, longitudinally, and causing the curved portions to raise the locking-bar A against its spring. During this motion the bar will remain stationary, because the bolt connecting the rod E and the link C is travelling in the longitudinal slot of the shifting-bar; but when the bolt reaches the end of the slot, the cam-plates and shifting-bar will be drawn together, until the locking-bar moves into the second notch, thus locking the switch-tongue in adjusted position. The movements are reversed when the parts are shifted to their first position. Since the boxing in which the locking mechanism is contained is covered, the parts cannot become clogged by snow, ice, or dirt.—*Scientific American.*

LARGE ILLUMINATIONS.

IN the course of an article on this subject in *The Optical Magic Lantern Journal*, Mr. G. W. Nash says:—There is a method by which we can use coal-gas under pressure from the main without resorting to an injector jet. A good water-pressure from the main is required, and, of course, gas must be laid on. Now, suppose you have a large closed tank of the necessary cubic capacity, connect this underneath with the water-main, and at top with the gas-main, and let each connection throughout be provided with its own tap. A tap is also required below to let out waste water after using the gas. In order to see the quantity of water and gas in the tank, a water-gauge should also be fitted. A tube fitted to the top of the tank serves as an outlet for the gas, as shown in the illustration. The tap from



gas-main must always be kept carefully turned off while using gas from the tank. Now, suppose we have the tank filled with water, and desire to fill it for use with gas, turn on the gas at the meter, and then open the outlet for waste water, having all others closed. It is evident that the water will gradually leave the tank, thus enabling the gas to supply its place. The tank being full of gas, which is ascertained by the gauge, we close the water waste, and then turn off at the meter. If we now turn on the water at the main we have the pressure below the gas, and can use it at a pressure varying with the force given by the water. A pressure-gauge should be used also to show the pressure we are dealing with, as, of course, the oxygen supply must be carefully regulated to balance it. A container could be used for the oxygen, and the gauge carefully watched, to prevent the pressure becoming too high. Very careful attention to all the details should be given, as they are necessary to proper working. These remarks will show the reader that a considerable amount of unusual apparatus is needed in this work, and the cost must be counted beforehand. In the limelight arrangements at the Empress Theatre, alluded to above, instead of the ordinary light-box being used, the light is concentrated by reflectors, which consist of a bowl of copper, silvered and suitably mounted, with the jet

in front; the incandescent portion of the lime facing the reflector, and not the surface to be illuminated. The limes used (often) are what are known as "cup limes," having no central hole for the pin, as we usually see. They are also longer than those in ordinary use.

HOW A BIRD SWIMS UNDER WATER.*

IT is a rare sight to see a bird swim under water, and one which but few are privileged to witness, yet by care I have watched the bird in its movements under water on two occasions, and will give my readers a description of the act. If I were to give the proper heading to this article, I should head it, "How a Bird Flies Under Water," for on these occasions the birds were scared and trying to escape, and their movements took the nature of flying rather than those of swimming.

Once I headed a Pied-bill Grebe, so that it was cut off from the deep water, and it had to pass through a strip of shallow water in order to get back into the pond, and very near to my position in a boat. The position of the bird was almost exactly as in flight, and the neck was stretched out to its full length. The legs, placed far back, as with the divers, were used as paddles, or, as we might say, as propellers to the craft, while the wings, partly extended, were beating the water in the efforts of the bird to escape. I am fairly satisfied that the bird secured as much power from its wing movements as from its feet. It went through the water like a fish.

At another time I was hunting whistle-wings or golden eyes on the river, and succeeded in heading one off in its efforts to escape, and by rushing up kept it from following the rest of the flock, and made it seek protection beneath the surface of the water at the hole in the ice on the river. The strip of water was about one hundred yards long, by ten or twelve wide in the centre, and gradually narrowing at each end, and was kept open by the rapid current of the stream. These spots of open water are generally to be found on Michigan streams even in the coldest weather, and are often occupied by the winter ducks and red-throated divers. The water was not over a foot and a half deep in the shallow places, and less than a yard throughout, and I could plainly see every movement of the duck as it literally flew through the water. Its feet moved as paddles, alternately and with great rapidity. But the wings were also used as a means of propulsion, and I think that a greater impulse was derived from this means. The motions of the wings were combined as in aërial flight, but were spasmodic, and the bird seemed at times to be actually flying in the water. The wings were but partially spread when the bird swam. Sometimes an unusual burst of speed would be made, as the wings, through an extra effort, were beaten with greater rapidity—much in the same way that a fish makes a sudden dash by powerful tail strokes.

All this time I was walking, or rather trotting, along the edge of the strip of water and trying to get a good shot at this duck, or rather drake, for it was a full-plumaged male. He rose often enough, but did not remain above the surface the length of a second, and I honestly do not think that the quickest shot in the world could have shot that diving whistle-wing, even with the privilege of trap rules, and could he have said, ready, pull. Talk of greased lightning, and of loons diving at the flash! I took several shots at that bird, as I followed up and down the strip of water, but I do not think I touched him, and I much doubt if any other man could have hit the bird as long as it had strength to dive and swim.

Up and down we went, the bird swimming, or, rather, flying, in the water, and I trotting along and loading my gun. The duck would turn back when it reached the end of the strip of open water, and dash by me, often within ten feet, and make for the opposite end, and at these times I could see the swimmer to perfection as he flew by me under the surface.

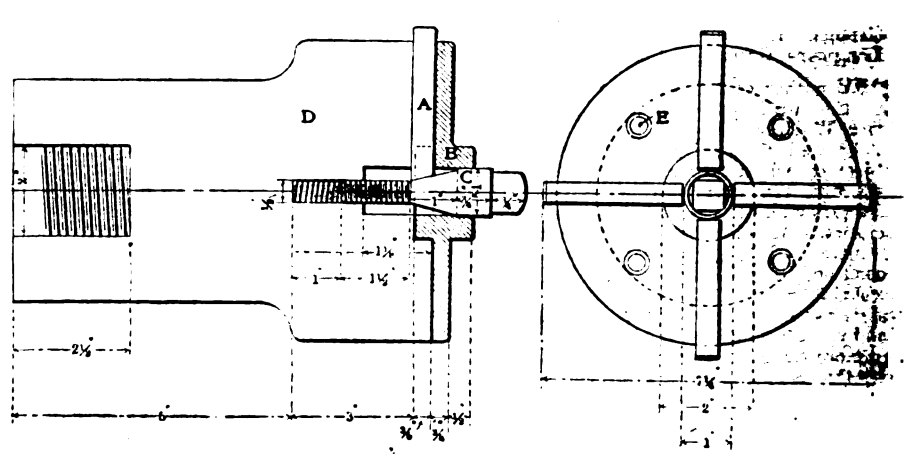
All at once I missed his drake-ship at the lower end of the opening, and, after waiting several minutes, concluded that the crafty fellow had been swept under the ice by the swift current and hurried to destruction. This may have been the case, but it is quite possible that the bird intentionally dove and made the distance to the next open space, a very small air-hole fifty yards or more below. There is no reason to doubt that the bird could do this after what I had seen. A companion with whom I was hunting came up soon after and strengthened the opinion, for he had heard wings below and had seen a bird fly from the lower hole, and he said that he was quite sure that there was no duck on the hole the moment before his attention was attracted.

I have had entire flocks of teal dive at a flash, have chased wounded ruddies, blue-bills and buffleheads, and have wasted my time and powder on mergansers, hell-divers, and loons, but these all had plenty of water and a chance. But here was a case where a bird could not be hit even in circumscribed quarters, and though too wise to seek escape by flight, yet had the impulse to dive, and finally to take the risk of passing under a stretch of ice and effecting its escape. At no time was this bird at a greater distance than 50ft., and often scarcely more than 10ft., from me.

* By Morris Gibbs, M.D., in *Popular Science*, N.Y.

AN ADJUSTABLE BORING TOOL.

THE following illustrated description of an adjustable boring tool is contributed by Mr. J. F. Morgul to the *American Machinist*. The designer says it is one that he has just completed



for his own use. The body D of the tool is of cast iron, and a taper shank, not shown, of machinery steel is screwed into the back, and enables it to be used on any boring mill or large drill as required, The cutters are of $\frac{1}{2}$in. square self-hardening steel. and the grooves in the face of the stock D should be milled only $\frac{13}{32}$in. deep, so that the steel plate B, which is held by four countersunk head screws, will properly bind them. The central screw with the conical bearing against the inner ends of the cutters gives nearly $\frac{1}{8}$in. adjustment, either for wear or for different diameters of hole, the size of tool here shown being $7\frac{1}{4}$in. It may, of course, be made with two, four, or six cutters, and the adjustable feature of it, and the ability to change the cutters for other bores, make it a handy and valuable tool.

A MILLING RIG FOR A LATHE.

IN one of the shops in which I worked a number of years ago we had some peculiar packing rings for piston-heads. The joints were milled so as to fit together and make a tight job, or at least that was the intention, says Mr. R. E. Marks in *Locomotive Engineering*, N.Y. These joints could not be handled very well on a milling machine, and as we were not blessed with a decent one anyhow, we were not troubled on that score. One of the ingenious chaps rigged up a fixture like the sketch, which was put on an 18in. lathe when it was needed, and it made a very handy rig for the work. The upright F, shown in Figs. 1 and 2, fitted the ways of the lathe, and was well supported; it had a vertical slot, as shown in dotted lines, so as to allow for different radius rings. There were separate front or springing pieces for each size, each within a worm thread cut on edge for feed, and a lip, *l*, for supporting work. This swing-arm faced the lathe-spindle, and the cutter *c* did the work.

It would have been easy to connect the swinging arm to a nut on the screw by a link, and then make one arm do for all sizes by blocking up to hold the work. This can be figured out by whoever wants to use it.

Fig. 1

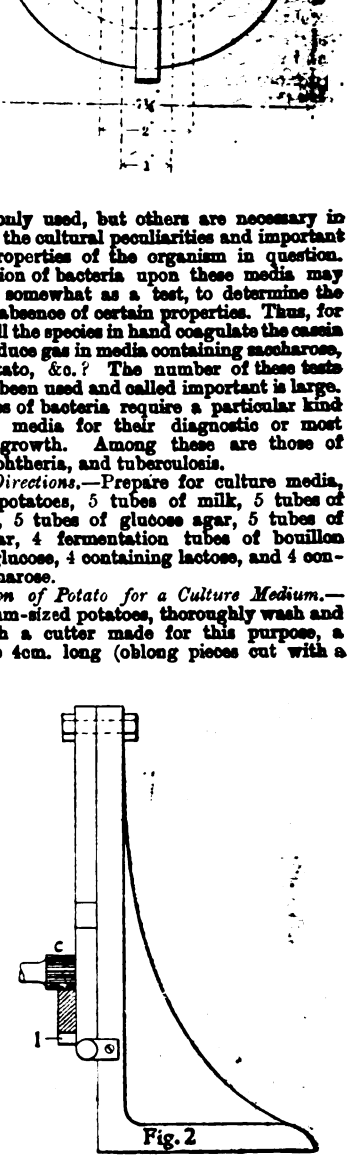


Fig. 2

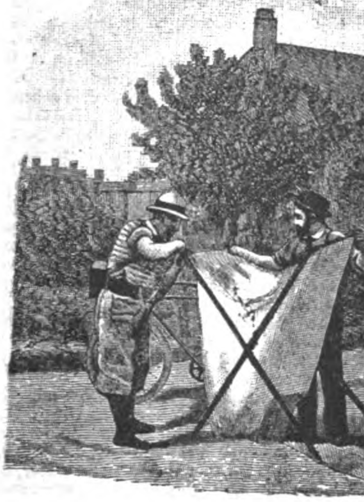
PREPARATION OF CERTAIN SPECIAL MEDIA.*

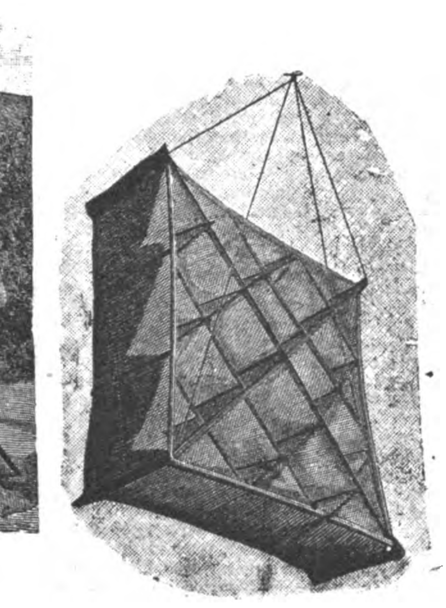
IN studying the properties of bacteria it is desirable to cultivate them on a number of different media. Bouillon, agar, and gelatin are most commonly used, but others are necessary in determining the cultural peculiarities and important biochemic properties of the organism in question. The cultivation of bacteria upon these media may be regarded somewhat as a test, to determine the presence or absence of certain properties. Thus, for example, will the species in hand coagulate the casein in milk, produce gas in media containing saccharose, grow on potato, &c.? The number of these tests which have been used and called important is large. A few species of bacteria require a particular kind or kinds of media for their diagnostic or most differential growth. Among these are those of glanders, diphtheria, and tuberculosis.

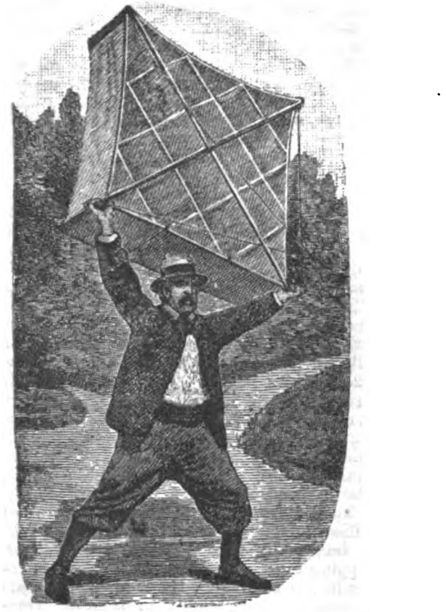
General Directions.—Prepare for culture media, 5 tubes of potatoes, 5 tubes of milk, 5 tubes of litmus milk, 5 tubes of glucose agar, 5 tubes of glycerin agar, 4 fermentation tubes of bouillon containing glucose, 4 containing lactose, and 4 containing saccharose.

Preparation of Potato for a Culture Medium.—Select medium-sized potatoes, thoroughly wash and cut out with a cutter made for this purpose, a cylinder 3 to 4cm. long (oblong pieces cut with a knife will do quite as well). Ordinarily two cylinders can be cut from each potato. The inclined surface is obtained by cutting out the potato projecting above the frame of the cylindrical knife. All of the skin must be removed. Wash the potato cylinders in cold, running water for some five minutes (a longer time is preferable), and place them in test tubes of the proper size (large or small according to size of cutter used), and add about 1c.c. of water to each tube. Sterilise them by discontinuous boiling or steaming for twenty minutes

* By V. A. Moore, in the *American Monthly Microscopical Journal*.







each day for three consecutive days. Wipe, label, and store.

Preparation of Milk for a Culture Medium.—Place about 100c.c. of fresh milk in a beaker in the ice box, and allow it to stand for from 10 to 15 hours. Then carefully remove all the cream. It is well to filter the milk through a thin layer of absorbent cotton to remove any masses of cream. The reaction should be tested, and if strongly acid it should be rejected or made 1·5 per cent. acid to phenolphthaleni by the addition of n 1 sodium hydrate. Distribute the skimmed milk in small test-tubes (7c.c. in each), and sterilise by discontinuous steaming in the same manner and for the same length of time as the potatoes. Label and store in locker.

Preparation of Litmus Milk for a Culture Medium.—This is prepared the same as the milk medium with the addition of enough of an aqueous solution of litmus to impart a decidedly blue colour to the milk. Sterilise, label, and store the same as the milk.

Preparation of Glucose Agar.—Prepare 100c.c. of agar. Reserve one-half of it for glycerine agar, and to the other half add 1 per cent. of glucose. Dissolve the powdered glucose in about 5c.c. of boiled, hot water before adding it to the liquid agar. After thoroughly mixing, distribute it in small sterile test-tubes. Sterilise, label, and store the same as ordinary agar.

Preparation of Glycerine Agar.—Take the balance of the agar prepared above and add 5 per cent. of pure glycerine. Thoroughly mix it with the liquid agar, after which distribute in tubes. Sterilise, label, and store as ordinary agar.

Preparation of Glucose Bouillon.—This is used in the fermentation-tube. Take 100c.c. of peptonised bouillon and add 1 gram of pure grape sugar (glucose). After it is dissolved and thoroughly disseminated through the bouillon by stirring or pouring, distribute the bouillon in the fermentation-tubes, filling completely the closed branch and the open bulb about half full. Sterilise it by discontinuous steaming for twenty minutes each day for three consecutive days.

Preparation of Lactose Bouillon.—This is prepared by adding 1 per cent. lactose to the peptonised bouillon. It is necessary, however, that the bouillon used does not contain muscle sugar. Bouillon free from muscle sugar can usually be obtained by macerating the meat for from 12 to 18 hours at a low temperature. After adding the lactose and thoroughly mixing it in the bouillon, sterilise, label, and store.

Saccharose Bouillon.—This is peptonised bouillon to which 1 per cent. saccharose has been added. It is prepared from bouillon free from muscle sugar, in the same manner as lactose bouillon.

THE LECORNU CELLULAR KITE.

THERE is no amusement more fascinating, more instructive, or more easily engaged in by everybody than kite-flying. Although it is much in favour on the other side of the Atlantic, it is yet too much neglected in France. Almost everywhere in the United States there are to be found kite clubs analogous to the French bicycle and photographic societies, and which are in the habit of organising competitions of various kinds. It is a great pity that the sport is not indulged in in France as much as it deserves to be, for the kite is a wonderful apparatus, of which a host of curious and interesting applications may be made. It is almost without a rival for the study of atmospheric electricity and for topographic photography. It may be employed as a life-saving and signalling apparatus, for the practice of wireless telegraphy, for the study of meteorology, and even, as with the balloon, for making ascensions. The ordinary kite is familiar to everyone. Whatever be its form, lozenge-shaped, rectangular, elliptical, hexagonal, octagonal, &c., it always consists of a plane surface provided with a bridle to which the string is attached, and with a tail of varying length. This last-named appendage was for a long time looked upon as indispensable, and it seemed as if a tailless kite could not be thought of; but the Oriental kites imported from China and Japan destroyed such an opinion.

If we attentively examine the tailless Japanese and Chinese kites we shall see that they are no longer plane, but either (like the Japanese flies) consist of a plane part and two wings forming pockets and inclined towards the rear, or (like the Chinese apparatus) present curved surfaces. This, in fact, is because the plane kite is unstable. It is like a plank that we should like to keep in equilibrium in a current of water, and at right angles therewith, in holding it by a single rope. It is evident that however carefully we fixed this rope at the centre of the thrust, the board would be in a state of unstable equilibrium, and would continually revolve around its point of attachment. It would be entirely different if we should fasten a string to the handle of an umbrella and present the concavity of the latter to the current. When we study the stability of the tailless kite, we are thus led to seek forms that are entirely different from those of the flat kite.

Without extending this brief statement of the question any further, we shall merely say that one of the best forms to adopt for the tailless kite is the cell. We mean by this the form obtained with at least three, but generally four, planes intersecting each other in pairs according to parallel straight lines. We thus obtain a sort of bottomless box. The walls are of paper or of some light fabric. To make the matter plain, let us conceive of a cell of square section. This will present itself in the form of a box, of which the four sides will exist, but of which the top and bottom will be suppressed. If we present this cell to the wind in such a way that two of the sides shall be horizontal and two others vertical, it is evident that the air will pass freely through the cell without exerting any pressure capable of raising it; but if we elevate the front edge of the cell slightly, the wind, in pressing the lower surfaces of the walls that were previously horizontal, will tend to raise the apparatus. The latter will have great stability by reason of the existence of the two vertical sides, which, in a manner, play the same part as the keel of a boat.

The sides of the cell that undergo a pressure are the sustaining planes, and the vertical sides the directing ones. If we place two of these cells one behind the other, in leaving between them an interval equal at least to their length, we shall have the Hargrave cellular hovering kite adopted at the Blue Hill Observatory (in the United States), where, through the intermedium of meteorological registering apparatus, it is used for exploring the upper regions of the atmosphere. In certain experiments such apparatus have reached heights of from 5,000ft. to 6,500ft.

If, on the contrary, we juxtapose not two, but a greater number of cells—say, six, eight, twelve, or more in the same frame—we shall obtain the multicellular hovering kite, which we have devised and constructed after numerous tentatives.

We at the outset placed four rectangular cells one above another, and thus obtained an apparatus having exactly the form of a set of shelves. We tried this upon the beach of Cobourg in 1898; but, since the stability did not prove as great as that which we desired to obtain, we were led to multiply the number of cells and to employ square cells, with one diagonal and horizontal and the other vertical.

Each cell taken isolatedly thus flies upon the side and presents to the wind surfaces that are inclined, one to the right and the other to the left, somewhat as in the case of a boat that is floating upon its keel.

We have in this way constructed a kite of wonderful stability, which rises with the greatest ease, and maintains itself in the air with complete immobility.

Our multicellular hovering kite is very easily constructed. It requires, as a rigid frame, only four wooden rods, having the length of one cell and placed at the four corners of the entire affair formed of all the cells, and two cross pieces, one in front and the other behind, to give rigidity to the whole.

It may be put together and taken apart in a few minutes with the greatest ease. After being taken apart, it may be rolled up and carried very easily upon a bicycle.

It is so easily managed that anyone can send it aloft and manœuvre it without difficulty. When it is in the air, it is so stable that ten yards of string may be suddenly paid out without causing it to fall. Finally, its sustaining power is so great that in a brisk wind we have been able to make it raise a dummy formed of a child's clothing and fixed to an umbrella. And yet the kite is not of very large size, its dimensions being 4ft. in length and breadth, and 16in. in depth, while its weight is little less than 4½lb. The *Scientific American* is indebted to *La Vie Scientifique* for the description of this form of kite. The figures represent the method of mounting the kite, the kite ready, and the method of raising.

BLACKSMITH'S STUDY OF CAST STEEL.*

THE most important element in steel, as far as the tool-user is concerned, is carbon. Cast steel is iron and combined carbon in the hardened state, and of iron and graphite carbon in the annealed state. Carbon in its combined state is akin to the diamond, and in its uncombined form is akin to black lead.

I might evolve a nice little theory by saying that the higher the percentage of carbon in the combined state, the closer it approaches the diamond, when we remember that two per cent. carbon is very high and is seldom used. The toolsmith should know the carbon points of steel he is working. For example, if he has been in the habit of making milling cutters out of steel containing 125 carbon points he knows just what degree of heat is suitable for the right temper. If he should, perchance, receive a piece of steel with only 110 carbon points, he would get the milling cutter too soft, yet he could in either case make a satisfactory tool if he knew the carbon points.

* Extracted from a paper read before the Northwest Railway Club by Mr. George F. Hinckens, master blacksmith St. P. and D. Ry.

Purchasing agents should bear this in mind, and give the mechanical department what they call for, for it is both common sense and true economy to leave such matters to the judgment of the mechanical department. Find out what carbon points are suitable for the purpose required, and if you will change, notify the mechanical department, or else you will confuse the temper, for he cannot discern the difference by inspection.

I will give you the carbon points as used in the St. Paul and Duluth Ry. shops with relation to the various purposes for which our tools are required. Remember a point in this case means one-hundredth of one per cent. of carbon—a very energetic element and a dominant factor indeed; hence a few words only are necessary to indicate the importance of carbon with its relation to steel.

One hundred and fifty carbon points, suitable for lathes, plantes, boring car-wheels, &c.; 135 carbon points, suitable for large lathe and planer tools, medium size dies, &c.; 125 carbon points, suitable for taps, reamers, and drills; 115 carbon points, suitable for screw-cutting dies, chisels, punches, and milling cutters; 105 carbon points, suitable for cold chisels, punches, dies, large taps, milling cutters, small shear knives; 95 carbon points, suitable for large punches, shear blades, large dies, and some blacksmith tools; 85 carbon points for stamping dies, hammers, cold sets, track chisels, and smith tools; 75 carbon points for swedges, flatters, cupping tools, and blacksmith tools generally. In ordering steel give the temper, or state the purpose for which the steel is to be used. Once in a while the steel worker will complain that the steel varies, and the results are not always the same; the trouble was that he got hold of the wrong bar, or got the bars mixed by mistake.

The carbon points given are obtained from average results, but must not be adhered to strictly, as conditions may necessitate a deviation. Take a chipping chisel containing 125 points, such as we use in the tool-room for fine and delicate work, and for comparison we will take a boiler-maker's chipping chisel containing 105 carbon points; now, here are conditions that cause a large variation, a difference of 20 carbon points in the two chisels. Again, as to planer and lathe tools possessing different values as to carbon. For example: a lathe tool for turning hard tires, tool steel, or for hard roll turning will require 150 carbon points, whereas a lathe tool for turning bolts or soft material will require from 125 to 135 carbon points. The speed of the machine and the nature of the material to be cut are factors in determining carbon points; so you see there are no hard and fast rules. I will also mention that carbon costs nothing, comparatively speaking. The difference in price between six-cent and thirteen-cent per pound steel is not due to the difference in carbon, but to material and skill. There are some difficulties in estimating exactly the value of carbon points, and it requires unusual attention, watchfulness, and thorough supervision on the part of the toolsmith and in the tool-room. There are many factors to be considered in estimating the results of all of the many uses to which steel is put, as well as the treatment of the article itself.

In heating steel, as in everything else, science and common sense should be exercised. It is very discouraging to the steel-maker to find that after all his care and expense his product is abused in heating after it leaves the mill. Unequal heating will produce an inequality of the particles, and will cause their displacement in one direction or another when the steel is subjected to the forging process. Thus the different or varying state of heat appears to be of greater moment than is usually taken into consideration. In working a piece of steel with uneven heat the particles are pushed out of their normal position, and no amount of annealing can altogether replace them. The particles of steel will arrange themselves only in obedience to natural laws.

Forging steel at a black heat will crush the particles or bring about rapid crystallisation. Some say that the word "crystallisation" is not applicable, so I will say, "enlarged the crystals." Steel should be in a plastic state during the process of forging, and the heat should be as even as it is possible to have it; the force of the blow should also penetrate the whole mass, so as to prevent the drawing of the exterior surface away from the core or centre. When the outside of the steel is worked more than the inside, the effect is telescopic, and the steel can only be rehabilitated by annealing, and then by no means will the temper be uniform. Hence, do not work steel at too low a heat lest you strain it. Do not work it at an uneven or irregular heat, or the particles will be as variegated as the frost lines on a window glass. Too high heating will make the steel brittle and destroy its cohesive properties. The secret of successful tool-smithing is proper heating, and I will say that proper heating commences from the molten state at the mill.

Overheating has this effect on steel, as a writer on the subject puts it: "It changes the particles of pure steel to crystal of oxidised carburet of iron, and by cooling in water little diamond points of combined carbon and steel are fixed, but fixed so loosely in this crystallised framework that holds them that it breaks down and they crumble out."

I will call your attention to the matter of judging steel in the merchant bar by its structure or size of grain, and ask you to remember that this comes under the head of heats. I have in mind a lot of crucible cast steel for springs which was rejected by the springmaker on account of its coarse texture. I knew that the steel was all right, but I could not convince him. So I wrote to the manufacturer about the coarse grain in his steel. I knew I would receive in reply a corroboration of my views in the matter, which are that this particular lot of steel was finished or had passed through the rolls as a final at a high heat, resulting in a very coarse texture. Had this same steel been reduced to a smaller size, which would have necessitated further rolling and a reduction in heat, the grain would have been finer in structure. Of course, this steel contained from 60 to 70 carbon points, and I think its structure was due more to temperature and the rolling than carbon.

Over-heating, under-heating, over-working, and under-working will change the structure of steel, that is, down to 40 carbon points and below, as we have fully demonstrated in our shops.

Every degree of heat in any of its stages registers itself in a piece of steel as correctly as a thermometer will register every degree of heat in the atmosphere. The higher steel is in carbon, the more mercurial; in other words, high carbon steel is more sensitive and yields to influence more readily than low carbon steel.

The proper heat is learned only from experience. If the toolsmith, in forcing a tool, were to reduce a piece of steel from 6in. to 3in. in diameter, he would use a higher heat than in reducing a piece a piece of steel from 2in. to 1½in. in diameter. In the first, or larger piece, he heats up to a coarse grain; but the sufficient amount of hammering in reduction of bulk refines the steel, and no harm is done. If the second or smaller piece is heated up to the same high heat as the first piece, you start with the same coarse grain as in the large piece, and a reduction of only ½in. diameter under the hammer is insufficient to hammer-refine the steel; besides, the larger piece will hammer-refine and reduce in heat at the same time. Not so with the smaller piece; it will receive no hammer-refining, and the high heat will leave its structure coarse.

In dressing a flat chipping chisel, the toolsmith will reduce or narrow-up the end slightly before the red leaves it, and on the final finish he will hammer on the flat side of the chisel until it becomes black, using judgment as to weight, number of blows, and condition of heat, remembering the "fatal blue." Now, this is the right heat for this particular tool, and the heat method for making the chisel compact. But beware lest you destroy the chisel with just one blow of the hammer, and with the same heat as when striking the flat side. One blow struck on the edge will rupture the chisel. You know that a book will stand considerable pressure when the force is applied to the flat surface; but the same pressure applied to the edge will distort every leaf in the book.

This also applies to side tools, thread tools, or tools where the transverse section is thin. But do not mistake this for a forging heat, for we are not forging in this case—only giving a final finish, or hammer-refining—packing the steel, as it were, and this procedure is limited to only a few cases, and cannot be universally practised. We know that the higher the degree of heat the more hammering or reduction in diameter the steel will stand. We also know that if we are to reduce the diameter of the piece only slightly, we should reduce the heat correspondingly, or we shall lose the desired compactness and fine grain. Of course, we can get a fine grain by annealing and hardening, but let us help that happy condition along throughout the whole course.

The restoration of the particles of steel to their normal state, that have been changed by forging, is brought about by annealing. Therefore, the answer to the question as to what degree of heat will cause the changes that will bring about uniformity in structure is, when the steel is uniformly hot throughout the mass, it should be removed from the fire at once. If left in any longer, it will become "soaked," and will not temper as it should.

The annealing due to slow cooling will remove in a great measure all undue strains that were put in the steel by hammer, sledge, or steam-hammer. Annealing allows the particles of steel to arrange themselves in their right condition, but we must remember that bad strains can only be imperfectly eliminated by annealing, and it should be the inflexible purpose of the toolsmith to guard against working strains into the steel while forging.

Steel that has been improperly worked, that is, that has had the grain crushed, cannot be rectified by annealing; there is a certain amount of brassness that no annealing can eliminate. The particles that, through bad or cold working, have become crushed, telescoped, and disintegrated will not come back.

The action of heat is closely related to the hardening process, and the value of the physical and carbon properties are certainly known to be dependent on the degree of heat in the steel article before immersion. The cohesion, adhesion, or whatever you may wish to call it, or the chemical affinity of carbon and iron, are without doubt influenced by too high or too low a heat.

In speaking of heat for hardening, we are governed by carbon points; the higher the carbon the lower must be the heat, which will register itself. When the tool is fractured, if it shows a sandy grain, it proves that the steel was overheated; if, on the other hand, the grain is fine and of clear appearance, it indicates a proper heat; if a variation in grain, it indicates uneven heating.

Cooling a piece of steel that is unevenly heated causes a complex arrangement of the particles—a separation in one place and a crowding in another—thus producing strains and water cracks. Hence it behoves the hardener to so regulate the heat on the article to be hardened that the whole mass will be uniformly heated. It should be as uniform in colour as possible. A piece of steel so heated, and immersed in water that is in motion, will give results that will gladden the hearts of all concerned. If the article to be hardened is bulky, the heat radiating from it will repel the water, and envelop the article in a film of steam surrounded by hot water, and as steam and hot water are poor conductors of heat, they will prevent rapid cooling. The more instantaneous the cooling, the more harmonious the particles, coupled with uniformity of good hardness.

One of the great difficulties about heating steel for hardening is that of determining the time when the whole mass is uniformly hot.

Mr. W. O. Johnson and myself experimented with two ⅝in. wornout taps. We laid both taps in the fire and brought them up to a hardening heat; we then withdrew one from the fire and plunged it in cold water. The other tap we held in the fire for about seven minutes; during this longer period we were very careful about keeping the heat in a fixed state, and also at the same temperature as the first tap. After the expiration of seven minutes we plunged it in cold water. On examination we found that the tap that received the short period of heat did not arrive at the refining heat, and consequently showed a very coarse grain, whereas the one that remained in the fire the longer period had attained the refining heat and showed, after breaking, a nice refined grain.

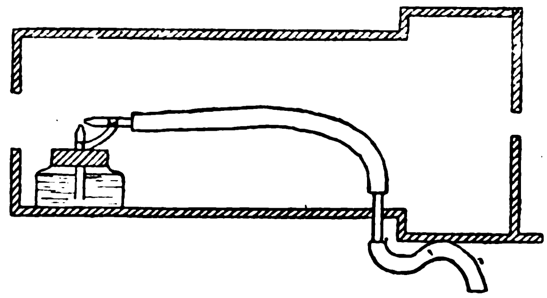
This experiment emphatically demonstrated that the relative difference between the coarse and fine grain was due to proper time exposure. The surface particles are heated first, and from the surface particles the heat is transmitted to the adjacent ones, and soon to the interior. The heat of the surface particles must lag or wait for the adjacent particles, and so on through the mass. When all the particles in the whole mass have arrived at a corresponding heat, the article should then be taken from the fire and immersed. If you ask me how I know when the mass arrives at the ideal heat, my answer is: I do not know. When in doubt, take the safer side, and keep the steel in the fire a little longer, as it is a question of judgment, and comparative at that.

Mr. F. Law, who perhaps has given the subject more study than any investigator that I know of, says that "the point of recalescence is indicated by prominent waves playing over the bar, when the wave disappears it disappears from the centre of the bar, which is an indication that the refining is completed, and the temperature of the bar is then uniform throughout, and if quenched under these conditions we obtain the ideal steel in the hardened state." The hope is justified that in the near future we shall learn to recognise that very exact point of recalescence, but for the time being the most of us will have to depend on the old methods.

AN X-RAY DELUSION.

THE following description of an X-ray delusion apparatus is by Gustave Michaud, D.Sc., in the *Scientific American*:—A Boston firm sells, under the name "X-Ray camera," an apparatus which apparently enables an object to be seen through any opaque substance. It is hardly necessary to say that the X-rays have nothing whatever to do with the phenomenon, which is really produced by a set of four hidden mirrors, that conduct the light round the opaque object. I have recently devised and constructed a little apparatus which is just as deceitful as the "X-Ray camera," but which is more readily made, and gives results far more astonishing for spectators who have not been told the secret of its construction. It apparently reproduces, instantaneously and neatly, the interior of the human body, giving to every organ its natural colour. The whole operation is performed under the eyes of the bewildered sitter, who watches the X-rays in what seems to be the act of drawing and painting, before his eyes, his vital organs.

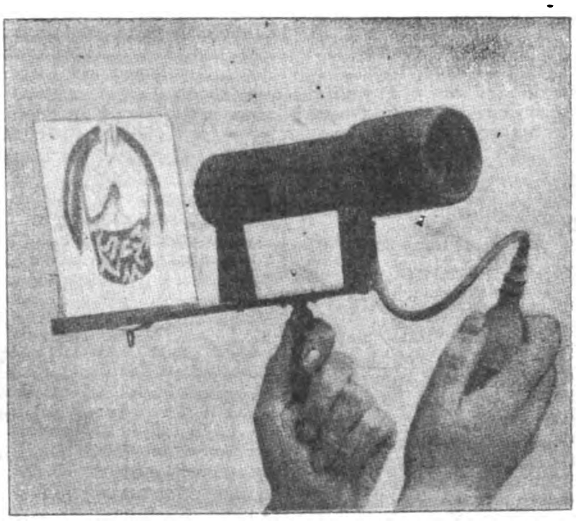
The apparatus looks like the objective tube of a camera, with the plate on which the image is to be



produced in full sight of everyone. The apparatus is placed opposite the person whose viscera are to be photographed, and to heighten the effect a lamp may be solemnly placed behind the sitter. The operator invites everyone to look at the white sheet of paper, and presses the rubber bulb of the shutter. A coloured image appears instantaneously on the paper. The lungs are of a bright red colour, the heart is darker, the veins are blue, the stomach and intestines are of a greenish tint; other parts of the body paint themselves in black on the white paper. This sudden apparition generally startles the sitter; but a few remarks on the healthy looks of his lungs will place him at his ease. The photograph is taken out of the apparatus and passed among the spectators.

Two distinct parts of the apparatus co-operate in the production of that X-ray trick—namely, the sheet of paper and the objective tube.

Before the experiment the sheet of paper is treated as follows:—It is pinned over any anatomical drawing showing the position of the principal thoracic and abdominal organs. If the sheet of paper is not too thick, the drawing can be seen through it. The space occupied by the lungs is then painted with a diluted solution of sulphocyanide of potassium. A more concentrated solution of the same salt is used to fill the space outlined by the heart and principal arteries. A few big veins are painted with a solution of ferrocyanide of potassium. A more diluted solution of the same salt is used for the stomach and a few intestinal folds. The rest of the body is uniformly painted



with a concentrated solution of tannin. The whole operation need not take more than five minutes. When the paper is dry the drawing is absolutely invisible, for all the above-named solutions are colourless. The sheet of paper is now ready for use in the apparatus.

The objective tube does not contain any lens, but merely a small atomiser filled with a solution of ferric chloride. When pressed the rubber bulb sends air, not as every spectator believes, into a pneumatic shutter, but into the atomiser. As a result a fine and invisible spray of the perchloride of iron solution reaches for a moment the sheet of paper. What follows is easily understood by every student of analytical chemistry.

The reactions between ferric salts on one side, sulphocyanide of potassium, ferrocyanide of potassium, and tannin on the other side, are among the most sensitive of analytical tests, owing to the extraordinary intensity of the red, blue, and black colours which originate in these reactions. Hence the instantaneous production of the coloured picture.

The illustrations show the objective tube in section, and the apparatus complete.

In Tasmania there are 437¾ miles of railways open, and the train mileage last year was 761,309.

NOTES ON OZOTYPE.

At a recent meeting of the Leeds Camera Club, a lecture was given by Mr. Thos. Manly, on "Ozotype," of which he is the discoverer. Ozotype is an important development in carbon printing, the essential difference being that in this process there is a visible image, while in the ordinary form of carbon working there is none. The image is printed on the transfer paper, and the tissue is then brought into contact with it. The print is formed by the chemical action of certain salts with which the transfer is coated. This solution is protected by letters patent, and will be shortly on the market. Any pure paper may be used, and is evenly coated with the sensitising solution, and dried in the dark. It will keep well for a month or six weeks if kept dry. It is placed under the negative in the ordinary way, and the image is clearly and distinctly visible of a brown colour, and printing is stopped when faint detail in the high lights is visible. The image is much more distinct than it is in platinotype. The print is then well washed, and in this state can be put aside for an unlimited time, and subsequent operations conducted at leisure. A piece of ordinary carbon tissue, insensitive, is now placed in an acetic solution of water 40oz., glacial acetic acid 30 minims, hydroquinone 30 grains, glycerine 1 drachm, and allowed to remain about a minute. The print is now plunged under the surface of the solution, brought into contact with the carbon tissue, and quickly withdrawn. Squeeze the two surfaces together, and allow to dry. It is then developed as a carbon print, giving a correct image, while the ordinary single carbon transfer gives a reversed image. The subsequent print is in every respect equal to any carbon print, with the advantage of possessing greater softness of outline and perfect half-tones. The prints may be coloured instead of being pigmented with the carbon tissue by using a colourless salt of aniline, strongly acidulated with sulphuric acid, pleasing and brilliant colours obtained, and, with subsequent treatment by ammonia and other oxidising agents, different colours produced at will.

CASTING ALUMINIUM ALLOYS.

Several United States patents have recently been granted to Mr. William A. McAdams, Borough of Brooklyn, City of New York, for a method of casting aluminium alloys, the essential feature of which is the rapid removal of the heat from the molten mass after pouring. From the specification of a patent relating to the casting of aluminium alloys composed of aluminium, zinc, and copper, with or without a small percentage of nickel, in which the metal aluminium predominates, the following interesting information is taken:—Aluminium when melted cools slowly, so slowly that other metals which are present in molten state in the molten aluminium are permitted to segregate and form large crystals before the slowly-cooling aluminium checks to any considerable degree their segregation and crystallisation, thereby materially reducing the strength of the casting. Furthermore, the zinc and copper, because of their greater specific gravity, have a tendency to fall towards the bottom of the molten mass, and thus render the casting non-homogeneous.

The object of my present invention is to prevent such segregation, crystallisation, and stratification of the mixture during the process of the cooling, and thereby to add material strength to the casting.

In an alloy composed of 72 per cent. aluminium, 24 per cent. zinc, and 4 per cent. copper, or similar alloys in which the aluminium forms a greater part of the alloy, the hereinbefore described segregation, crystallisation, and stratification of the commingled metals will be liable to take place unless the molten mass is cooled so rapidly after pouring as to check the segregation and stratification before it can have proceeded to any great extent. By means of numerous experiments I have found that the cooling should take place rapidly within certain well-defined practical limits, and that the heat should be taken from the molten mass at as nearly a uniform rate as possible. This may be accomplished where the casting is thin or small by using a metal mould of sufficient thickness to quickly remove the heat from the casting, and when the casting is to be thick or large the mould may be surrounded by a cooling medium to assist it in removing the heat with the required speed and uniformity.

To carry out my process successfully, the heat should be removed from the casting as rapidly as at the rate of one-fifth of a calorie per second, and, on the other hand, it should not be removed more rapidly than at the rate of two calories per second, as when removed more rapidly than this rate the sudden chill is found to produce the same weak structure that is produced when the heat is removed at a rate less than one-fifth of a calorie per second. The best results are obtained by removing the heat at the rate of from one to one and one-tenth calories per second—a rate much more rapid than is common in the ordinary use of metallic moulds. I found that this treatment of aluminium alloys, in which the aluminium forms the greater part of the alloy, will increase the strength of the casting from 80 to 100 per cent.

I have found by careful experiment that a bar composed of aluminium, zinc, and copper, combined in substantially the proportions hereinabove mentioned—viz., 72 per cent. aluminium, 24 per cent. zinc, and 4 per cent. copper—·968sq.in. area in cross section, cast by the process hereinabove set forth, supported upon inverted V edges 12in. apart and with the weight applied by a V edge midway of its point of support, showed a transverse stress of 32,000lb., with a deflection of ·21in. under a load of 3,200lb., the same bar showing a tensile strength of 39,000lb. A 2in. length of the bar standing on end supported a load of 70,000lb. without visible deformation, and actually sustained 98,000lb. before breaking with a shearing crack. I have further found by careful experiment that a similar bar of metal, composed of the same material and in the same proportions, cast in the ordinary manner, and allowed to cool at a rate not greater than one-fifth of a calorie per second, showed a transverse stress, under the same conditions as before, of only 2,050lb., a deflection of ·13in. under a load of 1,900lb., and a tensile strength of 22,000lb.

Can Ants Hear?—Whether ants can hear is a question which has for some time been engaging the attention of Mr. Weld, of the Iowa University, who has published an account of some of his experiments, and the conclusions he draws from the same in *Science* of Nov. 24. He states that for many years it has been the accepted opinion amongst naturalists that these insects are not endowed with an acoustic sense, at least within the range of sounds perceptible to the human ear. This opinion is based upon the failure of experiments to show that even the loudest and shrillest noises produce the slightest effects on ants subjected to their influence. This, however, is not the result of Mr. Weld's experiments upon several American species of these insects. In one case an ant confined in a test-tube was brought near a milled disc rotating in the air. At each sound from this apparatus the ant showed unmistakable signs of agitation, quickly moving its head and antennæ. Again, when shrill sounds were produced close to a colony protected under glass, the ants instantly showed by their rapid movements signs of excitement and alarm. This leads the experimenter to conclude that at least some (and possibly only American) species of ants are capable of perceiving vibrations, conducted though the air or other media, which are audible as sound to the human ear. He is, however, careful to add that this does not necessarily demonstrate that they hear in the strict sense of the word, but merely that they are capable of perceiving ordinary sound vibrations.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE monthly meeting of this society was held on Wednesday evening, the 20th inst., at the Institution of Civil Engineers, Mr. F. C. Bayard, LL.M., President, in the chair.

Mr. Baldwin Latham, M.Inst.C.E., read a paper on "The Climatic Conditions Necessary for the Propagation and Spread of Plague." The bubonic plague is primarily due to a specific organism or microbe of infinitesimal size—so small that probably 250 millions of them would be required to cover a square inch of surface. Plague is infectious and contagious, and is greatly influenced by pestilential emanations from polluted and waterlogged soils. The author gives accounts of various outbreaks of plague in this and other countries, including the Great Plague of London in 1665, when 7,165 deaths were recorded in one week in September. Plague is undoubtedly a disease of the poor, and attacks most readily those living on a low diet. The conditions which are conducive to the spread of plague are identical with those which give rise to the escape of malaria from the ground. That the ground itself exercises an enormous influence upon plague is shown by the fact that in all the epidemics, persons living on the ground floors suffer to a much greater extent than those who live in the higher stories of the houses. Mr. Latham says that there cannot be a doubt that the conditions which ordinarily produce evaporation from water or land surfaces are identical with those which produce exhalations from the ground; and these exhalations consist largely of vapour of water carrying matters injurious to health with them. Mr. Latham has discussed the meteorological observations (including the temperature of the soil at the depth of 9in., 20in., 60in., and 132in.) made at the Colaba Observatory, Bombay, and has compared them with the number of deaths from plague during the recent epidemics in Bombay. He says that if the temperature of the air increases beyond the temperatures of the ground so that its dew-point is above the temperature of the ground, condensation takes place instead of evaporation. To this increased high temperature may be due the sudden stoppage of plague after a certain high temperature has been reached, which, by raising the temperature of the dew-point, stops all exhalation from the ground, and may cause condensation to take place instead of evaporation. So, also, a sudden fall of temperature causes plague to arise; for a fall of temperature means that the temperature of the dew-point must fall, and the tensional difference between a low dew-point and a high-ground temperature would at once lead to exhalations escaping in large quantities from the ground, and so lead to the liberation of the plague bacillus from the ground, accompanied with the exhalations necessary for its development.

Dr. R. H. Scott, F.R S., communicated a note on a remarkable dust haze which was experienced at Teneriffe, Canary Islands, on February 16 to 19, 1898. The haze during the period was exceptionally dense—so much so that a steamer was two days and three nights on a voyage from Teneriffe to Las Palmas, a distance she usually covered in five hours; while the *Tintagel Castle*, of the Donald Currie Line, was delayed for thirty hours, and the *Roslin Castle*, homeward bound, had the dust so thick that for 900 miles the sun and stars were obscured, and the ship was delayed two days.

THE total quantity of iron ore raised last year was 70,000,000 tons, which would give 36,507,500 tons of pig iron. This quantity of iron, it is estimated, would form a belt round the earth at the equator 2ft. wide and 7½in. thick.

AN American firm claims to have made the largest glow-lamp. It is of 5,000c.p., and has been constructed for use in a lighthouse. The lamp is of the two-filament type, the filaments being in parallel and taking 236 volts; the power taken is about 3 watts candle-power, the total power being therefore about 15 kilowatts.

Most Powerful Locomotive. — The most powerful locomotive in the world is in America, and has, it is stated, a total weight of 232,000lb., or about 103 tons. The total wheelbase of the engine is 26ft. 6in., of which 15ft. 9in. is the driving wheelbase. The total wheelbase of engine and tender is 55ft. 2½in., and the total length over engine and tender 65ft. 7¾in. The centre of the boiler is 9ft. 8in. above the rails. The height of the funnel above the rails is 15ft. 5in. This engine was built at the Brooks Locomotive Works, in America, and will run on the Cairo Division of the Illinois Central Railroad between Carbondale and Fulton. The steam pressure is 210lb. per square inch, and is generated by 3,500sq.ft. of heating surface. The steam is used in two cylinders, each 23in. in diam. by 30in. stroke. The cylinders drive four coupled axles, on which are wheels 57in. in diam. The tender has a capacity of 7,000gal. of water and 12 tons of coal.

SCIENTIFIC NEWS.

BY means of a radiometer devised by Mr. E. F. Nichols, of Dartmouth College, the heat radiation of the stars has been tested at Yerkes Observatory. The radiometer consists of two discs of mica, each of 2mm. diameter, blackened on the face, and supported by a light cross arm on each side of a thin glass-stuff staff hung by a fine quartz thread in partial vacuum. The rays of light reach the radiometer through a window "glazed" with fluorite, and collected by a silvered-glass mirror of 24in. aperture.

It is stated that the University of France has, by special decree, recently been authorised to accept a magnificent gift from M. Raphael Bischoffsheim, the well-known member of the Institute and Deputy, who has presented it with the freehold of the Nice Observatory. M. Bischoffsheim founded this observatory many years ago, and in giving it to the University he includes the adjoining land near Mont Gros, the whole of its contents, which comprise instruments of great value, and a library of over six thousand volumes, together with the branch observatories at Mont Moumer and Mont Macaron. In addition, the donor has handed over a sum of two and a half millions of francs, the interest of which is to be devoted to the maintenance of the observatory after his death. The *Figaro* estimates the total value of this handsome gift at five millions of francs.

The *Journal* of the British Astronomical Society (Dec. 19) contains several reports of branches, the report on the meteoric section, several interesting papers, some correspondence, and, besides the usual notes, a biographical notice, with portrait, of a distinguished ex-president, Nathaniel E. Green, F.R.A.S. The report of the section for the observation of Jupiter has also been issued in the *Memoirs*.

With reference to the small planet discovered by Mr. Coddington, of the Lick Observatory, mentioned on p. 404, Herr Kreutz, of Kiel, thinks there is no doubt that it is identical with one discovered by Dr. Palisa in 1896. The ephemeris is given as R.A. Jan. 1, 1900, 1h. 10m., S. Dec. 3° 1·5'.

The *Astronomische Nachrichten* will, with the beginning of the new year, be confined to the recording of general observations, and a separate paper (presumably a sort of supplement) will be issued giving the ephemerides of comets, planets, &c. The address of the office for publication is Niemannsweg 103, Kiel.

The parallax of the sun is, according to M. Bouquet de la Grye, 8·80" ± ·01. The calculations from the photographic measures of the transit of Venus are not completed, but the figures given are probably as near the actual result as the revision will work out.

A "note" that may be useful appears in a memoir presented to the Paris Academy of Sciences by M. Janssen on the work done on Mont Blanc during 1899. It is found in the statement that naked galvanised iron wires were quite serviceable for telegraphic purposes between the observatory and distances up to 1,700 mètres, the wire lying uncovered on the glacier ice without making "earth" in the telegraphist's sense.

The total amount subscribed for a statue to Lavoisier is stated to be 98,000 francs (£3,920), and M. Barrias has been instructed to execute the statue and the bas-reliefs for the pedestal. The site granted for the statue is an open space behind the Madeleine, and an opportunity will be taken to unveil the statue probably in July—at all events while the Exhibition is open.

It is announced from Hobart, Tasmania, that Mr. James Backhouse Walker, F.R.G.S., died there last month at the age of fifty-eight. He was the eldest son of George Washington Walker, who, in conjunction with James Backhouse, between the years 1831 and 1840, carried out the well-known Friends' Mission to Australia, which had no small influence in reforming our convict system. Mr. Walker was widely known for his keen interest in all public work tending to promote the well-being of the colony, although he took no part in political life. As Vice-Principal of the University of Tasmania, he had an active share in advancing higher education, and he devoted much time to philanthropic objects, and especially to promoting the welfare of the working-classes by means of schools, clubs, and other societies. For many years his house was a literary and intellectual centre for visitors to Tasmania.

Before the Departmental Committee on Preservatives and Colouring Matters in Food, Mr. T. Bond, consulting surgeon to Westminster Hospital, states that he had given boracic acid, which was largely used for preservative purposes, internally, for many years, in doses of ten grains, chiefly in bladder diseases, as an antiseptic, and had never found any ill-effects, even following its administration for many weeks. His usual dose was ten grains three times a day. It did not seem dangerous to him that a drug prescribed by a doctor should be liable to be taken by the patient from other sources in uncertain quantities. Even in the case of children he did not think there would be any risk. Asked whether the public would be justified in insisting that the presence of that drug should be notified in all articles preserved by it, he said, I think that would be a proper thing to do. At the same time, I believe it to be an absolutely innocuous preservative. If a child of one or two years of age took 15 or perhaps 20 grains a day—a quantity it might get in four pints of milk—that would be more than he would like to give the child, but he knew of no harm that would result. Asked if he would advocate that if preservatives are used the nature and amount should be stated, he said, I think that would be an excellent thing to do. With regard to salicylic acid, he had given it in the same doses as boracic acid and had never seen the slightest ill-effects from it. If used as a preservative, its presence and quantity should be stated. Two grains in a pound of jam—sufficient to preserve it—would do less harm than the pound of jam. Ten grains each in a quart-bottle of wine, cider, or beer would be safe; and if a man drank a bottle of each the 30 grains of salicylic acid would do him less harm than the alcohol. He was distinctly of opinion that the presence and quantity of preservatives, generally, should be stated.

The committee on colouring matters in food and preservatives appear to be receiving some remarkable evidence. Prof. A. Wynter Blyth said that the so-called tar colours were used nowadays, but he is reported as stating that none of the aniline dyes would be injurious to health if used in the usual quantities. The question as to whether the copper used with "green" peas is injurious has been the subject of examination for many experts, but it appears that they do not condemn it—though it seems absurd to use a chemical to colour a vegetable, merely for the sake of pleasing the eye. Borax, boracic acid, salicylic acid, &c., have been under review; but whether harmless or not there is a general opinion that articles treated by any of them should be "labelled."

The Manchester Literary and Philosophical Society have awarded the Wilde Medal for 1900 to Lord Rayleigh for his work in connection with experimental and mathematical physics and chemistry, and Lord Rayleigh will deliver the Wilde Lecture in February. The Dalton Medal is awarded to Sir H. E. Roscoe, and the Wilde Premium to Prof. A. W. Flux for the papers on economic questions presented to the society.

It is announced that Prof. Freeman, of the Armour Institute, Chicago, has been experimenting on the continuous production of calcium carbide. He uses a powder composed of 6 parts lime to 4 parts coke, and feeds the powder through a hollow carbon electrode into the electric furnace, with the result that a continuous supply of "molten carbide" is obtained. It has not yet been determined whether the process can be worked commercially with economy, the object, of course, being the production of acetylene at a low cost.

At a meeting of the Royal Photographic Society, Capt. W. de W. Abney, C.B., R.E., F.R.S., read a paper on a "Sensitometer for Three-Colour Work," which consists of a disc with arcs of suitable colours, the bands being so proportioned that when the disc was rotated the luminosity of each coloured arc would be the same; to take a photograph of such a rotating disc it would be necessary to use a screen which would cut off such quantities of light from each sector as would make the densities of each ring the same. If one colour was too dense when a certain screen was used, the experimentalist must remember that its complementary colour must be added, or possibly a mixture of two complementary colours

where the rings were each of varying density. The luminosity of the colours of the several sectors, taken in the electric arc light, were given as follows:—White 120, yellow 70, red 45, green 32, blue 16 8, violet 12·2, black 2. Photographs were shown of the rotating parti-coloured disc, taken on Cadett's spectrum plate and with the Cadett screen, the densities of the different colour bands being identical. The application of the method to the production of the negatives for three-colour work was very fully dealt with, tables and diagrams being given for the facilitation of the production of the necessary screens; the details are of such a nature that they cannot possibly be condensed into summary form, but they will, in due course, be published in the Society's journal.

The largest express engines ever built are, it is said, now in use on the Lake Shore and Michigan Southern Railway. They are capable of hauling trains of 500 tons, exclusive of engine and tender weight, at speeds of over 50 miles per hour. The engines are six-coupled, with a four-wheel bogie, and have cylinders 22in. by 28in., and driving-wheels of 6ft. 8in. diameter. It is stated that one of these engines, with a total load of 580 tons (English), in spite of a heavy side wind, made the run of 183 miles from Buffalo to Cleveland in 3h. 26m., of which 16m. were occupied by stops for water at three intermediate stations. That gives a speed of 58 miles per hour for the entire run, while seven miles were made at 83¾ miles per hour, and 41 miles at 65 miles per hour. The train consisted of two sleeping-cars, five post-office cars—on six-wheeled bogies—and two ordinary coaches.

The "feeders" (that is, cables for conducting electricity) to the new North-Western Electric Elevated Railroad in Chicago are to be of aluminium, which is said to be cheaper than copper, although the conductivity is less. Weight for weight, however, the aluminium is stated to convey more current, and aluminium cables are coming into extensive use in America. The question of economy depends mainly on the durability of the aluminium as compared with copper.

The following statement requires some little corroboration before it can be accepted as truth:—"An interesting curiosity in ethnology has been reported to the United States War Office. Some Creek Indians (American), employed among the troops in the Philippines, discovered a tribe of Malays in the southern part of the island—negroes—whose dialect was identical with their own. The Creek Indians were able to act as interpreters without any difficulty." If true, the fact will then be most interesting and worth much investigation.

An illuminated address, his portrait, and a sum of money were presented last week to Prof. T. Wiltshire, who has been for many years the secretary of the Ray and the Palæontographical Societies. Sir J. Lubbock made the presentation in the rooms of the Geological Society.

The Berlin Academy of Sciences will celebrate its 200th anniversary of its foundation on March 19—20, 1900.

THE Norddeutscher Lloyd steamship *Kaiser Wilhelm der Grosse*, the fastest liner in the world, has again broken her own record, having made the run from Cherbourg to Sandy Hook in five days sixteen hours.

THE total length of the railways in the colony of Queensland in June last was 2,745 miles, an increase of 110 miles during the past year. The train mileage has increased in the same period from 5,007,370 to 5,822,230.

THE metal used in the casting of bells is an alloy of copper, in the proportion of four parts of copper to one of tin. The copper is first melted and the tin added just before pouring. One of the secrets in bell-founding is to have the molten alloy heated to the critical point exactly.

THE new shops of the Erie Railroad Company in Jersey City are driven by gas-engines using producer gas. The producers are of the Taylor pattern, using rice coal—the smallest and cheapest size of anthracite—and the plant is a simple and compact one, taking up much less space, and requiring far less labour and attention, than would steam boilers furnishing the same power. The working of the plant thus far has been entirely satisfactory, and the records show a consumption of only 1·1lb. of the rice coal per horse-power hour, while the average duty of the engines is equal to 22 per cent. of the theoretical efficiency of the fuel consumed.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

MARK IX. 50—THE FIFTH SATELLITE OF JUPITER—THE TWENTIETH CENTURY—CELESTIAL LATITUDE AND LONGITUDE—THE HARVARD COLLEGE PHOTOGRAPHIC TELESCOPE—THE MOON AND THE WEATHER—THE JEWISH CALENDAR—CEMENTING AN OBJECT-GLASS—δ, ϵ, AND ζ ORIONIS, AND WORKS ON THE STARS—THE PERIODICITY OF SUNSPOTS—TIME OF STAR TRANSITS—THE DELUGE—VIBRATION OF ETHER—STENCILS FOR SHADOWS—NAVIGATION—LUNAR VOLCANOES.

[43145.]—IT is a matter of common knowledge that the late Prof. Huxley was Dean of "the Royal College of Science" at South Kensington. Distinguished alike for his brilliant scientific attainments and for his fearless independence of character, it can scarcely fail to be a matter of interest to learn what his opinion was of those with whom he was associated in that charming little nest of rank jobbery, and this we are enabled to do from the utterance of the vice-president of the Committee of Council on Education at the dinner given to Sir John Donnelly on his retirement from the directorate. In proposing the health of the guest of the evening, Sir John Gorst, quoting from a letter from Sir E. Poynter, told how Huxley said: "To have a man like Donnelly in this place *keeps it sweet.*" What the scene of such barefaced and impudent self-advertising, jobbing, puffery, and log-rolling would have degenerated into without the restraining influence of the eminent man who has recently retired may be read between the lines of Prof. Huxley's dictum. Most happily for the nation, and for the dignity and purity of science generally, Sir John Donnelly is succeeded by as honourable and high-minded an English gentleman as himself. I mean, of course, Capt. Abney, who may be most thoroughly trusted not to connive at the low arts and wiles of some of those whom he has been appointed to supervise. But the whole thing is specially instructive as showing Huxley's opinion of (at all events, some of) his colleagues.

The *Astronomical Journal* for Nov. 13 (which I have only just seen) contains an elaborate series of measures of the fifth satellite of Jupiter made by Prof. E. E. Barnard with the 40in. refractor of the Yerkes Observatory. Among the most interesting results may be mentioned that it has been found that the motion of the line of apsides actually amounts to + 2·465° per diem, or something like 900° in a year, and that the period of revolution of the satellite = 11h. 57m. 22·647s., which Mr. Barnard alleges to be "doubtless correct to the $\frac{1}{100}$ part of a second." The distances of the satellite at the time of its greatest eastern elongation this year appear to have been—April 25th 48·34″, May 1st 48·29″, May 23rd 48·31″, and June 16th 48·03″, in each case at the assumed distance of Jupiter from the sun of 5·20. All the measures were made by viewing the planet through a plate of smoked mica, as otherwise irradiation must have seriously affected their accuracy, even if the brightness of the planet had not in addition rendered even the visibility of the satellite doubtful. Incidentally, Prof. Barnard compares the relative accuracy of measurements made with the filar micrometer and with the heliometer, expressing a very definite opinion in favour of the first form of instrument.

I was highly amused to see it announced in a morning paper, under the heading of "Berlin, Dec. 14," that "the Federal Council decided at its sitting to-day that the new century shall be reckoned from January 1, 1900." This, being interpreted, presumably means that the Berlin Federal Council will so reckon it; because, as regards the mere objective fact, it has as much, or as little power to decree that so fallacious a mode of reckoning shall operate as it has to prescribe that the planet Saturn shall revolve round the sun in 782 days 4h. 5m. 2·3064s., or that, for the future, the horns of the new moon shall point to the west. When will people realise that there never was a year 0? The year before our Lord's birth was 1 B.C., and the year of his birth 1 A.D. Until 1900 years (of which the first was 1 A.D.) are actually *completed*, we cannot possibly enter upon the 20th century.

Perhaps Mr. Lattey, the author of the article "Through a Small Telescope," on p. 394, will forgive me if I point out a misleading statement in (*a*) of his third paragraph, where he says, or is made to say, that celestial bodies are located "by their celestial latitude and longitude, termed in astronomy Right Ascension and Declination." Now, celestial latitude and longitude are the distance of a star not exceeding 90° from the *Ecliptic* north or south, and its distance measured *along* the same great circle from the First Point of Aries or Spring Equinox; while Right Ascension is its angular distance measured from the First Point of Aries eastward along the *Equator* (generally in time instead of in arc), and Declination is its distance (not exceeding 90°) north or south of the Equator. I mention this because a beginner finding in an astronomical work anything about Celestial Latitude and Longitude might well become hopelessly confused on reading the sentence which I have quoted above. What Mr. Lattey pretty obviously really meant to say was that Right Ascension and Declination in the Heavens were the equivalents of Longitude and Latitude *on the earth.*

We are certainly entitled to look for remarkable results from the very long-focussed photographic telescope of the Harvard College Observatory, to which reference is made in the first paragraph of your "Scientific News" on p. 404. Why, the image of the Sun in its primary focus will be upwards of 11in. in diameter.

To "A. B. M." (letter 43108, p. 405), who tells us that he will be glad to know what I have to say concerning Prof. Angot's "argument," I would simply reply that the entire extract which your correspondent gives seems to me strongly suggestive of the first two lines of the late Mr. Lear's well-known poem in "The Book of Nonsense":

"There was an old man of the Hague,
Whose ideas were uncommonly vague."

At the same time I am entirely in accord with the learned Frenchman in his expression of belief that "these studies are still too recent and too little developed to have already given results which may be considered sufficiently conclusive and general." *If* the position of the moon in declination has a definite effect on the general distribution of pressure on the surface of the globe, then (approximately) similar weather ought to occur every time she has, let us say, 22° of South Declination. But has the very cleverest of the statistic-dodgers and smoothed-curve manipulators ever yet succeeded in showing anything approaching to a weather-cycle?

And this brings me to letter 43109, on p. 406; in connection with which it is only necessary to remark that, if the *tidal* effect of the moon influences the weather, then ought there to be a semi-diurnal change in it everywhere. Is there?

In reply to "Student" (query 97237, p. 411), the ordinary Jewish year consists of 12 (approximately) lunar months, Nizan 30 days, Yar 29 days, Sivan 30 days, Thamuz 29 days, Ab 30 days, Elul 29 or 30 days, Tisri 30 days, Hesvan 29 or 30 days, Kislev 29 or 30 days, Tebet 29 days, Sebat 30 days, Adar 29 days; and in the so-called "embolismic" years, an intercalary month Veadar 29 days. It will be seen that, at the maximum, these regular months only amounted to 354 days, and the intercalary one Veadar was added on the 3rd, 6th, 8th, 11th, 14th, 17th, and 19th years of the Metonic cycle, so as to cause the coincidence of the festival of the Passover (which commenced on the 15th of Nizan) with the season when barley was ripe, because a sheaf of barley had to be offered with the Paschal lamb. Hence my querist will see that the connection of the actual lunar phase with the beginning of any month was of the most remote character. Proceeding to his next question, it would, of course, be possible by the aid of a most operose calculation to compute the day and hour of the New Moon on the 1st Nizan, A.D. 31. But Cui bono? It is very doubtful, indeed, if we know anything with the smallest approach to accuracy of the dates of Our Lord's birth and execution. Good Friday and Christmas Day are absolutely arbitrarily fixed, and there is not the smallest reason to suppose that they are in any legitimate sense anniversaries. As far as *historical* accuracy is concerned, the second Gospel is, I should think, immeasurably superior to the fourth. The first was probably expanded from it, and the third is admittedly a mere compilation from hearsay.

What in the world does "South Africa" (query 97252, p. 411) want to cement the lenses of his object-glass together if it defines properly with them uncemented? If they are properly adapted for the correction of spherical and chromatic aberration, the introduction of a medium of different refractive power between them might well derange their adjustment. It does, though, look a little as if your correspondent had had an inferior objective substituted for the original one.

The three stars to which "Orion" refers in query 97265 on p. 411, are, beginning with the left-hand one, ζ, ε, and δ Orionis. Now taking them in their order of Right Ascension, δ Orionis is situated in R A. 5h. 26m. 56s. and Declination 0° 22′ 26″ South; ε Orionis in R A. 5h. 31m. 11s. and Declination 1° 16′ 0″ South; and ζ Orionis in 5h. 35m. 43s. of Right Ascension and 1° 59′ 43″ South Declination. My querist does not say for what purpose he needs a book on the stars. If he wishes to obtain a good naked-eye acquaintance with the stars, Klein's Star Atlas, published by the S P.C.K., will be found useful, or if he wants a list of objects suitable and interesting for observation with the telescope, and can pick up a copy of Clark and Sadler's "Star Guide," published some years ago by Macmillan, he will find it very useful. I fancy that Proctor wrote a little book, too, called "Half Hours with the Stars," or some such title, but I have never seen it.

The query propounded by "W. A." (in letter 43121) on p. 425: "What has the above theory to say upon the subject?" strongly reminds me of the Frenchman, who, on being told that the facts were utterly against his hypothesis, retorted: "Tant pis pour les faits!"

In reply to the concluding paragraph of letter 43127, on p. 426, "E. P." must see that when it is 10h. 2m. 10s. p.m. at Maidstone, if we assume Maidstone to be 2m. 10s. East of Greenwich, it can only be 10 p.m. at the latter station, because the earth will have that piece more to turn on her axis ere the Greenwich Meridian comes under the star which is *on* that of Maidstone at the supposed instant. My querist is therefore perfectly right in his assumption that if Sirius souths at Maidstone on a given night at 10h. 2m. 10s. p.m., by a clock showing accurate *Greenwich Mean Time*, then, at that instant, the time *at Greenwich* is, as he supposes, precisely 10 p.m.

Mr. Monck (letter 43128, p. 426) is quite right in his assumption that Chambers was my authority for the conjunction of the four planets. I do not possess Mr. Williams's book. It is hardly necessary to add that I have not made the slight st attempt to check the calculations. I am very much too busy a man for that. Whether the conjunction happened B C. 2446, 2449, or 2441 is quite immaterial to my argument, which was simply that if Ussher is to be accepted as an authority the observation must ante-date the Deluge in B.C. 2349. Mr. Garbett cannot be allowed to dodge about and pick and choose among Ussher's dates, accepting them when they appear to support his crazes, and rejecting them when they oppose them.

The idea of Mr. Schucht propounded in letter 43139, on p. 428, rests upon the assumption that the ether is *matter*—which, in any sense that we can conceive, it most certainly is *not*.

I really could not help smiling when I read in letter 43144, p. 429, that Mr. Bywater's family had "kept secret" what used to be a most familiar thing among schoolboys. Why sheets of these "shadows," as they were then called, used to be purchasable at the shops where toy stages and plays were sold, thirty or forty years ago, and, for aught I know, much more recently still. Some of them were almost works of art, and demanded a considerable amount of care in cutting out. If I knew where to lay hands upon them, I am fairly sure that I still possess, somewhere, a number of them. Certainly I have, or had, one of the head of Our Lord much finer and more artistic than that of which your correspondent gives a facsimile.

M. Richards (query 97293. p. 432) will find Stebbing's "Navigation and Nautical Astronomy," published by Macmillan and Co., very good indeed. It contains, at least, one worked-out example of every rule given, and very often several.

In answer to query 97297 (p. 432), there can be no reasonable doubt that Sir William Herschel was mistaken in his assumption that the three bright points he observed on the dark part of the moon were active volcanos. Such lights may often be seen, and are referable to mountain peaks whose unusual power of reflection renders them perceptible by earthshine. "Dalphinus" may thus see Aristarchus for himself with the greatest ease, when the *lumière cendrée* renders the whole of the unenlightened part of the lunar disc visible soon after New Moon. A small telescope will exhibit this perfectly.

A Fellow of the Royal Astronomical Society.

THE PARTIAL LUNAR ECLIPSE OF DECEMBER 16, 1899.

[43146.]—THE day itself gave little promise of a fine evening, generally overcast conditions prevailing, and although there was a brief space between six and seven o'clock, when the moon shone brilliantly, as the night wore on thick clouds gathered most ominously, and by ten o'clock there was not the slightest probability of being able even to glimpse the eclipse. At 10.30 it was obvious that no observation could be attempted of the first contact with the penumbra, for the moon's place in the skies could not be identified by the eye, and at eleven o'clock several friends who had meant to watch the earlier stages at least, retired from the scene. Past experiences have taught me, however, never to abandon hope, and to be prepared, under even unfavourable conditions for observation. At 11.15 hope revived, for the moon showed itself through the clouds, and by 11.30 it was fairly well seen. There was then a perceptible darkening of the north-east limb, and at 11.40 it seemed to the naked eye as if the actual contact with the shadow had taken place. For my own part I found it quite impossible to note the exact moment of contact, even in the telescope, owing to the diffuse character of the edge of the shadow; but I would certainly say that it was on the limb at 11·45.

I had provided myself, as last year, with about a dozen outline maps of our satellite, and on these, which were placed by my side under the light of a bull's-eye lantern, I marked from time to time the progress of the eclipse, and jotted down the more striking features. The following are the notes I made:—

11h. 48m. Shadow very diffuse, and dirty-looking.

11h. 49m. Shadow's edge centrally through Grimaldi and on the west side of Aristarchus.

12h. 0m. Edge of shadow skirting east side of Copernicus, and slightly to the west of Sinus Iridum.

12h. 5m. Eclipsed portion almost entirely blotted out; no features discernible.

12h. 11m. Clouds thinning considerably; sky clear towards the north; eclipsed portion decidedly brightening.

12h. 14m. Edge of shadow a little north of Schickard, passing along the east side of the Mare Serenitatis, and just touching the east of Aristoteles.

12h. 20m. Edge of shadow bisecting Schickard and crossing the Mare Serenitatis.

12h. 23m. Edge of shadow west of Ptolemaus and west of Posidonius.

12h. 34m. Edge of shadow touching the north-east of Tycho, and bisecting Mare Tranquillitatis.

12h. 38m. Shadow passing off Tycho, and skirting the north-east of Mare Crisium.

12h. 40m. North and north-east of moon becoming very coppery coloured.

12h. 45m. Details beneath the shadow coming out distinctly. The principal *maria* and craters quite easy. Moon almost a bright red to naked eye.

12h. 49m. A most beautiful sight. Tycho and the ray system unmistakably seen beneath the shadow.

12h. 55m. Sky clear all round, and stars—even very small ones—coming out with marked distinctness. Aristarchus, now a conspicuously bright spot on eclipsed portion, and all lunar details striking.

12h. 59·5m. Small star occulted at about 25° from north point (rough estimate only).

13h. 0m. Haze gathering round the moon blotting out all stars Coppery colour now much less marked; what trace there is, is on north-west side.

13h. 30m. Moon now almost a deep red, brightening generally east of south.

13h. 35m. Thick haze coming suddenly up from the sea, obscuring stars and giving the moon a dull and uninteresting appearance. This lasted over twenty minutes.

14h. 0m. Beginning once more to clear.

14h. 3m. End of shadow a little to the north of Tycho, and touching south side of Grimaldi.

14h. 5m. Details beneath shadow again very distinct.

14h. 20m. North-west limb a decided copper-colour once more, though duller than before.

14h. 24m. End of shadow across Copernicus, and to the west of Aristarchus.

14h. 35m. End of shadow cutting across the centre of Apennines, and touching the promontory Heraclides on the south-east side of Sinus Iridum.

14h. 44m. End of shadow bisecting both Mare Serenitatis and Plato.

15h. 0m. Edge of shadow again very diffuse. Difficult to note the moment of last contact. It occurred, as nearly as could be made out, at 15h. 8m. The penumbra was distinctly seen for some few minutes after this, when, in view of Sunday duty, I closed the Observatory and retired, well pleased with my continuous watch from 11h. 30m.

One or two general remarks may not be out of place before I conclude this report. The somewhat varying conditions made it quite impossible to note with any accuracy the exact times of disappearance and reappearance of stars.

The slightest cloud or haze caused the moon's disc to become a dirty dark grey; but during such periods as were marked by a perfectly clear sky, the resemblance of the eclipsed moon to that of December 27, 1898, was very remarkable. As a mere spectacle the effect was best when viewed through a good binocular, but the detail in the telescope was very striking. I must once more call attention to the ray systems, especially that radiating from Tycho. It is generally said that these are seen only under high illumination. But this is not so. I have more than once reported in the "E. M." that these have been observed on the dark moon when seen by earthshine; and last year's eclipse revealed these systems during the whole time of totality. This year, as the above notes show, they were again seen whenever the sky was clear of cloud or haze, through the earth's shadow. They are not, therefore, by any means dependent on any high degree of illumination.

May I also use these notes to point a moral? Never retire from the scene because conditions look unpromising. No appearances could have been more disheartening than those of the evening of the 16th inst., yet the eclipse was, on the whole, very nicely seen, and the pleasure to the writer all the greater that his zeal had not been easily quenched.

The next day I was stopped in the road by a kindly-disposed police-sergeant, who said:—"Oh, sir, you should have been out on the promenade last night, or rather this morning about half-past one: *there was a total eclipse on.*" From the tone of voice and look of triumph it was clear that this vigilant officer of the law had congratulated himself on having seen what, to the astronomers, would be a great surprise when it was duly reported. I was, of course, obliged to reply that I had watched the same eclipse through from my observatory in the garden. There was a long-drawn "Oh!" as the constable quietly walked away, as if he had said: "Well, I thought I had caught them napping this time!"

Instrument used, a 5in. Wray equatorial refractor, with a power of 60; also an excellent binocular.

Robert Killip.

St. Anne's-on-the-Sea, Lancashire,
December 20.

THE PERIODICITY OF SUNSPOTS—THE MINIMUM OF 1878.

[43147.]—I SHALL be glad to supplement my last week's letter by the following few remarks upon the above minimum: I possess a score of *Nautical Almanacs*, but they do not form a consecutive series. Upon looking through the list of six sunspot minima previously observed, I find that the only one which my almanacs cover is that of 1878·5, or July 1 of that year. The exact date is given upon the authority of Proctor. But in *Nature* of May 26, 1898, it is stated by Mr. Ellis (late of the Greenwich Observatory) that the date is 1879·0, or Jan. 1, 1879. Here, then, is a difference of six months in the date as given by two competent authorities. Which of them was right? Were they both right, or only one of them, or neither? What says the theory on the subject? An examination of the *Nautical Almanac* for that year shows that Aug. 12 to Sept. 19 all the six planets nearest the sun were on the descending or down side of their orbits. Between Sept. 25 and Nov. 8 Mercury was on the up side of its orbit. Between Nov. 8 and Dec. 22 all these planets were on the down side, with the exception of Venus, whose orbit is so nearly circular. The theory consequently indicates that there would be a double minimum, the first part between Aug. 12 and Sept. 25, and the second part between Nov. 8 and Dec. 22.

Is it too much to hope that some reader of the "E. M." who has access to sunspot records will take the trouble to compare them with the above?

May I venture to hope that some one who has access to a complete set of *Nautical Almanacs* will examine the position of the planets at the times of the other five recorded minima and report.

Ryvecton, Dec. 22. **W. A.**

THE MOON AND THE WEATHER.

[43148.]—THAT the moon has no appreciable influence on the weather I firmly believe; but still, since the moon produces tides in the ocean, I see no reason why it should not produce tides in the atmosphere also, and so cause general displacements of the air. But we fail to observe corresponding changes in the weather which might result from these displacements; yet there is a meteorological fact that clouds under the full moon tend to disperse, and I think this may be produced by the reflection to the earth of some of the tremendous heat received by the moon from the sun. Moreover, we find that there is a slight preponderance of rain at or near the time of new moon than at the full moon, which would be a natural consequence of a less cloudy sky at the time of full moon. But we have no real evidence, in the present state of our knowledge, of any other influence than this. To the person who says that the moon has no influence on the weather because it is local, I would reply that the moon then has no influence on the ocean tides, because they are local. I have heard of a belief among some useful people that the moon accelerates the circulation of the sap in trees. This may appear reasonable to some people; but when formerly it was supposed that the moon favoured animal putrefaction, and then it was discovered that it was due to moisture, which was always produced on a clear moonlight night—not through any influence of the moon, but owing to a cloudless night, and consequent formation of moisture, then we can have doubt of any

other influence of the moon. There certainly is one *great* influence the moon has, and that is over some people's brains. Why do not such influential people try some other cosmical body—the sun, for instance? We have heard such a lot of funny things lately in the "E. M.," such as watery comets and Leonids destroying Sodom and Gomorrah, and meteors made of salt, that we may now expect to hear that Mars is made of roast beef or turkey, or perhaps plum-pudding; and that the sun is made of whisky, and that the spots in the sun are blackbeetles. Such absurdities in astronomy only set the science up to ridicule, and lower it in the estimation of the laity.

N. M. Munro.

CUTTING-OFF ON A MILLING MACHINE.

[43149.]—Here is a method of doing on a milling machine in a better way certain work that is generally considered screw-machine work, and it is said to be far more economical for cutting studs and pins to a uniform length and square on the ends. The following remarks are by Mr. H. E Harris, and appeared in the *American Machinist;* but I thought they might be useful to your readers, so I send them over at first opportunity. Mr. Harris points out that the screw machine will cut the pins off all right with time; but if the stock varies a little in size and comes small the split chuck has to close up more, and that causes a longer piece to be cut. This trouble, he says, has been obviated in some later designs of chucks. Then our tool has to be ground and set, also causing error, and unless we use two tools there is bound to be a little neck or burr on one end of the piece.

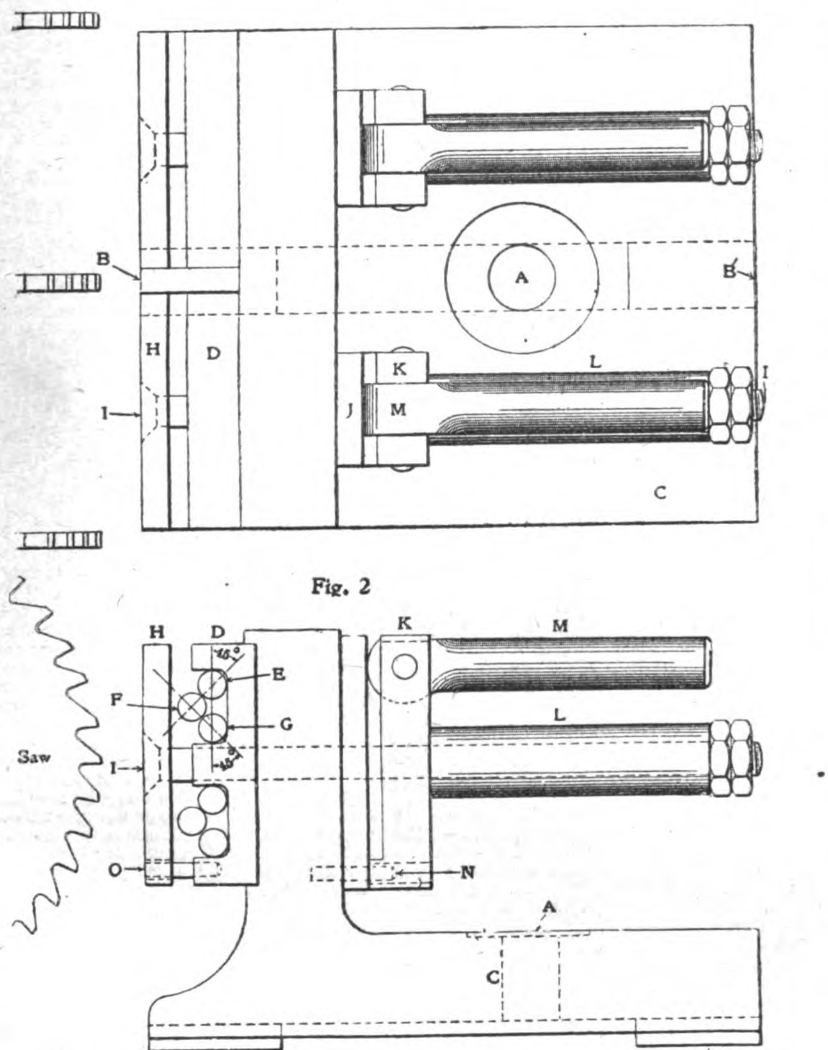


Fig. 2

The arrangement here shown is a gem of its kind, and gives real satisfaction. Our cutters are put on the milling arbor and set to cut the exact length by means of the adjustable collars shown at Fig. 1. The bushing A screws into the bushing B. Both are hardened and ground together, true as to bore and bearing faces. The adjustment is readily made by screwing them together or apart by means of the knurl, or pins inserted in the holes shown at C.

Our fixture (Fig. 2) is clamped to the milling machine table by means of bolts passing through the hole A, and is held in alignment by means of the screwed-on lugs B, B', which fit the slot in the table. The body or angle-piece C is machined only on the face to receive the holder D, and on the bottom. The holder slots are so designed that the line of centres of the touching-rods E, F, and G to

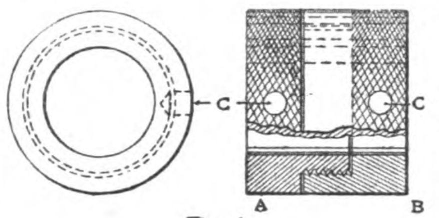


Fig. 1

be clamped and cut off shall set at an angle of 45°. If smaller stock is used, five rods can be set in a slot instead of three; and if shorter pieces are required, more cutters may be used and more pieces cut at a time. Any variation in the size of the stock will be compensated for by the shape of the stock itself, and also by the clamp H, which is held loosely by the head of the clamping-screw I, and is kept from turning by the pin O.

The holder D is screwed to the angle-piece, and is drilled through the centre to let the clamping-screw I pass through. This screw is put through the holder, the angle-piece, the piece J and loosely through the lever K, which should be rounded slightly at the fulcrum end, and the tube L, against which the nuts on its ends bear. These nuts give the adjustment for the proper action of the cam on the end of the cam-lever M. The reason for leaving the tube L long is that it may serve as a grip for the workman to get his fingers around and aid him in bringing down the lever M. The pin N is simply to keep the levers and the piece J from turning around on I. J is used to provide a hard, smooth surface for the fulcrum end of K and the cam to bear against.

We raise our lever M, and that throws the clamp H back. The stock, in rods of convenient length, is inserted from the side, and the lever is then brought down, clamping them securely in place. It then takes but a short motion of the milling-machine table to cut off from six to fifty pieces (varying inversely with the size and length of stock) almost simultaneously. The stock is moved along each time enough to let the cutter nearest the spindle bearing cut off a short piece, and thus prevent any deflection of the cutter or saw.

If the job calls for a tapped hole in one or both ends of the piece, we can afterwards drill them, ten at a clip, in a jig in a multiple-spindle press. The tapping can be then quickly done in a hand-screw machine or a specially-arranged tapping-machine. The materials in the construction of the jig are as follows:—C is of cast iron; B, B' and L of machine steel; K of case-hardened machine steel; D, H and J of hardened tool steel; M of tool steel hardened at the cam end, and I of tool steel.

It seems to me to be a valuable arrangement, so I send it on.

Sterling, Ill. J. B.

PRESERVING BRASSWORK FROM CORROSION.

[43150.]—The paragraph with this heading on page 433 reminds me of an idea which occurred to me some years ago when reading a paper on Pigments published by the Society of Arts.

The lecturer had found that in the majority of cases the varnish used for pictures was not absolutely damp-proof, but that in old pictures in which the colours were still bright, the varnish *was* damp-proof. He concluded that damp was the cause of faded pictures, and set to work to find which varnish answered the purpose of excluding it. He found—if I recollect rightly—there was no such varnish on the market; all allowed damp to get through minute holes or pores in the dry varnish! He experimented by dehydrating some sulphate of copper so as to get rid of the blue colour, and then mixing it with the varnish to be tested. A little painted over a glass slip was examined from time to time, and the goodness or otherwise of the varnish was shown by the time necessary for sufficient damp to penetrate to turn the "bluestone" blue again.

After trying a number of mixtures he at last found that the addition of a minute quantity of Venice turpentine conferred the desired property on the varnish. It appeared to stop up the interstices I have referred to.

Now would Venice turpentine answer as well with lacquer? The heating may spoil its effect. Will someone try and report the result? Glatton.

PLASTICITY.

[43151.]—The title which I have used for this paper is derived from the Greek language. From *plastikos* = fit for moulding; or from *plastos* = formed, moulded; or from *plasso* = to form, to mould, and that is having the power or property of giving form or fashion to the mass of matter. So far the dictionary. Thus plastic clay was in geological parlance used for a clay that was capable of being moulded or formed when wet. So, as clay when wet was plastic, any kind of earth which contained clay becomes plastic or yields a matter, which like dough, can be readily moulded into form. As we mould clay into clay pies when we are young, and I presume all of us were young enough to form clay pies or mud pies at some period of our existance, so we were practising plasticity then. And our minds were plastic enough also, and only formed, as it is said, by the plasticity.

The plasticity of clay was known to the ancients; that is to say, as man came to feel the clay when moist with water, he saw that it could be moulded into forms, and so he made the first vessels of unburned clay to form his cups and plates, and we have in the aborigines the clay that was thus moulded, sometimes on the inside of straw baskets before they had wheels to fashion the clay upon. These baskets were sometimes burnt off, and thus the clay was rendered hard, being burnt clay. Of course, when the clay was white or blue and pure, the objects were porcelain. But we do not have porcelain vessels amongst the ancients. And we have the aboriginal clay vessels unbaked. They were first made by moulding without baskets; but when baskets were formed it was seen that they could be lined interiorly with clay. This clay was at last burnt off and the baked clay vessel left. The origin of pottery, which was the name the art received, is unknown and hidden in darkness, but this was the manner it grew. At least such is the case with North American aborigines.

But the plasticity of clay when wet with water brings us to the knowledge of still another fact, and that is that the solid crust of the earth is not solid at all. That the word "solid," when applied to the earth, is a misnomer. That it is plastic and very plastic too. Let us see how hard rock, granite, for instance, which is thought to be so solid and inflexible, can be moulded into forms. If we look closely at a piece of granite we find in it traces of its being elastic, of bending. The particles can be pushed out of place. The quartz and felspar,

although seeming so fixed, have been moved out of their relative positions. Granite is crystalline, showing that it must have been plastic from solution or fusion some time ago. And gneiss, which is formed of mica mostly, shows the bending very clearly. The mica is very elastic, springing to its places when bent by a slight pressure.

And upheavals of the earth, or earthquakes, are very common everywhere, being heard from, single or many, in every quarter of the globe. These are caused by the contraction of the globe; most likely by the cooling, and the earth is thus thrown into folds or crumpled up. So when the ice or glacial period came, the ice itself accumulated to a depth of one or more thousand feet on the surface of the earth. To the weight of the load of this has been attributed by Jameison and Warren Upham and others to the succeeding subsidence of the same called glaciated regions. This caused a period which has been called by Hitchcock the Champlain period, from the locality on the shore of Lake Champlain between Vermont and New York, where he first studied it. We will have to speak of this Champlain period and the clays laid down in them later on.

At all events, the earth and rocks also can be bent, or are plastic very evidently when we look closely at them. So that the term solid rock is a misnomer, and we must put it aside, and not use it. Now, as the earth during the ice or glacial period was thus elastic, before the Glacial period, in the miocene period, or what is known as the Tertiary by the older geologists, and was higher, nearer the sun, the source of heat, and therefore the temperature was affected, and it was hotter also. That is to say, they had a warmer climate than now in the same zone. But the ice of the Glacial period accumulated, not over that section of the country where the Miocene or Miocene rocks appear now, but where the older rocks, and where they were still higher, when they passed beyond the influence of the sun and came into the region of perpetual snow. In the temperature it was very cold all the time, as it is now in the regions of perpetual snow in the mountains. In fact, there were high mountains then, and the ice accumulated on them, The Laurentian mountains in Canada, the Adirondack mountains in northern New York, the Apalachian mountains, and the Cordellarian mountains, besides small ranges of mountains in various parts of the country, so that we find glaciers, which were formed in these various places. And they began to move, as glaciers do now, down the mountain sides into the valleys below, from the centres of glaciation, east and west, and to the south and south-east, for this is the way they went, not to the north, for the Laurentian range of mountains, extended across almost the whole continent. These turned the whole tide of the glacier to the south-east, whilst the Cordillarian mountains in Western British America, lying south and north, turned it into the Pacific Ocean.

They left their traces on the rocks, and deposited boulders and gravel, and mud and clay on all sides of the elevated land. The clay was pushed before the advancing ice, and rendered turbid the stream that flowed, making lakes or lakelets on the borders. The boulders and gravel were deposited first, the mud, which consisted of fine sand, next, and the clay eventually last, as we see it. In fact, in some places in New York and New Jersey, where I have studied it, the gravel and clay are very well marked and distinct. Now, when the ice melted, it broke off at the margin, and formed icebergs, as they are called, which floated away to melt gradually, and the ice was not clear, but had mud and clay immersed in it, and when it melted the water was cloudy by reason of the clay suspended in it, and it formed a milky water which was at the temperature of melting ice (1° C.), and then floated away to mingle with the clear water of the ocean near by. At this temperature the bacillaria, which are minute organisms which have been ranked first as animals, and then vegetables, and, lastly, as protista, flourished. They flourish most common when it is not very warm—in fact, in spring. When they died they deposited their shells, which are thus made up of the same substance almost as clay, and formed the various fresh-water infusorial earths, the lacustrine sedimentary, the diatomaceous deposits, the bacillarian layers that are so common and prized by microscopists everywhere. This was the iceberg clay period of the modern geologist.

Can we wonder that "species" of the so-called diatomaceæ or bacillaria are the same? Be they gathered in Italy at Santa Fiore, in France in the Auvergne, in Germany at Berlin or elsewhere, in Great Britain at Aberdeen or Mull or Lough Mourne, and in North America at South Beddington, in Maine, in New Hampshire, or Weequachih Lake in New Jersey, or the hundred other localities in which they are found. And can we wonder that the bacillaria are living now in every stream and pond, in lakes and rivers, in fact in the ocean, are the direct descendants of those which were living in the iceberg age period, which is the Glacial period also. So they lived, unchanged by evolution or other means, from that period until now. In fact, they are fresh-water forms now, owing to the plasticity of the earth.

Beyond the Glacial period they also lived back into the Silurian, unchanged in outline still, and I have shown how they came, but from what they came cannot, of course, now be determined. It can be found out undoubtedly by studying the living bacillaria, and it can be seen that they were evoluted, so to speak, from a simple form that has been called protococcus—the green slime of the marshes, meadows, and rocks, or woods.

In this country the ice when it melted formed a vast lake or sea that covered all of the region from the Rocky mountains to the sea and the north of Mexico to British America. This is known as the Occidental sea, and was fresh water and formed at the temperature of melting ice, in fact in the iceberg period. The so-called "species" are different from those on the east coast in Nova Scotia, Maine, New Hampshire, and New Jersey, but are the same over the region of the Occidental sea. Perhaps as time goes on they will be discovered in South America and the region of the southern ice sheet thus be shown. In fact they have been already discovered by Darwin in Patagonia.

Thus the plasticity of the so-called solid earth is shown, and mountains are elevated and obliterated and glaciers are seen now at Mount St. Elias and in Greenland.

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IS THE THEORY OF GRAVITATION A FINALITY?

[43152.]—MATHEMATICIANS tell us that "all the celestial motions are explained by the one law of universal gravitation." But is this strictly correct? Does the law of gravitation explain the rotation of the sun upon its axis, or that of the earth and the planets? Did Newton profess to have explained the cause of the sun's or the earth's rotation by his theory? It seems to me that each of these questions must be answered in the negative. The task which Newton originally undertook seems to have been to account for Kepler's laws of planetary motion—i.e., to explain the cause of the orbital motion of the planets only, leaving unexplained their independent axial rotation. He also claimed to have discovered the *mathematical* cause only of the planetary orbits, an admission which implies that the real or *physical* cause remained untouched by his theory. Indeed, to this day mathematicians speak of gravity as a mystery, which virtually amounts to the confession that the true cause of the celestial motions have yet to be discovered. The correlation of the so-called physical forces now known to exist and to play such an important part in the economy of the world, but what is still only partially and imperfectly understood, was wholly unknown to Newton, Laplace, and all our great mathematicians who lived prior to the present generation. And even during the present century, as Lord Kelvin pointed out 30 years ago, the geology of Hutton, Playfair, and Lyell is diametrically opposed to that held by our great mathematicians and natural philosophers. (See article on "Geological Reform" in Huxley's "Lay Sermons.")

Taking these things into consideration, it is not too much to say that the theory of gravitation does not embrace and explain the whole of the phenomena, and consequently it is not the finality so often attributed to it.

That I am not merely writing at random the following quotation will suffice to prove:—"The generalisation gravity leaves behind it a sense of mystery unsolved, *as if there were something further that we might arrive at* if obstacles did not intervene. Newton himself seemed unable to acquiesce in gravity as an ultimate fact." (Bain's "Logic," Vol. II. p. 125.)

This frank admission, however, is most exceptional. Mathematics, as a rule, will not allow that the theory is in the least degree imperfect, and speak of it as if it were a full and final explanation of every known movement possessed by the heavenly bodies, regardless of the fact that it affords us no explanation at all of the earth's diurnal rotation. No one has been able to explain by means of the theory of gravitation why the moon so revolves around the earth as to always present the same face to us. And even supposing this peculiarity to be accounted for by the law of gravitation, the same law would not account for the converse—i.e., the motion of a planet round its primary so as to expose its whole surface periodically to the central body—which occurs in the case of the relations of the Earth, Mars, Jupiter, and Saturn to the Sun. There are other anomalies also which cannot be explained on the theory of gravitation. The moon, for example, during a lunation, *cæteris paribus*, is nearly half-a-million miles nearer to the sun when she is new than when she is full, and yet her velocity is as great in the latter position as in the former. Supposing this had not been discovered by observation, would mathematicians have anticipated the effect of solar perturbation on the theory of gravitation? Would they not have unanimously come to the conclusion that the moon's velocity would be at its maximum when the moon is new and nearest to the sun, and at its minimum when she is full and at her farthest distance from that body? A similar anomaly presents itself in the phenomena of the tides. Who would have supposed, on the theory of mutual attraction, that the moon would apparently generate tides simultaneously at the antipodes? Or that the sun and moon would generate spring tides when in opposition, as well as when they are in conjunction? With these and other irregularities, well known to be insufficiently explained by the theory of gravitation, I have no hesitation in saying that it is not true to say that "*all* the celestial motions are explained by the one law of universal gravitation."

The accuracy with which astronomers are able to predict the tides and eclipses is sometimes very improperly attributed to the theory of gravitation. The absurdity of this claim on behalf of any theory has been convincingly proved by Mr. Hopkins, who says: "Mathematicians think that the celestial bodies are sustained in their orbits by means of an original impulse given to them, combined with a centripetal force, and not according to the principles we observe in terrestrial physics. They have laws of motion peculiar to themselves, which have been assumed and blended with the laws of geometry. Indeed, so far as physics are concerned, it matters not much what hypothesis may be adopted in astronomical phenomena, provided our calculations be founded on uniform spaces and velocities, and the whole are reduced to the laws of proportion which subsist between sines and cosines, and not in the least depending upon the laws of physics. Many persons who read and admire the degree of consistency of our almanacs in predicting the eclipses and tides, &c., suppose that such predictions are founded on the law of gravitation; but the fact is that such calculations are entirely dependent upon direct observations of the periodical movements of the heavenly bodies, and have nothing to do with the physical theories of philosophers. *The ancients made similar calculations at a period when their doctrines were very different.*" ("On Terrestrial Magnetism," p. 174.)

That gravitational astronomy is but a partial explanation of the facts becomes still more conspicuous when we compare it with descriptive and observational astronomy. As everyone knows, the physical constitution of the moon differs greatly from that of the earth, and even more so from that of the sun; but gravitational astronomy does not take into account these differences. And, again, everyone knows that the physical influence of the sun differs very remarkably from that of the moon. The former is an immense source of dynamical energy to the earth in the form of heat; but our satellite gives us no sensible heat whatever, and, therefore, cannot be a source of dynamical energy to us. This difference is not taken into consideration by gravitational astronomy. On this theory similarity only is recognised. The heavenly bodies are supposed to be of an exactly similar nature, and are supposed to act and react upon each other by means of an exactly similar force, or species of energy called gravity.

No philosophers have more strongly insisted upon the importance of attaching due weight to those facts which differ from, as well as those which agree with, any general theory in physical science than mathematicians themselves. The following is a sample of many similar quotations, that might be adduced from the writings of our great mathematicians, touching upon this point:—"It has often been noticed that many of the great discoveries in science have had their origin in nice observation and explanation of minute departures from some law approximately true." (Ball's "System of the Heavens," p. 108.)

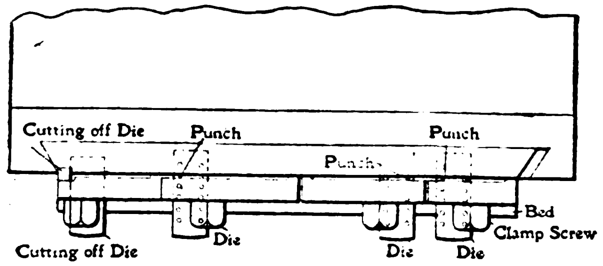
Gravity has hitherto been regarded as a simple and unique force. But can this view be any longer seriously maintained? Gravity must be related in some way or other to magnetism, electricity, and heat. Such potent agents in the production of motion will certainly have to be included in any complete theory of celestial dynamics. So long as they are excluded out of a kind of superstitious reverence for authority, the explanation of the cause of the motions of the heavenly bodies must remain imperfect and incomplete.

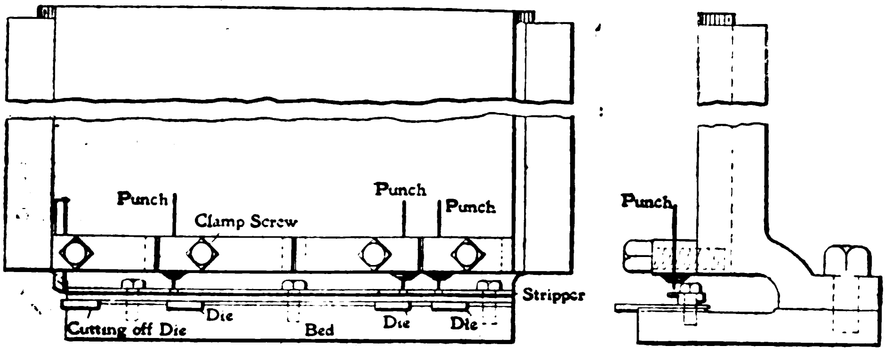
What mathematicians call gravity, and regard as a unique force, ought, in my opinion, to be treated as a dual force—similar to, it if not identical with, electricity.

Supposing gravity to consist of repulsion as well as attraction, would not the former force be concealed or masked, as a rule, by the greater force of attraction, as in the case of magnetic induction, which always gives rise to repulsion as well as attraction?

This supposition, if it could be proved by a comparison with the facts, would remove gravity from the isolated position that it has hitherto occupied, by showing it to be a natural agent familiar to us all, instead of a mysterious force ill-understood even by mathematicians.

The theory of gravity as a dual force would not affect the law that action and reaction are equal and opposite in the least; neither would it affect the law of the inverse square as the measure of the intensity of any natural force diffused from or converging to a fixed point. The law of gravitation, expressed in abstract terms, would be amplified, but





not invalidated, if gravity were regarded as identical with electricity, as the attractions and repulsions between two electrified bodies are inversely as the square of their distances. If the celestial bodies are electrified bodies, this law will apply to them as surely as it applies to terrestrial bodies.

If gravity is a dual force, it is easy to explain the apparently irregular behaviour of the moon during her second and third quarters. The solar attraction and repulsion would be in equilibrium when the moon and earth are equidistant from the sun. His attraction, however, would predominate when the moon is within, and his repulsion would predominate when the moon is outside, the earth's orbit. Hence the variation from quadrature to syzygy, and vice versâ, which is so perplexing on the theory of attraction alone. The co-existence of the two forces explains the fact that the matter of the tail of a comet is repelled instead of being attracted by the sun, and may also be found to account for the planetary orbits better than the current theory.

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SHEARING AND PUNCHING SMALL SPRING STEEL.

[43153.]—As I have seen many inquiries in the English Mechanic about the methods of working spring steel, I send you the following which may be of use to your readers, and may possibly bring out some useful comments. I found the remarks in the *American Machinist*, to which paper they were contributed by Mr. C. E. Quimby a few weeks ago. The sketches show a sub-press and set of dies made to punch and cut off flat spring-tempered steel about ⅛in. wide and $\frac{1}{32}$in. thick. The temper of the steel is somewhat lower than that of an oil-tempered spring drawn by burning off the oil yet is hard enough not to cut easily. As the work wears out the dies and punches very quickly, it was necessary to adopt a design that would permit a rapid change of either or of both, to replace broken ones, and the easy removal of punches for sharpening. The punches are straight pieces of "drill rod," about 4in. long, hardened in water and drawn to a blue in the middle, where the pressure of the holding-clamp tends to break them, and the ends left a very light straw colour. They do not need to be very straight, as the clamps are smooth, and by placing the punch in the clamp with the curve to right or left, the end will be in the same plane as if the punch was straight. They are sharpened on both ends, and, when dull, are reversed, thereby saving trips to the grinder.

The dies are ⅛in. thick and ½in. wide, and have no finish except to grind the scale off the top side and true the edges with a file to fairly fit the recess in the bed. The holes are drilled in a jig, and the only accuracy called for is that they shall be true to size and the same distance from the nearest edge of the die. The die is first placed in the jig, and each hole started, then removed from the jig and drilled through with a drill smaller than the required size. Clearance is secured by drilling about two-thirds through from the back side, and then a sizing drill through each hole completes the die. They are hardened in water, drawn to a light straw colour, and the top ground smooth on a grindstone in water. This leaves the holes smooth and very sharp.

The stripper and gauge are in one piece, and the work is held against the gauge by light springs, near each punch, on the front side. The dies are not let into the bed quite their full thickness. The combined gauge and stripper being screwed down upon them holds them in place. The holding-down screws are so located that any one die may be removed, without disturbing any other, by loosening the nearest screw and springing the stripper up a little.

Should the hole in the die become worn by use, so that the work comes off rough or with a slight burr, the stripper-holding screw is loosened and the die pushed in until a new hole is under the punch, the punch lowered until it enters the die, and the die carefully moved in or out until the punch, upon repeated trials, enters the die freely, when the holding screw is tightened and the work proceeds.

When the punch becomes worn or breaks off, it is removed and about ⅛in. broken off to remove the worn or slivered end, the end again ground square and the punch returned to its place, the press being in its lowest position when the punch is clamped.

In setting both punch and die at the same time, the die is first slipped into place, the punch entered in the die and clamped, and then the stripper is tightened down on the die.

The punches are only fifty-one thousandths of an inch in diameter, and are a close fit in the dies, usually requiring a little pressure or a light blow on the upper end to force them into the die when both are new.

The sub-press shown sits under the gate of an old press that gives it the necessary motion, and an attachment automatically feeds the wire. The slide is disconnected when setting a punch or die, and can be easily moved by hand to feel if the punch enters the die properly.

We think this construction is unusual, and quite a departure from the accepted methods of holding dies and punches, but it serves the purpose admirably. The punches usually make from 1,000 to 5,000 holes without sharpening, and have at times made 10,000 holes each, at the rate of 110 per minute. The dies make from 5,000 to 50,000 holes for each hole in the die. A number of these sub-presses are in use for different lengths, styles, and sizes of the pieces made from the steel. They have been used for about ten years, and are satisfactory in every way. The work is uniform, accurate to gauge, and, considering the hard and trying nature of the material worked upon, is cheaply produced. The sketch is not made to scale, but shows approximate proportions and the relation of the parts.

It seems to me that the above is a useful method, while the hints about the temper of the punches are valuable.

Cleveland, Ohio. **J. Swan.**

BIBLICAL SCIENCE.

[43154.]—One is disposed to deprecate the discussion of the Deluge, Destruction of Sodom, and Scriptural questions in general. It cannot be free, and is rarely fair. More than the fear of being called heretical, and what not, is that of offending many devout and worthy persons who are still deeply pained at any doubt thrown on the entire infallibility of the Bible. A friend of mine lately delivered a lecture on the Solar System, the evolution of worlds, and life—ordinary commonplaces to the readers of this journal. It was within six miles of a large manufacturing town. But two denunciatory sermons were preached against him in the village chapel. The preacher went about proclaiming that Mr. —— "ought to be stopped," and my friend was privileged, in a small way, to become a martyr of science.

Mr. Garbett, whom we could so ill spare, must not be offended at his readers for refusing to accept his implicit fundamental assertion of the special historical authority of the Jewish books. With Moses we must deal as with Livy; allow the credible, reject the incredible. There is nothing irreligious in this; nor in reasonable interpretations of statements in the light of the condition of knowledge at the time they were penned. The Bible is not one book, but a library of books, composed, or compiled, at widely separated times. Whether we hold it to be inspired, or only a collection of the highest known teachings for the moral elevation of the race, it cannot but show the development from lower to higher of both science and morality. Experience and natural religion show that man's Maker has certainly left the slow growth of knowledge to be the result of man's own discovery. Otherwise there would have been revealed to him the use of steam and the secret of healing disease. And, consistently, the inspired teacher must be left to use, for his framework of illustration for enforcing reverence and duty, only the secular knowledge and science of his day. Otherwise two things must follow. In that day his teaching would be utterly rejected, and in future time the book containing it could be only treated as a forgery. In view of the moral purpose—the call to reverence and restraint—premature disclosures of knowledge accessible to man's natural faculties would defeat the end of supernatural revelation, which deals with what is inaccessible, and leaves the domain of sensible nature to revelation by his own painful effort.

So, I take it, a preacher of old had in hand to tell of punishment following evil doing, and used an accepted tradition of a great calamity in days of wickedness. Both the evil and the natural event are only too credible; and that some punishment must follow the evil, though it be not a flood, is certain. Only the particular connection and the details are mythical—a tapestry woven out of threads of primitive beliefs. I contend that all ancient wide-spread traditions are echoes of facts, precious histories buried and smothered in accretions, and all the more interesting for that. The Biblical story is one only of several accounts of the Flood among the people betweeen Persia and the Syrian Desert. It prevailed in other lands. We read that the date asserted for it is the date of the Hindoo festival of the dead, and the same in Australia; among the Egyptians the festival in honour of the dead; the Persian month of the Angel of Death; the Druidical three days' festival for the dead, when every light was put out, and the phantoms flocked through the air to the boats that carried them to the abode of the gods, and the time when the Aztecs offered solemn human sacrifice against the destruction of the world, as their tradition alleged, had, at that time, occurred of old. This means only that there *had* been a flood, and vast, in some remotest time, before the earliest now surviving species of man began his migrations to the ends of the earth, carrying the great tradition of their common ancestry. But we are sure that to those earliest men their locality must have been the world, the unknown beyond being not even conceived. Then the late version of a Semitic tribe decks the story, and explains it with Oriental fancy, and fits it to the ancient notion of the solid heaven arching over the little plain of earth, bearing sun and moon for his sole use, and the little stars to amuse him. That vault of which, long after, falling stars were broken bits. Beyond that vault was water, far later taught to be the element from which all was made. "God made the firmament (Josephus says 'a crystalline'), and divided the waters which were under from the waters above." "The windows of heaven were opened" "and were stopped." Josephus has it, "it became 15 cubits higher than the earth," speaking plainly of an earth like an island, flat and surrounded with ocean, inside the shell, as believed in his time; and quotes Berosus, "There is still some part of this ship in Armenia, and some people carry off pieces of the bitumen." The small view of a small universe and its ruler can be seen in his curious expression. "But when God came into the garden, Adam went out of the way. This surprised God, and he asked what was the cause." We have a grander idea of both, and a more reverent interpretation of the working of the Creator's law.

The destruction of Sodom has the same teaching, the same distortion of tradition, the same accommodation to the opinions of the time. We interpret the tradition according to the knowledge and convictions of ours. It is to be reasonably taken as the, perhaps long post-dated, memory of the actual volcanic rending and upheaval which severed the Jordan from its ancient exit to the Red Sea, and formed the "asphaltic lake." The topography bears that out.

If we choose to indulge our fancy with speculation, we may, declining to be tied to archaic chronology any more than science, picture a great catastrophe long ago, connecting both these dim histories as parts of one event, of which the geological puzzles of the origin of the West Asian inland seas, the vast rendings that appear to have

cleft the courses of Thibetan and Chinese rivers, and the strange entombments of the Siberian mammoth may be traces. Gossip.

RODINAL AS A DEVELOPER.

[43155.]—I SHOULD like to know what are the experiences of your readers with rodinal as a developer. Mr. Thomas, F.R.P.S., says in the *British Journal of Photography* :—

Of this particular developer more has been used in my own practice since its introduction than of any other developing agent, although it is by no means the only one I use, for, indeed, there are but two of the late introductions, diogen and kachin, which have not been tested, and tested as I prefer to test any such matter, not by using it on two or three specially-exposed plates, and upon the results basing one's opinions of its usefulness or otherwise, but by making up some amount of it in stock solutions, and employing it for plates, exposed in the ordinary manner, out of doors, and under such conditions as one's work is mainly undertaken under, and continued over some reasonable length of time; for, however clever a photographer the experimenter may be, it is impossible to pick up and at once employ any strange reducing agent with the same facility as those which constant use has given complete control over. The more is this so when any radical change has been made either in the manner of its working or nature of the resulting negatives given.

Each new developing salt introduced to us comes with its accompaniment of high-strung praise over its wonderful qualities, then a few letters, and, it may be, one or two articles appear, followed later by the usual crop of complaints. So was it with Rodinal; but its chief, if not only, sin seems to lie in some supposed difficulty to obtain dense negatives. No greater mistake could be made, for density may be built up as readily with it as with any other developer, if it be desired and means taken to insure it.

What I like about it in particular is the simplicity and readiness with which any variation is possible, for, being highly concentrated, and in one solution, at a moment's notice either negative-making, bromide enlargements, or lantern slides may be dealt with, the only difference being a more copious dilution with water of this developer is advisable when paper or slides are being treated than when making negatives, with regard to which, by the way, some considerable correspondence lately has been carried on in the photographic press relative to that highly-important topic, Should a developing solution be used more than once? it produced some interesting, and certainly amusing, reading, one side holding, with true British doggedness, that, after having once done its work on a plate, a developer should be consigned to its resting-place, the dark-room sink, while others asserted the contrary, and for a time right merrily waged the wordy warfare.

To me it was intensely amusing, for just about the time I had five dozen exposed plates awaiting development, and hitherto it had been my practice, when anything like a batch of, say, one dozen or more were dealt with at the time, to mix up my developers, and proceed gaily to pass one plate after another through, until either the whole batch were finished, or development became slower, when the addition of 10 or 20 minims from the stock bottle set matters going briskly again. Such had been my practice in a general way, and, in spite of the woes and evils supposed to follow such a practice, past experience seemed to justify the risk, and four dozen exposed plates were in one evening transformed into 47 decent, respectable-looking negatives, most, if not all, of which possess some measure of success, if Mr. Chapman Jones's definition of that desirable article, the perfect negative, be a correct one—viz., that it is pure silver in clean gelatine for all through the series of 23 whole-plates and 24 quarter-plates. So far as diversity of subject, exposure, and so forth would allow, they presented a uniformity of colour, density, and general good quality which left little to be desired, and certainly no cause of complaint; yet for this batch I had used the selfsame solutions right through, with only, as already pointed out, one or two additions from the stock solution to revive its developing action.

Some slight discoloration necessarily takes place when a number of plates are passed through the same developer, whatever it may be composed of; but, with rodinal, and indeed pretty nearly any of those reducing agents of kindred nature, this appears to have no detrimental effect upon plate or film submitted to its action, which is certainly not the case when pyro is employed; and where this particular developer, pyro, is the one used, there can be no doubt of the better plan being to treat each plate with a freshly-made solution, for the simple reason oxidation quickly transforms a pyro developer into a dirty, muddy concoction, unless a large percentage of sulphite has been employed as a preservative.

One reason why difficulty arises, when developing plates with rodinal, to obtain ample density, is because, as a rule, it is used considerably diluted, and time is not allowed for it to build up sufficient density, which, by the way, is somewhat slowly, *if the developer is being used weak*, where, for any reason, exposed plates are first treated with dilute rodinal, after such detail has been brought out as may be thought desirable, density may rapidly be obtained, either by adding rodinal from the stock, or transferring the plate to another dish containing 1 part of rodinal to 10 or 15 parts water, to which has been added sufficient potassium bromide to hold in check its action. In this manner density may be obtained quite as quickly and effectually with this developer as when employing any other. In the same way, where plates submitted to it are found to have been much over-exposed, they may likewise be transferred to the strong and restrained developer just referred to, when development will proceed more correctly, and the results should prove quite satisfactory.

On the other hand, where either excessive contrasts in the subject itself, or brought about by insufficient exposure having been given the plate, the effects of this evil may be much reduced by employing a developer considerably weaker than normal; for instance, 1 part of rodinal may be added to 60 or 90 parts water. A batch of plates may then be submitted to it, and practically we have "stand development, for which I have found nothing more convenient when dealing with small sizes, such as quarter-plate, than one of the glazed pot tanks sold by all dealers, and used for fixing or aluming negatives in. A dozen plates may then be treated at once by placing them in the grooved tank, with sufficient of this dilute developer to cover them; then a tray or lid, or, indeed, anything, being placed over the tank, one may go about other matters, and feel perfectly certain no harm is likely to occur if, from time to time, examination be made, and such negatives as have progressed sufficiently be fixed and washed in the usual way. One matter, however, should not be forgotten, plates developed with this or similar reagents are rather deceptive as to density, and need to be carried apparently further than where pyro, or even hydroquinone, has been used. So also, for some reason or other, when developing in the manner just referred to, they are better for being carried slightly further than when developed with a solution of normal strength. Curious as it seems, the fact remains, and should be noted when commencing stand development.

Used for developing prints on bromide paper (contact or enlarged), it gives pearly greys and good rich blue-black, while for lantern-slide work it needs development carried very far indeed before the shadows become blocked, when the developer is used reasonably dilute, say 1 in 40.

A curious effect was noted some time back while making a series of lantern slides, many of which were given full exposures, and so developed as to get the brightest red colour possible. The plates were Paget's slow, and, having towards the end become rather weary, I hurried up development of the last ten or twelve slides by adding a few drops of rodinal to the slow-acting developer in which they had been. The small transparencies at the moment under treatment were very red in colour, but after the slight addition of rodinal it rapidly cooled down to a pleasant brown, and having several duplicate exposures, by varying the amount of rodinal added to the developer, specially intended to produce a maximum warmth of colour, showed that, as it was added in greater or less quantities, so did the vivid red slide rapidly alter in colour, and, if pushed by the addition of much rodinal, and allowed time, they seemed to turn to a rich warm black. Some of the resulting slides treated in this manner turned out a beautiful rich, warm sepia, while others, having had just the same lengthy exposures, but developed straight away in rodinal, gave a warm black image, and I can well imagine, to first partially develop for bright red colour, and then cool it down, by a brief immersion in rodinal developer, would prove a useful method of obtaining any desired warmth of colour between black and red entirely by development, with considerable certainty, and in a speedy manner.

A commendable feature also about this developer is its sociability, for it will mix with and work in conjunction with any other developing agent I have used, and from its all-round usefulness, should find a place on the shelf of every practical photographer, be he professional or amateur. T. R.

TELESCOPES, GREGORIAN, AND DIALYTE: TO "HIPPALUS."

[43156.]—WITH a preliminary word of thanks to "Hippalus" for his courtesy, I will try to say a little about the points that he refers to in his letter 48129. As "Ell Hay" uses his telescope as a Newtonian, the large mirror must be a parabola, and to use it also as a Gregorian the small mirror must be an ellipse. It would, therefore, be specially interesting if "Ell Hay" would tell us how he secured this curve, whether by a happy accident or by repeated trials, and in what way the small mirror was tested during working. Hitherto, we have had results; but no methods given by which such remarkably good results were attained.

Though I say the small mirror should be an ellipse, on the authority of many writers, I do not myself think this true when the image has an appreciable size; but the point needs investigation, as I formerly stated.

As regards cast and wrought discs, the former can be cast approximately to the required curve, which saves labour; but I have heard that the rolled plate is more equable in texture, and, therefore, better to work. I may also warn "Hippalus" not to attempt to stiffen a cast disc by ribs at the back, as Mr. Wassell found them do more harm than good. Messrs. Chance used to supply cast discs, and would probably do so now.

Now I want help myself. Could a fluid lens be constructed of two capsules of glass containing fluoric acid, the acid being previously saturated with glass so as not to affect the containing capsules? The form might be that of a dialyte, or possibly a compound o.g. might be constructed, using different kinds of glass to saturate the acid. I admit the idea seems hardly practicable; but I venture to thus throw out the suggestion.

If "Hippalus" can keep a secret, I will confess that I think more has been made of the "Schaeberle aberration" than it deserves, so far as telescopes of ordinary proportions are concerned. A. S. L.

SPLICING.

[43157.]—MY letter (43113) was written in no carping spirit. In 1892, "J. H." says "the splice is carried over a length of 4ft. or 5ft.; in exactly the same year another writer advises it to be carried over 84ft. I admit that the first applies to a cotton rope, the other to a wire rope, and that a greater length is required for splice in a wire rope; but certainly not twenty times as much. It was this great difference that impelled me to ask "J. H." to give us the benefit of his experience.

I fail to see where he would lay himself open to the charge of "repeating himself." Seven years brings a generation of new readers, and I don't see why the jointing of ropes should not have a place in "Millwright's Work" as well as the jointing of belts.

I take it from the latter part of his letter, with the Editor's permission, he would be willing to write a special article on "splicing," which I hope our Editor will grant. Richard Pudson.

ECCENTRIC CHUCK.

[43158.]—I HAVE read with great pleasure and profit the able series of articles on the spherical sliding-rest by Mr. Evans. I feel sure a hearty vote of thanks is due to him from all amateurs. If we should not encroach too much on his kindness, might we ask for a detailed description and drawings of the geometric chuck?—a difficult piece of work, but I hope not beyond the capabilities of some of the readers of the "E. M." E.

ERRATUM.—"Poison in Fish." In letter on p. 407, for "*his*" read "six." Glatton.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96727.]—**Elementary Optics** (U.Q.)—Rays proceed from any given point, *a*, on the object to all parts of the lens. They converge again until they meet again at a certain distance corresponding to the proper position of the screen. At any intermediate point these images of the point are still separated, and produce a blurred picture. Similarly the rays from another point *b* converge at the same distance from the lens, and are blurred elsewhere. The images of the points *a* and *b* are usually further apart, of course, than the points themselves, which is what probably made the querist picture single rays from each point diverging in space instead of a multiplicity of them. GLATTON.

[96740.]—**Efficiency of Small Gas-Engines** (U.Q.)—I am sorry I have not the figures by me, but "Improver" will find the efficiency of a small engine—though less than that of a large one—is not nearly so much less as in a steam-engine. GLATTON.

[96751.]—**Diving** (U.Q.)—I remember seeing in *Science Siftings* the statement that lenticular glass vessels filled with air enabled an observer to see under water without the distortion and indistinctness usually observed. Can any reader confirm this, or quote the passage? GLATTON.

[96779.]—**Boiler** (U.Q.)—If your boiler is a water-tube one, copper and brass are both bad. Brass gets brittle, and so does copper. In the latter case it is due to deoxidation of the metal. (Copper is tough only so long as it contains a certain proportion of oxygen.) If this boiler is a fire-tube one, brass or copper will do well, since the flames

will not enter the tubes much without being extinguished. There are plenty of patented automatic-feed regulators made. I doubt if a very small one would answer, however. GLATTON.

[96784.]—**Grate Front** (U.Q.)—Why not cast the wrought-iron rods in the cast-iron bars? Must they be loose? GLATTON.

[96796.]—**Marine Condenser** (U.Q.)—Probably a bit of naval brass pipe running along close to where a bilge-keel could be fixed, and exposing about 2sq ft. of surface to the sea would answer—3ft. would, of course, be better. The exhaust should enter one end (preferably the after end), and a small pump will be required to extract the water and air from the other. Send an inquiry to Simpson, Strickland, and Co., of Dartmouth; they make these things. GLATTON.

[96970.]—**Reversing Arrangement for Oil-Engine.**—Probably the best way to reverse the shaft would be by means of friction-clutch and gear-wheels. There are many ways, however, by which this may be accomplished.
AUTO-CAR ENGINEER.

[97056.]—**Xylonite.**—The company making xylonite supply full details as to polishing it and fixing it on wood. It can be polished by rubbing with the usual chalk polish, and it can be affixed to anything with what is, I think, called acetone glue. The methods have been described in previous numbers, and, as mentioned, can be obtained from the company. M. T.

[97059.]—**Celluloid.**—See reply 97056, as the materials are much the same, and all necessary particulars can be found by searching the back volumes of this paper. M. T.

[97067.]—**Bluing Steel.**—Described many times. Only done properly by the temperature to which the articles are raised. The querist will probably obtain a reply from the correspondent he mentions; but if he cannot do the proper bluing, he can varnish his articles with a blue shellac varnish. T. P. L.

[97073.]—**Bleaching Horn.**—Can try peroxide of hydrogen or chloride of lime; but if can spare a little time, might look through the back volumes. Probably a quick bleach might be arranged with sulphurous acid; but, anyhow, the horns must be thoroughly clean beforehand. M. B. D.

[97090.]—**Salt-Water Ice.**—The sea ice is not salt. The salt remains in the water under the ice—at least, that is the fact. Why Arctic ice is "fresh" is another matter. It is a bit of a puzzle, as the querist says; but I understand it is true that the sea ice which forms in Arctic regions is practically free from salt. It is a question that has puzzled many, and, so far as I know, no satisfactory explanation has been given. M. T.

[97092]—**Cranberries.**—There is no difficulty in procuring cranberries. They can be had all the year round, as they come from America, Russia, and other parts of the world. Can nearly always be had in Covent Garden Market at about 5d. or 6d. a quart. Russian kegs about 2s. These prices are wholesale, but the retailers' prices are very little more. The answer to the query is that cranberries can always be obtained by those who want them. They are never "out of season." M. T.

[97235.]—**Melting Brass.**—Attach to tue-iron a piece of 1in. gas-barrel with angle-piece at end to point blast upward. Round it build, with loose bricks, a temporary stove, square in form, and about 18in. or so across. Light fire with a few shavings and bits of coal, and fill up between the bricks with coke. A small plumbago crucible holding about 3lb., and costing something under a shilling, should be bedded in the top of the coke. Hard coke is the best to use. A gentle blast at first, increasing as the mass reaches incandescence;—will melt brass in about 30 minutes. Nothing need be mixed with the brass, but if in lumps it could be cut up small with a hack-saw or chisel to save time in the melting. CLARA.

[97187.]—**Calculation of Sun's True Bearing and Altitude.**—May I point out to "Fleur-de-Lys" that I described the method of calculating the sun's hour-angle in a letter on p. 402 ("E. M." of June 16), where I made use of the formula generally used? In the "E. M." of following week there were letters signed D. J. Carnegie and "H.," in which other formulæ were given. To find the time of sunrise or sunset is to find the time at which the sun's alt. is *minus* 35′; therefore, if in any of the formulæ for hour-angle we put alt. = − 35′, it will give us the apparent time of sunset, or, by subtracting from 12h. of sunrise. The triangle "Fleur-de-Lys" mentions is not properly a spherical triangle at all, as the side X A (sun's path in the sky) would not be a great circle except at the equinoxes. The triangle used in all these calculations is that formed by zenith, pole, and sun (Z P S), in which Z P is co-latitude, P S polar dist. (co-declination), Z S zenith dist. (co-altitude), angle P the hour-angle, angle Z the azimuth (measured from north). To find the sun's azimuth or altitude we must know the latitude, declination, and apparent time (or hour-angle). For azimuth, compute A and B from these formulæ—

$$\tan. A = \sec. \tfrac{1}{2}(PS+ZP).\cos. \tfrac{1}{2}(PS-ZP).\cot. \tfrac{1}{2}P,$$
$$\tan. B = \operatorname{cosec}. \tfrac{1}{2}(PS+ZP).\sin. \tfrac{1}{2}(PS-ZP).\cot. \tfrac{1}{2}P.$$

Then $180° - (A + B)$ is azimuth when P S is greater than Z P,

$180° - (A - B)$ is azimuth when P S is less than Z P,

estimated from the south in N. latitude. For altitude, compute α from the formula $\cot. \alpha = \tan. ZP \cos. P$. Then $\sin. (\text{alt.}) = \dfrac{\cos. ZP \sin. (\alpha + SP)}{\sin. \alpha}$.
ARCTURUS.

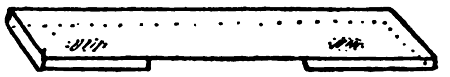
[97246]—**Air Heating.**—To obtain the amount of radiating surface required for a given room to compensate for heat lost by radiation from windows, doors, and walls, take difference in temperature in degrees Fahr. between lowest outside temperature to be provided for and the temperature at which the room is to be kept, and divide by the difference in degrees Fahr. between temperature of steam-pipes and the temperature at which room is to be kept. Multiply quotient thus obtained by number of square feet of glass thus obtained plus number of square yards of external wall surface in room, and product will be number of square feet of radiating surface required. Suppose a room with 36sq.ft. of window glass and 20sq.ft. of external wall surface to be kept at 70° Fahr. external temperature, being 10° below zero, that it is to be heated by direct radiators with low-pressure steam, taken as with a temperature of 210° Fahr. Then $\frac{80}{140} \times 56 = 32$ft. or number of square feet of radiating surface required. To provide for leakage from cracks, a square yard or 9sq.ft. of wall is reckoned as equal to 7sq.ft. of glass. If zero Fahr. be taken as lowest temperature, ¼sq.ft. of radiating surface at 210° Fahr. is required for each square foot of glass or square yard of external wall. Internal walls not included in calculation, it being assumed they are next to heated rooms or halls. If not, reckon as external walls. Having amount of radiating surface to compensate for loss of heat through windows and walls, next calculate the amount of radiating surface needed to heat cold air coming into room. Rough formula is: Multiply number of cubic feet of air per hour by number of degrees Fahr. to be heated, and divide by 12,500. Quotient equal number of square feet of radiating surface required. Suppose cubic contents of room to be 1,700c.ft., that it is on side of building exposed to winter winds, that usual amount of leakage around windows and doors exist; then an amount equal to that contained in room will probably pass through it per hour. And $\frac{1{,}700 \times 80}{12{,}500} = 11$, nearly, which, added to 32, gives 43sq.ft. as amount of radiation surface required, or equivalent to adding ⅓ to radiating surface for leakage, or 1sq.ft. radiating surface for 40c.ft. of space. Suppose ventilation of 6,000c.ft. per hour or over, three times per hour for two persons. Then $\frac{6{,}000 \times 80}{12{,}500} = 38{\cdot}4$, which, added to 32, gives, in round numbers, 70sq.ft. of required radiating surface. Suppose a 24-bed ward in brick hospital, where temperature of 20° Fahr. below zero is to be provided for; the internal temperature to be 70° Fahr. Assume this ward contains 24,000c.ft., has 288sq.ft. of window surface, and 241sq.yd. of external wall surface; and that, under ordinary circumstances, supply of air to be 3,600c.ft. per bed per hour, or 86,400c.ft. of air per hour. To supply loss of heat through walls and windows, there will be $\frac{90}{140} \times (288 + 241) = 0{\cdot}643 \times 529 = 340$sq.ft. of radiating surface. To heat 86,400c.ft. of air from 20° Fahr. to 70° Fahr. would require $\frac{86{,}400 \times 90}{12{,}500}$ = 622sq.ft. of radiating surface. Theoretically, 340 + 622 = 962sq.ft. of radiating surface required to keep ward thoroughly heated and ventilated in coldest weather, or at rate of 1sq.ft. of radiating surface to 26c.ft. of space heated.
REGENT'S PARK.

[97256]—**Windmills.**—In my reply on p. 431 I omitted to say that *h* is measured in inches.
GLATTON.

[97257.]—**Coherer.**—The latest and best form is one consisting of a number of short metallic tubes, ¾in. long, $\frac{3}{16}$in. bore, fitted with metallic bottoms and ebonite caps. These are furnished with wire stalks of different lengths, attached to the metal bottoms. Similar wires pass through the ebonite caps, reaching nearly to the bottom of the tubes. The tubes are then half-filled with antimony filings of different grades of fineness, the coarsest being put in those with the shortest wires, and the finest in those with the longest. These tubes are then mounted, like the strings of a harp, between a triangular metal frame, made in two halves, and united at its apex and at the centre of its base by insulating strips of ebonite. This is our "multilocular polytonic coherer," patent applied for, and is exquisitely sensitive. You cannot make a *small* alternator for this purpose. You had better use an 18in. plate Wimshurst in connection with a Tesla coil. The Wenbelt break consists in a ¼in. tube of glass, drawn to a point at one extremity. This is broken off, and a short piece of No. 20 platinum wire inserted, so as to project ¼in., and reach ¼in. in the tube. It is then sealed in over a spirit-lamp. The other end of the tube, which should be about 4in. long, is opened out slightly in the shape of a funnel. Any suitable glass jar is now fitted with a slotted ebonite cover; a sheet of lead passes down one side of jar inside, the tube is let down in slot, the jar nearly filled with diluted sulphuric acid, and the tube half-filled with mercury.
S. BOTTONE.

[97267.]—**Marking Ink.**—Why not try solution of silver nitrate? Quill pen. Hot iron will make it turn black. I have not tried following, but they may suit:—(1.) Iron sulphate 1 drachm, linseed oil 1oz., vermilion ½oz.; grind perfectly smooth. (2.) Manganese sulph. 1 drachm, water 1 drachm, powdered sugar 2 drachms, lampblack ½ drachm. (3.) A solution of coal-tar in naphtha is largely used by bleachers to mark their goods.
CLARA.

[97275.]—**Smoky Chimney.**—"Amateur" may find the following plan, by which I have cured many a smoky chimney, effective. It is from a little book on smoky chimneys by the Rev. Prebendary Ainslie. A hole (or, if needful, two holes) of 5in. or 6in. diameter are made in the hearthstone in such a way as to communicate with the space below the flooring. They thus draw air through the ventilators, which are (or ought to be) in the walls, to supply air below the boards and prevent dry rot. At the fireplace the holes are covered with an iron plate, raised an inch from the hearthstone. This is closed on the three sides towards the room, but is open for two or three feet towards the fire.



The figure shows the shape as seen from the fireplace side. Of course, the dotted lines and holes are hidden by the plate. The plate is a little larger than the fender which stands on it. The holes supply air when the door is shut, and so cure the trouble without making the room cold. I don't think there is much chance of this failing; but the only alteration is so completely to build up the fireplace as to reduce the chimney all the way up to about the breadth of the grate. F. BENNETT.

[97276.]—**Boiler.**—A boiler has tenacity of about 31 tons and 58 tons per square inch in tensile and compression strength. Then there is a new alloy partiminium, used by motor makers in France, such as Dion and Bouton. The specific gravity is 2·89 cast, 3·09 wrought. Elongation varies from 5 to 8 per cent., and tensile strength from 45·500lb. to 52·600lb. per square inch. REGENT'S PARK.

[97280.]—**Steam Pressure in Locomotives.**—The North-Western and North-Eastern have 175lb. Probably others. REGENT'S PARK.

[97281.]—**Straight or Curly.**—I am not able to quote an example where the hair has been shaved, but can confirm Rose Thorn's statement in the case of loss by illness in the case of my brother, whose hair was wavy after an attack of typhoid fever, having been straight before. I believe straight hair is always circular in section, and curly hair elliptical or more or less flattened. It is difficult to see why the section should be altered by illness, but still more so by shaving. GLATTON.

[97284.]—**Geometrical Progression.**—"Ontario's" strictures come a little late. In attempting to assist correspondents we cannot be responsible either for the nature of their queries or the uses to which they can put the replies. If "Ontario" will turn to p. 189 (Oct. 6) he will find four answers to the question proposed, two only of which are strictly formal, although he selects mine alone for attack. Mr. Shaw and "C. P." each reduce the given pair of simultaneous equations to a resultant biquadratic, which happens to permit of further resolution into quadratic factors. Thus Mr. Shaw gives—

$$10r^4 - 21r^3 + 10r^2 - 21r + 10 = 0,$$

i.e., $$(5r^2 + 2r + 5)(2r^2 - 5r + 2) = 0,$$

or— $$(r^2 + \tfrac{2}{5}r + 1)(r^2 - \tfrac{5}{2}r + 1) = 0,$$

which give *four* values of *r*, two of which are rational. "C. P." in his elegant and recondite solution gives us—

$$\frac{r^2+1}{r} - \frac{r}{r^2+1} = \frac{62^2 + 1{,}364}{62^2 - 1{,}364} = \frac{5{,}208}{2{,}480} = \frac{21}{10}$$

or— $$r^4 - \tfrac{21}{10}r^3 + r^2 - \tfrac{21}{10}r + 1 = 0.$$

or— $$(r^2 - \tfrac{5}{2}r + 1)(r^2 + \tfrac{2}{5}r + 1) = 0, \text{ as above.}$$

But in all equations primarily of higher degree than the second we cannot be quite sure of reducing them to lower degrees, and, even when this can be done, it may be essential to resort to more or less arbitrary assumptions. As in Euclid, such assumptions are only justified by the conclusions to which they lead.

Algebra does not disallow assumption; it simply exacts rigidity in our employment of it, and reasoning therefrom. There was no "guessing" in the solution I obtained, because the assumption was justified by the result. "A. O. S.," in his neat solution, obtained the final equation $a + 20r = 42$, which is indeterminate, and only solvable by assumption. He reasoned thus:—"But a and r are integers, therefore $a = 2$ and $r = 2$." It is true r is certainly not necessarily an integer, although this supposition leads to a correct solution, and for that reason is admissible. Athough I do not propose to solve "Ontario's" present question, yet I may state that the two simultaneous equations he gives reduce to a quintic in x, which, therefore, admits of five solutions. This cannot be reduced to a quadratic, for even mathematicians cannot perform the impossible. I would remark, however, that if r be assumed to be an integer—which is quite permissible—then "Ontario" is justified in concluding that if—

$$\frac{315 - x}{150 + x} = r = 2 + \frac{15 - 3x}{150 + x}$$

Then r is necessarily 2, and the remainder 0, hence the numerator must vanish, and, therefore, $15 - 3x = 0$, or $x = 5$. This would be *one* of the five answers; but since r might also be ½, x would be 160, another solution. Perhaps I may be again reminded that "any little schoolboy" knows these things; but while we know that schoolboys are proverbially clever, this is no reason why a correspondent who asks for information should not be courteous to those who try to give it.

West Norwood. HENRY T. BURGESS.

[97282.]—**Automatic Feed.**—The "Fromentin Automatic Boiler Feeder" would seem to be just the thing that "J. A. C." wants. It will keep water level in boiler without constant attention. He will find full description on p. 100 of Salomon's "Electric Light Installations."

RICHARD HUDSON.

[97287.] — **Photography.** — Purchase 1oz. of Nelson's gelatine, soak in cold water for half an hour, take out and drain, place in a small tin saucepan, and hold over a small gas-burner or stove, stirring until thoroughly melted. While hot, brush this on back of sheets of photos., hang by clips on line to dry; when dry, cut as desired; lay on damp pad, and press on card. PHOTO.

[97287.]—**Photography.**—Powdered starch (at chemist's), best, or best Glenfield's, 1oz.; rub up into stiff cream with 1oz. of water. In clean white enamelled saucepan put 8½oz. water; bring to boil. Pour in the starch cream, constantly stirring; should form translucent jelly, lump free. Transfer to saucepan, just boiled, well strain through fine linen or old cambric handkerchief into jar, add ten drops of carbolic acid. Does not keep long, say a week; and Le Page's glue advised by E. J. Wall in "Everybody's Guide to Photography." This liquid glue mixed as required with equal quantity of water forms an excellent and cleanly mount.

REGENT'S PARK.

[97290.]—**Galvanometer.**—An ordinary post-office galvanometer has a fairly high resistance in the "intensity" coils, so that it could be used with fair accuracy for measuring E.M.F., provided this did not greatly exceed 5 volts. It would not even be necessary to alter the grading, as a table could be made in which the number of degrees of arc equivalent to 1, 2, 3, 4, or 5 volts were recorded. Of course, such an instrument could not be used in the vicinity of iron, steel, magnets, or dynamos. The comparative grading can be done either by coupling direct to 1, 2, 3, 4, and 5 Daniell cells, and noting the deflections with the "intensity" terminals in circuit, or by putting it in shunt with another voltmeter or source of electricity. But, of course, very great accuracy must not be expected, as the coils are probably copper, and not German silver or platinoid. S. BOTTONE.

[97298.]—**Cement.**—Glass and brass: Caustic soda 1, colophony 3, water 5; boil together. Knead up resin soap, formed with half its weight of gypsum. It hardens within three-quarters of an hour. If zinc-white or white-lead is used in place of gypsum, hardening is slower. Metal to glass: Copal varnish 10, drying oil 5, turpentine 3, oil of turpentine 2, liquefied glue made with least quantity of water, 5; melt together in water bath, add fresh slaked lime (perfectly dry) in very fine powder 10. Cement electrical: Black resin 7, red ochre 1, plaster of Paris ½ (both well dried and still warm), melted together, heat and agitation continued till all frothing ceases and liquid runs smooth: the vessel withdrawn from fire, mixture stirred till cool enough. Used to cement plates in galvanic troughs, chemical vessels, &c. REGENT'S PARK.

[97298.]—**Cement.**—1. Good "fine" plaster of Paris, to be mixed just before using, with a mixture of equal parts of water, white of egg, and one-eighth of freshly-slaked quicklime. 2. Burnt alum 1 part, plaster of Paris 8 parts, good vinegar, sufficient to make up a stiff cream. For the above recipes, the plaster must be of the finest quality, as used by the Italian modellers, and freshly baked; coarse, stale stuff is of no use. S. BOTTONE.

[97298.]—**Cement.**—Roughen your glass with No. 2 emery-cloth, get some good plaster of Paris and mix it up with glue-water or some of the stick-fast gums. Such things as I have stuck with the above I have had to smash out with a hammer, if the plaster is good. You must, of course, remove all grease. JACK OF ALL TRADES.

[97299.]—**Budding Roses.**—The Manetti rose is a rampant variety of the ordinary dog-rose, originally cultivated for budding purposes by an Italian of the name of Manetti. I have sometimes allowed a budded Manetti to throw up suckers from its own roots, just to see what its blooms were like. They are somewhat double, very pale in colour, and not possessing much scent. It is very doubtful whether they are really superior to a good Dog-rose stock for budding purposes. S. BOTTONE.

[97299.] — **Budding Roses.** — A genus Rose stock, much used for low plants. Frequently Teas are budded to them. But the Dog-rose is a favourite stock for most kinds, if budded at all. Many prefer on own roots. REGENT'S PARK.

[97299.]—**Budding Roses.**—Manettia (named after Xavier Manetti, Prefect of the Botanic Gardens at Florence in the middle of the eighteenth century), a genus of thirty species of very ornamental stove, evergreen, herbaceous, suffruticose, climber, natives of Tropical America and sub-Tropical Australia. Many are exceedingly useful for growing on trellis, rafter, or pillar.

161, Albion-road, N. A. CLARKE.

[97300.]—**Pretroleum v. Coal.**—Units of heat average of petroleum out of nine kinds about 11¼—i.e., crude oil—nearly three times as large as air-dry pine, 1·5 times as large as Moravian coal (with 8·28 per cent. ash); massive, about 1·5 times denser than crude oil. Both fuels occupy about same volume, but in consequence of communication coal requires more space (Braunt). Crude petroleum is more than twice as efficient as best anthracite coal. In practice 16lb. of water per pound of petroleum have been operated, and an efficiency of 20,200c. was obtained as against 8,603c. for anthracite. Coal gas for kilo coal gives about 0·3 cubic mètre gas or about 20 per cent of heating value, see A. H. Gill on gas and fuel analysis, 1896.

REGENT'S PARK.

[97303.]—**How to Solder.**—For hard soldering or brazing, meeting edges scraped or filed clean. Bind with iron wire if necessary. When pieces placed in position, granulated spelter and borax mixed in cup, very little water, and spread along joints by sheet-metal or small spoon. Work placed above clear fire first at small distance, gradually to evaporate moisture and deprive borax of its water of crystallisation. The flux boils frothy, and at times shifts solder away. Heat now increased, and when metal assumes faint red, borax melts. As metal becomes deeper red, solder flushes. Should it not do, the work may be tapped with tongs to make it move; care taken not to melt metal. Spelter solder made of equal parts of copper and zinc, and for brass and copper. For iron, meeting surfaces filed bright; smear with water and borax. Tie together, if necessary, with fine iron wire. Then wind round at joint with several coils fine brass wire, rubbing borax paste over them. Lay on fire, and put on blast. A small blue flame appears, soon reflecting over place, a sign that brass is melting and heat is dissipating zinc constituent of brass; the brass having melted and run into joint, job is done. Centesimal composition of various hard solders:—(1) Very refractory, 57·94 copper, 42·06 zinc, 5 tin, 1·20 lead; (2) very refractory, 58·33 copper, 41·67 zinc; (3) refractory, 50·00 copper, 50·00 zinc; (4) readily fuse, 33·34 copper, 66·66 zinc; (5) half white, 44·00 copper, 49·90 zinc, 3·30 tin; (6) white, 57·44 copper, 27·98 zinc, 14·58 tin; (7) malleable sol., 72·00 copper, 18·00 zinc, 4·0 tin; (8) hard sol., 53·30 copper, 46·70 zinc., &c. See Braunt—"Metal-Worker's Handybook."

REGENT'S PARK.

[97304.]—**Oxygen.** — Think not, as C.C. by water. Generally from metallic oxides, in usual way of retort over lamp with double-neck glass globe, and by bent tube under glass jar, lower end immersed in water trough. See books on chemistry.

REGENT'S PARK.

[97304.]—**Oxygen.**—Oxygen is easily obtained by adding cold water to dioxide of sodium $Na_2O_2 + H_2O = 2NaHO + O$. Aqueous solutions of ferrates give off oxygen when concentrated.

W. M.

[97305.]—**Small Milk Separator.**—No doubt most are made so. 2,000 revs. per minute may be fair; large ones—say, Alpha Laval—run 6 to 7,000 with 12 to 360gal. per hour. See Oliver on "Milk, Cheese, and Butter," or inspect Dairy Supply Co.'s and other dealers' makes. REGENT'S PARK.

[97307.]—**Fireclay.**—Get some good fireclay—granite, if possible, what they use for crucibles, and at Sheffield, &c., in furnaces, mix with water to a proper consistency, workable without dropping, lay on with trowel, wetting the place first, and leave to dry for several days before use. You may, in some ironmongers, get fired clay blocks ready to insert. The expense of either would not be great. Should you fancy using petrifite plaster at about 6s. or more the bushel, I think, at depot, Orchard-yard, Blackwall, E., that stands a great heat is very adhesive, to anything and dries adamantine in hardness. REGENT'S PARK.

[97307.]—**Fireclay.**—Take the finest ashes from under your grate, and mix about two parts in bulk to one of good fireclay or pipeclay, well work it up with brine or water with about as much salt in it as it will take up cold, and fill up your odd corners with that. JACK OF ALL TRADES.

[97308.].—**Soda and Uric Acid.**—Bicarbonate of soda used in certain stewed fruit, say what will cover a shilling to each pound of fruit. Cane-sugar more prone to create acidity than milk-sugar. Digestible form of fat is cream and hot water equal parts, with 10 drops of sal-volatile to each fluid ounce. You can soon see whether you have uric acid by testing with litmus paper; the urine turns red. Probably arises from overfeeding. It is difficult to define diets for different ages and temperaments; habits, outdoor or indoor, each require modification.

REGENT'S PARK.

[97311.]—**Soluble Sodium Silicate.**—This is an ordinary glass, made of sand (silica) and soda, with so large an excess of soda as to render it soluble in water. The resulting solution, which is rather syrupy, has been used to render wood and textile fabrics uninflammable. It was employed by Von Fuchs in his stereochromatic wall-painting, also by Ransome in the preparation of artificial stone, and for preventing the destructive influence of the atmosphere on certain soft stones in public buildings—e.g., the House of Commons. Soluble sodium silicate, or "water-glass," may be prepared by fusing together 45 parts of silica, 23 parts of calcined soda, and 3 parts of charcoal.

S. BOTTONE.

[97311.]—**Soluble Sodium Silicate.**—Suppose you mean water-glass; if so, for protecting white colours in printing processes, for silicifying stones, for bleaching purposes, for finishing linen and cotton goods, binding and fixing medium for ground colours for cotton goods, for painting, for rough-casting walls, for painting metals and glass, for cements, &c. REGENTS PARK.

[97313.]—**Screw Propeller.**—If models of each other, the pitch of the small ones will be half that of the large one, so the speed will be considerably less. If the pitch is the same, the blade area of two propellers with ½in. blades will be less (about half) than that of the single propeller with the same number of similarly shaped blades 1in. long; so there will be more slip and less speed in this case also. GLATTON.

[97314.] — **Wimshurst Machine.**—To MR. BOTTONE.—An 18in. Wimshurst, with even one pair of ebonite plates, will light up a tube that no 6in. spark coil will touch. You will find full working directions for making such a machine in my book "Radiography," which you can see at almost any public library. In the new edition of "Electrical Instruments," which is now in the hands of the printers, I have dedicated a chapter specially to the construction of X-ray Wimshursts. Should you not be able to wait till that appears, and care to write to my address as below, I will post you a little pamphlet on the subject.

S. BOTTONE, Electrician.

Wallington, Surrey.

[97315.]—**Increasing the Power of a Steam Engine.** — Utter balderdash! It don't. This American joke (?) has not even the merit of being funny or plausible. GLATTON.

[97317.]—**Coaling Locomotives.**—If trucks of coal are shot in automatic self-acting hoppers and weighing machines to waggons or sacks below, as done for years at Midland Coal Depot, St. Pancras-road, by the invention of a deceased member of Parliament, the introducer, and persistent advocate, in or out the House, of the load line mark for ships. I see no reason why something of the sort should not be done for loco. tenders by having a movable sloping floor between axles of waggon, and lifting trucks by hydraulic pressure is rampant nowadays, and thus shooting out the five tons usual.

REGENT'S PARK.

THE Board of Trade have informed Mr. J. E. Ellis, M.P., who has taken an interest in the question of the date of issue of railway companies' time-tables, that in future time-tables will be issued five days clear before they are to come into operation. The Railway Companies' Association have, within the last few weeks, informed the Board that this arrangement has been made as the result of the meetings held by the general managers of the various railway companies to consider the matter.

UNANSWERED QUERIES.

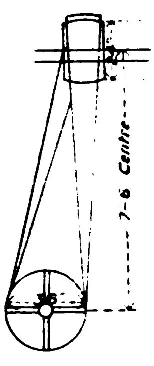
The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last, "Glatton" has replied to 96727, 96740, 96751, 96779, 96784, 96796.

QUERIES.

[97318.]—**To "Jack of All Trades."**—I am sorry I am not able to comprehend the information you kindly gave on screw gear-wheels, although I have looked at number you refer to. I cannot understand how to use and where to fix the angle-plates. Also how to use the tool and where to fix for cutting, although I am used to a lathe—yet it seems a mystery.—J. A. C.

[97319.]—**Belt.**—Will "Monty" or some other reader kindly advise me as to the following? I have a 6in. belt on a quarter twist (as per sketch inclosed). Ordinary leather



belts only last a very short time, owing to the great strain and such short centres—only 7ft. 6in. I thought of trying rope-driving, but am told that ropes would be no good on such small pulleys, and I have only room to enlarge them 6in. Will someone kindly tell me what would be best. About 12H.P. Also, could anyone give me the name of a good book on carding machines?—W. MOORE.

[97320.]—**French Black Stain.**—Can any kind reader oblige me by giving correct recipe for above? I have tried numerous experiments from books, but each one will not penetrate into the hard woods (such as oak and birch) sufficiently deep to stand thoroughly glass-papering.—T. DYSON.

[97321.]—**Oxyhydrogen Blowpipe.**—Will any reader kindly give me the full information regarding the making of an oxyhydrogen blowpipe, also that it may be used for limelight? What is the best method of preparing the gas (oxygen and hydrogen) under pressure? What will be the cost of a platinum burner for same? Is there any danger in the use of this gas?—R. M.

[97322.]—**Cement for Rubber.**—I have a long cut in the rubber of the outer cover of my bicycle tire. Ordinary rubber solution will not hold the cut together. Can you tell me how I can make something suitable for the job?—HAROLD WATKIN.

[97323.]—**Dynamo.**—I have a dynamo which I cannot get to work. Would any electrical readers kindly tell me the cause, &c.? Field-magnets, 2in. long by $\frac{3}{4}$in., thick, wound with No. 22 B.W.G. in the form of ∾, the two ends joined together, and the two beginnings connect, on to brushes. The armature wound with No. 20 B.W.G., and the ends connect on to two-part commutator Siemens armature. Slits in the commutator face slits, in armature, the dynamo is of under-type, and brushes are set in upright position. The dynamo is magnetised. Kindly state the cause of not working. I cannot get the slightest deflection with a galvanometer. I have also tested for leakage.—MUNROE.

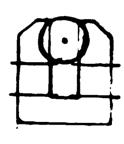
[97324.]—**Gas-Engine.**—Will readers who have had considerable experience in gas-engines kindly answer me the following in as simple a way as possible? I have a $\frac{1}{4}$H.P. gas-engine, which has been working well up to this last week; but since then, for some unaccountable reason, it has suddenly stopped, and, try my best, I cannot get same to work. I had a new crank put in lately, and this crank has a $\frac{1}{16}$in. longer throw than the old one. I have had both valves out and cleaned. When trying to start, and after revolving fly wheel for about thirty times or revolutions, I get a tremendous explosion, which almost takes the engine off its bed. Just before engine stopped working altogether, the exhaust, instead of making the usual noise, used to go off like a gun. Ought the spring on the inlet valve to be stiffened, and is the exhaust working quick enough? I should feel greatly obliged if any reader would give me a full explanation as to the cause of this bad working of the engine?—MOUSETRAP.

[97325.]—**Wireless Telephone.**—To MR. BOTTONE.—Many thanks for reply to query "Wireless Telegraph." Now, would you kindly inform me concerning the above? I want to make a wireless telephone to work for about a mile. How is it arranged? Is an induction coil and coherer used, and, if so, how? I understand that an ordinary telephone receiver and transmitter are used. A sketch would greatly oblige, giving dimensions.—F. C. CHASE.

[97326.]—**To Mr. Bottone.**—I have made a sort of musical-box arrangement for simultaneously striking, with ordinary electric-bell strikers, three sets of hand-bells, of eight bells each, which are to be placed in different parts of a large house. What will be the best way of arranging these—in series or in parallel? Any information will be gratefully received.—R. M. G.

[97327.]—**Sparking Coil.**—Will any kind reader tell me how to make a sparking coil for motor-tricycle, or refer me to a good work on the subject?—STYL.

[97328.]—**Small Dynamo.**—To MR. H. HUMPHRIES.—I wish to make a small dynamo of the type shown in sketch, and it must have either a ring or drum armature.



The output required at 3,000 revs. is 1 or 2 amps. at six-volt. pressure. Please say what size to make it, and what quantity of wire to use? I wish to keep to the proportions of sketch, so as to have the armature low.—F. C. CHASE.

[97329.]—**Electrical Contact for Regulator.**—Will some kind reader please tell me how to make and fix an electrical contact to an eight-day regulator with seconds pendulum to operate an electro-magnet, the armature of which is to work with a wheel having 60 teeth, so that at each swing of the regulator pendulum the magnet shall attract the armature and by so doing shall cause the wheel to make a revolution in one minute, and this wheel to work others for minutes and hours. Sketch would oblige.—NOVICE.

[97330.]—**Steel-facing Copper Plates.**—I beg to thank Mr. Bottone for his reply (p. 410) to my question No. 97210, p. 388, but must confess I had hoped to receive fuller information. He seems to have supposed that all I required to know was whether my series-wound Gramme dynamo could be used for this work, whereas I was, and am, quite prepared to employ a more suitable machine if he had suggested one, after having given his reasons why the said machine is unsuitable. In part (2) of this query I asked how to regulate intensity of current with varying surface of copper in vat, and instruction for constructing a variable resistance if needed. In part (3), what is the best solution to employ, having experienced little success in preliminary experiments? All this Mr. Bottone appears to have overlooked, unless his answer is "to procure Bonney's 'Handbook on Electro-Plating'" (which I have written for). Hitherto I have carried out my experiments based on the contents of Watts' "Electro-Deposition," but regret that this book does not give sufficient details of plating plant by current from dynamo. Moreover, this being a relatively little-practised process, the information is necessarily scant. I shall be extremely obliged to any reader who has had experience in this class of work for a sketch of plant, best voltage, number of ampères for given surface of copper, recipe of solution, and any other hints he may be disposed to give me.—TRINACRIA.

[97331.]—**Dynamo Coils.**—Could any reader kindly tell me the reason the coils of a shunt-wound dynamo heat after a few minutes' running? Would putting a resistance in shunt make the lamps glow more brilliant and stop the heating, or does it want more than four lamps in circuit for a 50 volt 4amp. dynamo?—PERPLEXED.

[97332.]—**Electric Ignition Coil for Motor Car.**—Will Mr. Allsop or Mr. Bottone please furnish me with particulars for making coil to be worked from four dry batteries?—viz: (1) length and diameter of iron core; (2) number of turns and gauge of primary wire; (3) weight of secondary wire and thickness of same; (4) is it essential that the secondary should be wound in several sections?—F. W. BERNARD.

[97333.]—**Spring Pressure.**—I want to work the downward thrust of a pump by means of an open spiral spring, so as to get pressure of 40lb. to the square inch. Size of plunger is $\frac{3}{8}$in. diameter, cylindrical. What pressure of spring should I use?—B. E. S.

[97334.]—**Spiral Barrels.**—To "J. H."—It is some time ago that I wrote to the "E. M." asking how spiral barrels were made. I was very pleased on opening the "E. M." of Dec. 22 to find such valuable information on the subject. I wish to thank "J. H." for the same, and ask if he can give information on making the larger barrels in loam?—ROBT. CRAWFORD.

[97335.]—**Dandruff.**—Among the innumerable preparations advertised for allaying and preventing scurf or dandruff, only one out of all I have tried has anything like the desired effect, but the price of latter is so high that its continued use means a very big item. I would be glad, therefore, if any of "ours" will suggest the probable ingredients employed in the preparation referred to (it appears like lard, and when rubbed on the hands or head shows traces of some white gritty powder), as I am certain it would prove a boon to many thousands of your readers besides—ME.

[97336.]—**Roller Bearings.**—On p. 174, "J. H." mentions some trials with roller bearings on tramway cars, which proved an advantage in their usage. Would not roller bearings be useful on ordinary carts, cabs, &c., and what is the reason they are not employed on locomotives, traction engines, &c.? Is there any mechanical difficulty? The opinions of your readers on this matter would be welcomed, for if roller bearings are useful on road-cars, why not on locomotives?—ROTA.

[97337.]—**New Form of Microscope.**—Can any reader explain this new form of microscope, thus described? According to *Technische Notizen*, the celebrated Parisian oculist, Dr. Emil Berger, has constructed a binocular microscope which admits of seeing objects plastically—i.e., in relief. As is well known, the stereoscopic effect is lost by the use of only one eye, and consequently of our monocular microscope, not to speak of the harmful suppression of the vision on one eye at the expense of the other. This new microscope places the object in a normal distance (about 33 centimètres) from the eye.—MYOPS.

[97338.]—**Motor Tricycle.**—To "THE WRITER OF THE ARTICLES" OR "MONTY."—Will either of the above gentlemen say if they know any two-speed gear suitable for the Di Dion tricycle, preferably one that can be thrown in and out of action while engine is running? By this, I mean that if I am compelled to stop tricycle when going up a stiff hill, I wish to leave engine running so as to avoid doing the treadmill business before I can again start on my journey.—F. W. B.

[97339.]—**Accumulator.**—Will Mr. Bottone or any other reader kindly tell me how I can charge a four-volt pocket accumulator with a dynamo giving 50 volts 4amp.? Kindly state the resistance required, and position of resistance, if any? A sketch would greatly oblige.—PERPLEXED.

[97340.]—**Oil-Engines.**—Could "Ignition Tube," or any other reader having had experience, kindly tell me the cost of running per hour with a $\frac{3}{4}$B.H.P. engine, also starting and driving; and is the knocking in cylinder caused by not having sufficient oil with mixture? The engine I refer to is one of Barker's $\frac{3}{4}$B.H.P. oil-engines, running at 350 revs. per minute.—W. P.

[97341.]—**Small Dynamo.**—Could Mr. Bottone kindly tell me a simple way I could wind an eight-cogged drum armature 3in. long by $1\frac{1}{4}$in. diameter, spaces for winding $\frac{3}{8}$in. wide by $\frac{1}{4}$in. deep, for a 20 volt 3 to 4 amp. dynamo? Would No. 22s.c.c. wire be suitable for winding F.M. and armature, as I should like to obtain the best result possible? Kindly state size and weight required.—PERPLEXED.

USEFUL AND SCIENTIFIC NOTES.

A NEW type of wheel for traction engines has been invented in America. Surrounding the hub of the wheel is a ring carrying rollers which bear upon the bottom of a groove formed in the hub. Arms pivoted to lugs on the outer side of the ring extend outward tangentially to the ring, and carry at their free end blades which project through openings in the rim, and which adapt themselves to the nature of the ground. Springs are connected at their inner ends to the ring, and are adjustably secured at their outer ends to brackets on the rim. Should the wheel travel over hard ground, the blades, as they engage the ground, will be forced inward, causing the ring to rotate on its bearing rollers. Upon reaching soft ground the blades will be moved outward by means of the springs, acting upon the ring, so that they will engage in the ground.

Electric Locomotive for the Jungfrau.—The electric locomotive constructed by Brown, Boveri Co., destined for the Jungfrau Mountain Railway, is said to be the most powerful rack-wheel machine hitherto constructed, and is designed to haul trains over the steepest portion of the road. The motors are placed under the passenger cars, whereby greater adhesion between the driving-wheels and rails is obtained. The car truck is provided with two bearing-axles and two driving-wheels, the latter being situated between the former. Two motors, each of 125H.P. at 800 revolutions per minute, actuate the toothed wheels through the medium of duplicate gearing. If required, these motors are capable of working up to 300H.P. The driving current is conveyed overhead at a tension of 500 volts. The pivots of the toothed wheels are of aluminium-bronze, the teeth being of cast steel.—*Feilden's Magazine.*

Belgian Artificial Stone.—An artificial stone from Belgium has recently been introduced into the French market, which is said to have four times the force of resistance of French freestone, and which has nearly all the properties of Cobestang granite. Consul Atwell, of Roubaix, states that it has been tried in the Malines Arsenal, and is found to be insensible to the action of cold, absorbs only 6 to 7 per cent. of water, even after a long dry spell, and cannot be crushed under a pressure of 40 kilogrammes (88lb.) to the square centimètre (square centimètre = ·155 square inch). This artificial stone is manufactured at Uccles, near Brussels, in the following manner:—Eighty parts of extremely clean and dry coarse sand are mixed with 50 parts of hydraulic lime reduced to a fine dry dust; this mixture is put into an iron box, which is plunged into a boiler of water, and this is hermetically closed. During 72 hours the cooking goes on under a pressure of six atmospheres, the temperature being maintained at 165°. At the end of this time, the iron box contains a perfect homogeneous mass of stone, which rapidly hardens upon exposure to the air. The most varied colours are given to this stone, and its manufacture costs only one penny per cubic foot.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such iinformation, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Dec. 27, and unacknowledged elsewhere:—

S. R. Bottone.—T. G. Challis.—W. Murdoch.—W. M.—Rev. A. C. Allen.—S. R., Bromsgrove.—James Paris.—William Godden.—Comus.—E. L. Garbett.—Ell Hay.—Jack of All Trades.—O'Dermid W. Lawlor.—A. Stammwitz.—Richard Inwards.

I. F. H. Gregg.—Thanks; but your account comes too late. A fortnight or three weeks ago we should have been g'ad of it.

W. H. S. Monck.—Too late for this week, and will be still later next.

W. H. Skelton.—Glad to see you any time. Have posted another copy.

C. G. S.—M.—Too vague and too vast for us to discuss. You must remember it is only the educated minority that are alive to the healthier influences you mention. The majority are still dominated by superstition and empiricism. Take the average doctor—he is as much a creature of rule of thumb as his forbears of five thousand years ago! The race has to live all this out; that is the only hope.

R. C. Gilson.—Probably the roller you have is one of the indiarubber or improved forms. The purpose for which the "inking rollers" are required is not stated. Some of those used in ordinary printing are made of glue and treacle—others have glycerine added with a little bichromate of potash solution to make them insoluble after exposure to light.

John Bowden.—All information of the kind required can be obtained from the secretaries of the institutions. In the special case, probably the "qualifications" amount to *nil*.

F. A. M.—Doubtful if there is such a work published. Electricity is a "wide" subject now, and although there are manuals giving practical directions for making apparatus, they cannot cover the whole field. You will find much information as to special points in back volumes; but "showing how to make the apparatus" is the point. Several useful works are advertised in our columns.

L. W. Hutchings.—Thanks; but we cannot spare the space just now.

The world's loss of sailing vessels during the first half of this year amounted to 92 ships, of 51,191 tons; of this number the United Kingdom supplied ten, of 9,109 tons.

The application of power-brake and automatic couplings in the United States, according to the latest report of the Interstate Commerce Commission, stands as follows:—Out of a total of 9,956 passenger locomotives, 9,845 are fitted with train brake apparatus; and out of a total of 33,595 passenger cars, 33,149 were so equipped at the end of June, 1898. Of the passenger locomotives, 5,105 had automatic coupling, and 32,697 passenger cars were thus equipped. In freight service 19,414 out of a total of 20,627 locomotives had train brakes and 6,229 had automatic couplings. Out of 1,248,826 freight cars, 567,409 had train brakes and 851,533 had automatic couplings.

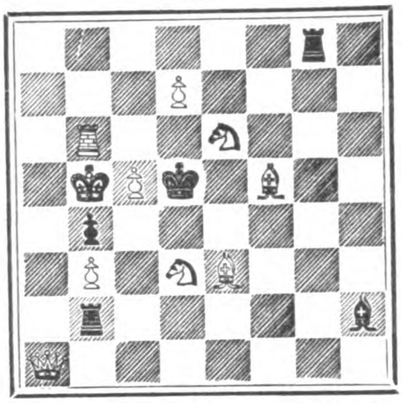
Night - Blindness.—Night - blindness, called also nyctalopia or hemeralopia, is a functional disorder of the visual acuity causing great inconvenience, and often producing a state of mental panic in the unfortunate person who is suddenly affected by it. An individual still retaining his normal acuity of vision in the daylight suddenly notices that his sight has failed when twilight comes on. It is caused by exposure of the eyes to a very bright light, such as a Tropical sun reflected off the dazzling surface of the Tropical ocean. Soldiers affected have been campaigning or on long marches exposed to the glare of the sunshine, and liable to find rations run short, and to be bereft of their usual and necessary amount of sleep, so that their vitality becomes lowered. This also accounts for the cases recorded accompanying attacks of scurvy.—*Hospital.*

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1706.—By J. Graves.

Black. [5 pieces.



White. [10 pieces.

White to play and mate in two moves.

(Solutions should reach us not later than Jan. 8, 1900.)

Solution of Problem No. 1705.—By L. Hawkins.

Key-move, B-K 2.

NOTICES TO CORRESPONDENTS.

Problem No. 1705.—Correct solution has been received from Richard Inwards, T. Clark, Rev. Dr. Quilter, A. Tupman, Whin-Hurst, F. B. (Oldham), Quizco, Jas. Mason, Will Barton.

T. C. (Barnet), Frank Gowing, H. B. F.—Only solution, as above.

ADVERTISEMENT CHARGES.

The Charge for Advertisements in the Columns headed:—

For Exchange.
For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. *No* reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

For advertisements on inside pages, except page facing leader, for less than a quarter-page; per inch single column—

1	6	13	26	52 insertions
7s. 0d.	6s. 6d.	6s. 0d.	5s. 6d.	5s. 0d. each.

Per Column.—

1	6	13	26	52 insertions
£3 0s.	£2 15s.	£2 10s.	£2 5s.	£2 0s. each.

	1	6	13	26	52 insertions.
	£ s.	£ s.	£ s.	£ s.	£ s.
Per Page....	8 8	7 0	6 0	5 5	5 0 each.
Half-page ..	4 10	3 15	3 10	3 0	2 10 ,,
Quarter-page	2 10	2 5	2 0	1 15	1 10 ,,

Back Page, £10 10s. A few dates open during 1899.

ORDINARY ADVERTISEMENTS.

	£ s.
Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "——," care of the English Mechanic Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to The Strand Newspaper Company, Limited, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent One Month before expiration, in order to give them time to forward fresh remittance before subscription expires.

SPECIAL OFFER.—CHEAP VOLUMES.

In the course of the next few months we are compelled, owing to the making of the new street from Holborn to the Strand by the London County Council, to remove our Offices and Printing Works. Due notice of our removal will be given shortly. In the mean time, to reduce stock and save trouble of removal, we offer readers desirous of making up sets of back volumes *any volume* in the list below at half price, or post free for 4s. 1d.

Any reader desirous of making a free library or working men's club a present of a few sets of volumes will find this a favourable opportunity. The offer is only available till our removal.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXIV., XXX., XXXII., XXXVI., XXXIX., XL., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., and LXVIII., bound in cloth, 7s. each. Post free, 7s. 7d.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except xapu numbers, which are 3d. each, or post free 3½d.)

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

Special Notice. — ***Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.***

Steam Launch, 27ft. multitubular boiler, 130 working pressure, fast, sell cheap, exchange Motor-Car.—Wheeman, Richmond.

3½ by 5 **Launch Engine**, complete, first-class article, £10, or exchange Gas-Engine.—Wheeman, Richmond.

Telescope. Calver 8½in., finder, eight eyepieces. Wanted, good light Brass-finisher's Lathe.—Banks, Corporation-street, Bolton.

Exchange good **Broadwood Piano** for lady's and gentleman's Bicycles, or good offer.—C. W. Searle, Sunning Hill.

Wanted, Gramophone Records. Exchange Echophone Phonograph, takes Edison's wax records, clockwork, with governors, in carrying box, value 20s.—James Sharp, High-street, Sanquhar, Dumfriesshire.

Organ, pipe, nearly finished, 339 pipes, two manuals and pedals. Exchange American Organ and cash to value, or offers. 363, Mile End-road, E.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of **Screws, Bolts**, and Nuts for model work, drawn to actual size, sent on receipt of stamp.—Morris Cohen, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—Morris Cohen, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—Clegg, Belinda-street, Hunslet, Leeds.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—Jarratt, Queen-street, Leicester.

Eyesight.—All whose sight is in any way defective should send to Horne and Thornthwaite, 416, Strand, for—

"Hints on Spectacles" (Why the Eyes want Help), by Overstall, F.S.M.C. (with distinction), post free.—Above.

Rubber Outer Covers, 3s. 6d. Prepared Canvas, 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—Pemberton.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—Pemberton.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—Pemberton.

Detachable Outer Covers (Licensed), 12s. 6d. each; all cycle accessories and cycle rubber goods stocked.—Pemberton and Co., 1, Cardwell-place, Blackburn.

Nuts and Bolts for Model Work. Illustrated List, 2,800 varieties, 3d.—Butler Bros., Haggerston, London.

Screws, Screw-plates, Taps, round and hexagon special steel brass and iron rods. See list.—Butler.

Brass and Gunmetal Castings of finest quality. Prices on application.—Daniel Young, Witney, Oxfordshire.

"Acetylene: its Characteristics, Generation, and Use," with Descriptive Catalogue of "Incanto" Apparatus; just published, 2d. post free.—Thorn and Hoddle 1 Tothill-street, Westminster, S.W.

Simplex Typewriter, 14s. 6d., delivered. Thousands in use. Illustrated particulars free.—Atkinson and Co., Harehills-avenue, Leeds.

The English Mechanic
AND WORLD OF SCIENCE AND ART.

FRIDAY, JANUARY 5, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—I.

IN introducing this design of motor-carriage to the readers of the ENGLISH MECHANIC, I would point out that there are no startling innovations; but I have endeavoured to make it as simple and cheap to build as is consistent with efficiency and strength. To this end, I have adopted the single-cylinder horizontal motor and belt transmission gear as the most simple arrangement. The use of belts makes a much more silent car than gearing; the starting is more gradual than with the usual friction-clutch as used with gear-wheels, and with quite a moderate amount of attention they will be found to work extremely well. As requested by several readers, my first article gives a general arrangement and description of the car, from which the disposition of the motor and gearing will be apparent. The car, as shown, is fitted with two speeds—one a slow or power gear, the second for use on level roads or when fairly fast travelling is required. The two belts give speeds of five and fourteen miles per hour respectively, any speed between or under these being obtained by regulating the engine. As will be seen later on, when treating of the belt gear, three, or even four, speeds forward and a reversing gear can be readily fitted, at the option of the builder.

Whilst fully recognising the desirability of having plenty of power, yet it must not be forgotten that a very powerful motor mounted in a light car gives rise to unpleasant vibrations, and tends to shake the carriage to pieces very rapidly. Therefore, for our carriage, which is intended to carry two persons only, I believe the happy medium will be a three-brake horse-power engine. As many of my readers may like to know the data on which the dimensions of the engine are based, I give them here. Bore of cylinder, 4in.; stroke, 5in.; compression, 50lb. per square inch above atmosphere—i.e., 65lb. per square inch absolute. Now it may be taken that the mean effective pressure in the cylinder is roughly 75lb. per square inch. The engine is designed for a normal speed of 700 revolutions per minute, and using the ordinary formula—

$$\frac{P \times L \times A \times E}{33,000},$$

where P = mean effective pressure in pounds per square inch.
L = length of stroke in feet.
A = area of cylinder in square inches.
E = number of explosions per minute.

we get— $\frac{75 \times \cdot 416 \times 12\cdot 56 \times 350}{33,000} = 4\cdot 17$ I.H P.

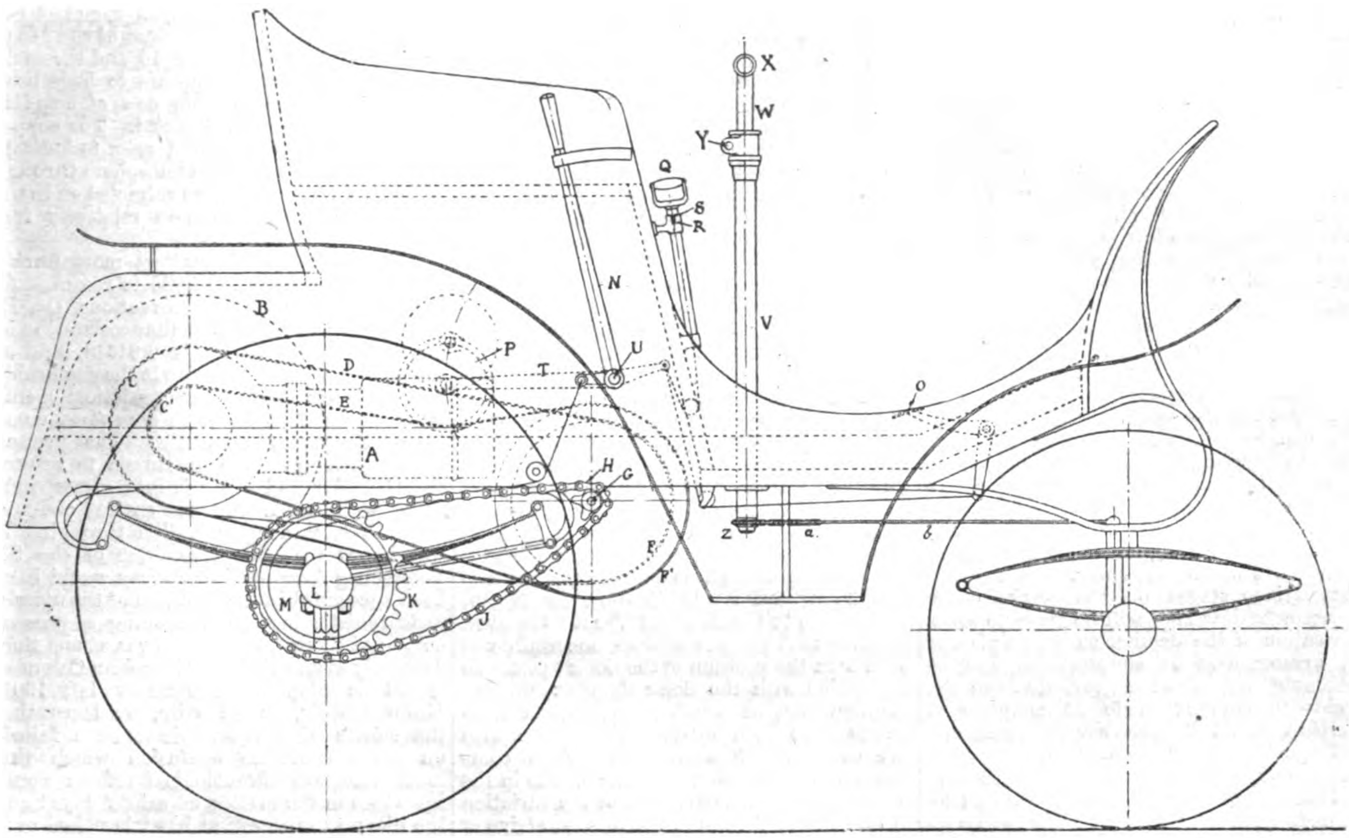
Allowing an efficiency of 75 per cent. makes it 3-brake horse-power. At times it would be possible to increase the speed of the engine slightly with a corresponding increase of power. This engine will be of ample power to propel a light car, such as I am about to describe, carrying two persons over any ordinary route where the gradients are not abnormal. A third passenger, if of light weight, or luggage, could be carried, but in this case the hill-climbing powers would suffer.

With regard to the cost of building the car, much depends on the upholstering and finish, and on the tires selected, whether pneumatic or solid rubber. Fig. 1 is a side elevation of the complete carriage, with the motor, &c., shown dotted. The reference for the letters is as follows:—

A is the motor, with its flywheel B placed horizontally in the rear of the car. On the crank-shaft are keyed the high-speed pulley C and low-speed pulley C'. These pulleys drive, by means of the belts D and E, the pulleys F and F' keyed on the countershaft G. This countershaft has a differential or balance-gear, and on the extremities are the spocket pinions H, one of which only is shown. A chain, J, connects each sprocket pinion with a larger sprocket-wheel K fastened to the road wheel-hubs L. Concentric with the sprocket-wheels are brake-drums M, encircled by brake-bands operated by the hand-lever N. Another band brake-drum is keyed on the countershaft, but not shown in Fig. 1. This brake is put into action by depressing the pedal O with the foot. When either brake is used, the engine is put out of gear with the countershaft in this manner. The belts normally run slack over their pulleys. The jockey-pulley P is arranged in such a manner that it can readily be brought vertically over either belt and depressed into contact with it. Hence the belt is tightened, and the car propelled at a slow or high speed, according to the belt in use. When, however, the brakes are used the jockey-pulley is raised, thus cutting off the power from the road wheels and allowing the motor to continue running although the car is stationary.

Change of speed is effected by means of the spade handle Q, which is first raised till the peg R is free of the slot S, this movement raising the jockey pulley, the handle is next rotated till the peg R is over the next slot, and this slides the lever T, carrying the jockey pulley laterally, along the shaft U (or rather along a sleeve on that shaft), when, the handle being released, the jockey pulley is lowered on to the other belt. The jockey pulley is kept down to its work by means of helical springs, not shown, which are adjustable so that the tension on the belts may be arranged to the best advantage. It will be observed that the connections from the brake lever, brake pedal, and speed-changing handle to the jockey pulley are made by means of flexible steel wire cords, which is a much cheaper method of construction than rods and bell-crank levers. Moreover, it allows of the various parts being arranged to suit the convenience of the driver much more readily than rigid rods and levers would do. The cords are always in tension, hence they may be used very easily.

V is the steering post, which has the steering-rod W carried on ball bearings within it, in the same way that a bicycle steering head is made, but stronger. At the top it is furnished with either a handle-bar X, or wheel, adjustable for height by the clip Y. At the lower end of the steering rod, below the footboard, is a small sprocket pinion Z. A short length of chain a, and



rods *b*, connect this pinion with the steering gear on the front axle. To start the motor I shall use a steel wire cord, connected to a clutch gear on the crank-shaft, the other end of the cord being attached to a handle within easy reach of the driver. The back of the car will be made to open to give access to the mechanism. The petrol will be carried in a tank below the seat where there will be room for about 4gal., sufficient for a run of from 60 to 70 miles over easy roads. The carburettor is of the surface type, the flow of petrol from the tank to carburettor being regulated by a float and valve of simple construction. At each side of the car are water tanks, the circulation of the water being natural; but I shall describe an addition in the form of a water cooler, though for this a pump will be necessary to insure circulation.

The ignition of the charges in the motor cylinder will be by electric spark, and the timing of the ignition will be regulated from the driver's seat. In addition to this there will be two other small levers, one of which is to be used to adjust the relative quantities of air and gas for the engine, the other being connected to a throttle valve. By manipulating this latter and the ignition gear, the speed and power of the engine can be regulated to a nicety.

The frame of the car can be made of various materials, either steel angle-bars, weldless steel tubing, or wood flitched with thin steel plates. For ease of construction the last mentioned will be the material selected for our car. If carefully made, this will be found in every way suitable, and though probably slightly heavier than steel tubing, yet the ease with which the various parts can be attached, combined with low cost and suitability for amateur work, renders this method of construction preferable. If desired, either of the other materials can be used. A little thought will indicate what alterations in the design of the various component parts will be necessary.

At various stages of the work, other arrangement drawings will be given to show the relation of the details, such as a plan of car, arrangement of countershaft and of front axle and steering gear, &c., and the articles throughout made as complete as possible to avoid the necessity for guesswork on the part of intending builders.

At the present time I do not think there is a belt-driven car which can be stopped by putting on the brake only. With those on the market, one has to first shift the belt on to a loose pulley or raise a jockey pulley before putting on the brake. Thus, two entirely separate movements are necessary, whereas with our arrangement it will be possible to drive the car amongst traffic and regulate the speed, stopping and restarting entirely by the foot, leaving the hands at liberty to steer, apply the second brake, or signal to drivers of other vehicles. The convenience of this when hemmed in by traffic is very great. It also allows of a sudden stop, in case of emergency, being made without the risk of forgetting to attend to the belt, which, if left "on," stops the engine as well as the car when the brake is applied. The pressure of the jockey pulley on the belts will be found to be much less than would appear at first sight: hence the wear and tear of the belts will be slight. To prevent slipping and breakage of the belts, I intend using them about double the width of those in use on cars of equal, or even slightly greater, power. There is one make of car of which a large number have been sold, which is 3½H.P. The belts in this car are 1¾in. wide, and to transmit the power they have to be tight, which rapidly wears out both belts and bearings. In our car I shall use belts 3in. wide, which will give a greatly-improved drive with much less tension.

In carrying out the design of our car, I have endeavoured, as far as possible, to rectify whatever my experience teaches me to have been defective or wanting in the majority of light motor vehicles at present on the market, at the same time bearing in mind the necessity for simplicity and low cost.

THE PROGRESS OF ASTRONOMY IN 1899.

VIEWED from an astronomical point of view, the penultimate year of the 19th century has proved by no means a sensational one. Probably the most interesting event which has occurred in it has—if we may be forgiven the Hibernicism—never happened at all. We refer, of course, to the shower of Leonids on Nov. 14-15, to which reference will be made in its proper place.

Of observation of, and fresh discoveries in connection with, the Sun, we have little or nothing to chronicle. The small partial Solar Eclipse which occurred during the early morning of June 8 was not seen at Greenwich, owing to cloud. The few observations of it which were published are quite destitute of interest. Another partial eclipse, which happened on Jan. 11, was only visible from inaccessible parts of the Pacific Ocean, while no reports of observations of the annular one of December 3 have reached this country from either West Australia or New Zealand at the time at which we write. As, however, it was merely the line of simple contact that passed through both these localities, it may easily be imagined that nothing whatever of the slightest scientific value is to be expected. Yet another determination of the direction and velocity of the Sun's motion in space has been attempted by Prof. Newcomb, with the result that he finds, by one selected set of stars, that we are travelling at the rate of some 18·64 miles per second (and by another at a speed of 10·25 miles per second!) towards a point whose Right Ascension is 18h. 30m., and its Declination 35° North, i.e., a little to the South of Vega. He adds, however that there is still an uncertainty of 3° or 4° in the position of the Solar apex. In connection with the Solar Parallax, we may mention that, as usual, observers and computers have been busying themselves with the constant of aberration. First come Messrs. Rees, Jacoby, and Davis, who in the course of their investigation of the variation of latitude at Columbia University, arrive at 20·461″ ± 0·006″ as the value of this constant. We next have Mr. Thackeray discussing the observations of Polaris made at Greenwich between the years 1836—1893, with a resulting constant of aberration of 20·49″; while finally, Herr Kniesche, of Göttingen University, employing the same observations, but in this case from 1851 to 1888, obtains a constant = 25·537″ ± 0·003″. Regarding the imminence of the Sunspot Minimum, a remarkable outburst occurred on the Solar disc on the morning of March 16th in a group which had appeared on the east limb of the Sun on the previous day. Another expiring effort took the form of a spot of considerable size, which persisted from June 23rd to its passage out of sight at the sun's western limb on July 6th. The area of this latter spot was estimated at some 500,000,000 square miles. Preparations for the observation of the Solar Eclipse of May 28th, 1900, are in active progress.

It can scarcely be legitimately said that any addition worthy of record has been made to our knowledge of the Moon during the year which has just ended. Prof. Very, as the result of an elaborate comparison of the radiation of heat from the Moon, and that from the surface of snow in full sunshine, found that the quality of the radiant heat emitted from the two sources was very different. A much greater percentage of the lunar rays was absorbed by a glass plate placed in front of the bolometer than it stopped from those reflected by the snow. It will be seen at once what grave doubt this throws upon the hypothesis of the late Mr. Peal, that the surface of the Moon was covered with, or made up of, ice and snow. The actual surface temperature of the Full Moon is estimated by Mr. Very to be something approaching to 206° Fahr., which is very near, indeed, to that of boiling water; while in the centre of the lunar disc, when the Sun is vertical, he believes that a temperature of about 324° Fahr. exists. On the other hand, Prof. Very supposes that the temperature of the Moon's night must fall to —360° Fahr.! With such tremendous alternation of temperature, it may well be that rocks are rent and shivered in all directions. We may perhaps mention here that MM. Lœwy and Puiseux continue to take their superb photographs of Lunar detail with the great equatorial coudé of the Paris Observatory. The Eclipse of the Moon on the night of December 16 and the early morning of the 17th appears to have been well observed, but nothing new of any importance to have been detected. The copper colour of the shadow would seem to indicate that that portion of our atmosphere through which the Sun's rays were refracted on to the Lunar disc must have been relatively free from cloud.

In connection with matters more purely terrestrial, we have but little to record. As the result of a series of observations, Dr. R. Schumann has found that the acceleration of gravity at Copenhagen is 9·81578, and at Christiania 9·81945. Owing to the deplorable war in South Africa, the geodesical operations at the Cape have, *ex necessitate*, come to a temporary standstill. The praiseworthy attempt made in Russia to reform the Calendar and bring it into correspondence with that of the entire civilised world has, unhappily, fallen through. It was hoped that the Committee of the St. Petersburg Astronomical Society would have been successful in the abolition of the utterly anachronistic mode of reckoning at present employed there. In fact, it was at one time definitely stated that the Gregorian Calendar would be adopted on January 1st, 1901. Unfortunately, as we write, we learn that the efforts of the committee have failed, on account of the confusion which this most necessary chronological reform would introduce in the matter of saints' days! and the like; so superstition has triumphed over science, and the priest over the philosopher. Such a state of worse than Mediæval ignorance, however, cannot endure for ever, and as education progresses in Russia we may look forward to her coming into line with the really civilised nations who are her neighbours. A remarkable series of observations and experiments in connection with the study of refraction have been made by M. F. A. Forel on and over the surface of the Lake of Geneva, who finds that the displacement of the apparent horizon due to refraction varies between +501″ and −272″, or a total variation of 773″. It must be noted that this applies to the horizon as viewed across a mass of water. Considerable discussion as to the nature and cause of the Gegenschein, or counterglow, has taken place during the past year, in which Prof. Barnard, Mr. Backhouse, Mr. Evershed, and Mr. Anderson have taken part. It does not, however, appear that any theory has yet been propounded, which will embrace and reconcile all the appearances that have arrested the attention of observers.

Turning now to the members of the Planetary System, we have nothing of any very great importance to record. Dr. G. W. Hill has attacked that, at present, practically insoluble problem—the mass of Mercury—from a novel point of view. The curious discordance between the values given by the perturbing action of this planet on Venus

and on Encke's Comet, drives Dr. Hill to the hypothetical conclusion that the materials forming Mercury, Venus, the Earth, the Moon, and Mars have approximately the same chemical constitution, derived from the primæval nebula from which our system was evolved. Finding, then, the mass of Mercury from analogy with Venus, the Earth, the Moon, and Mars, he finally deduces 11634200 as the mass-reciprocal. We greatly fear that he has simply wasted time over a most operose calculation. Yet another attempt has been made by Prof. W. Schur, of Göttingen, to measure the diameters and compression of Mars by the aid of the Repsold heliometer there, with the result that they indicate a compression of actually one-fiftieth. Employing another heliometer, also by Repsold, at Bamberg, and yet another, the Breslau one, at Strassburg, Dr. Ernst Hartwig arrives at very different results, inasmuch as he brings out the compression as equal to $\frac{1}{62}$. That the heliometer, though, is a trustworthy instrument for accurately measuring the diameter of a planet may very well be doubted. A series of valuable observations of Areographical detail have been made during the last opposition of Mars, by Mr. Gledhill, of Mr. Crossley's Observatory, with one of the new 9in. triple object-glasses. It is exceedingly interesting to find how the observations of this well-known and competent observer testify to the accuracy of the classical map of our neighbour in space, drawn by that splendid astronomical draughtsman, the late Mr. N. E. Green, F.R.A.S. Mr. Stanley Williams has also recorded a series of observations of his own of some of the so-called "canals" on this planet, but they call for no special remark. A most careful determination of the rotation period of Mars, made by W. F. Denning, F.R.A.S., makes it 24h. 37m. 22·70s.; Proctor's value, it will be remembered, being 24h. 37m. 22·735s., and Bakhuyzen's more recent one 24h. 37m. 22·66s. It is obvious that this quantity has now been determined with a very great degree of accuracy indeed. The detection of no less than 20 new Planetoids, whose orbits lie between those of Mars and Jupiter, has been announced; but at least seven of these have been proved to be identical with others previously discovered. Of the thirteen remaining ones, E E was discovered by Wolf and Schwassman at Heidelberg on Feb. 15, and E F on Feb. 17. The same observers have detected E O on July 17, E R, E S, and E T on Oct. 27; E U and E V on Oct. 31; and E W on Nov. 4; while Coggia, at Marseilles, first observed E L on March 31; Witt, at Berlin, E M on April 5; Coddington, at the Lick Observatory, E X on Oct. 2; and, finally, Charlois, at Nice, E Y on Dec. 4. As far as can be ascertained without an amount of investigation wholly incommensurate with the value of the result, 454 of these small bodies are now known. The comparatively favourable opposition of Eros during the present year will, of course, be utilised for the more accurate determination of the Solar Parallax. The latest determination of the eccentricity of the orbit of this remarkable body by Osten makes it amount to 0·2227695.

No discovery of importance has been made in connection with the superficial constitution and detail of the planet Jupiter; but the careful and elaborate researches and observations of Messrs. Denning and Stanley Williams among others have established the fact that the most curious discrepancies appear in the time of the rotation period as determined from spots in different latitudes, and even in some at the same distance from the planet's equator. If even now the question be asked: In what time does the solid body of the planet as a whole rotate beneath the superficial currents which we observe? the only reply that can be given is that we do not know. The work of the greatest interest in connection with this planet which has distinguished the past year is that performed by Prof. Barnard with the 40in. equatorial of the Yerkes Observatory, in his micrometrical measures of the Vth satellite, which have added notably to our knowledge of the orbit of this tiny attendant on the giant planet. *In limine* he finds that the line of apsides is moving round at the remarkable rate of some 2·465° per diem, or about 900° in a year; in fact that it makes a complete revolution in only 4·9 months. As the result of a most careful series of measures of the greatest elongations of the satellite, Mr. Barnard has finally determined its period to be 11h. 57m. 22·647s., and this he affirms is doubtless correct within 0·01sec. We have just said that Prof. Barnard computes the diurnal motion of the line of apsides of this satellite's orbit as 2·465° per diem. We may perhaps add that Dr. Fritz Cohn puts the motion of the perijove as being even more rapid still—i.e., as 911·7° annually, which would make its daily motion 2·496°. As far as Saturn is concerned, the chief interest may be held to reside in two papers by M. E. M. Antoniadi, F.R.A.S., read before the Society, on the constitution of the so-called "Crape" ring, in which he has successfully shown that the question of the relative brightness of the different portions of the planet's annular system may well be referable to the extent of the aggregation of their particles, and, in short, that it is more than probable that the albedo of the components of the three rings may be identical, and their brightness merely a function of aggregation. A far more sensational announcement in connection with this planet was made in March last, taking the form of an assertion that the examination of four photographic plates, taken at Arequipa with the 24in. Bruce telescope, had revealed to Prof. W. H. Pickering the existence of a 9th satellite to Saturn, *or* "a more distant outside planet." And here matters become a little vague, for we are told (or were told eight months ago) that the apparent motion was about 10·4" per diem, at a distance of 1,480" from the planet, and that a computation shows that if the orbit is circular, the period must be either 4,200 or 490 days! All this was made public last April, but as nothing whatever has since been heard of this remarkable new moon, there is some fear of its being relegated to the position of a celestial "Mrs. Harris." In connection with Saturn, it may be incidentally mentioned that Mr. Lynn has called attention in the columns of our contemporary, *The Observatory*, to a curious blunder which has been blindly copied from book to book concerning the time of the planet's rotation. It is put down as occupying about 10¼ hours, a quarter of an hour longer than the actual time occupied by Saturn in turning on his axis. The most extraordinary thing is that Sir John Herschel repeats this odd mistake. Of Uranus we have nothing to record, and of Neptune merely to mention that photographs of the planet and its satellite continue to be made at the Royal Observatory at Greenwich with the Thompson photographic equatorial with a view to the determination of the satellite's orbit.

The first, new, comet discovered in 1899 was found by Prof. Lewis Swift at Mount Lowe in California on March 3. It subsequently became a somewhat conspicuous object, and its head became duplicated, or was split into two. Photographed at the Lick Observatory, it was found that it had streamers and rudimentary tails diverging from the tail proper. The second discovery of an absolutely new comet was made by M. Giacobini on Sept. 29. Its orbit is seemingly hyperbolic. Numerous observations were also made of Brooks's, Coddington's, Denning's, Holmes's, Encke's, Perrine's, and Wolf's comets; but these are all periodic ones, and do not in strictness pertain to the year under review.

During the greater part of the year just past, scientific journals, quasi-scientific journals, pseudo-scientific journals, and journals and magazines without any atom of right to be considered scientific at all, vied with each other in predicting a superb display of those November Meteorites, now so familiarly known as the Leonids, on or about the 14th-15th of that month, and public expectation of a marvellous spectacle akin to that witnessed in 1866 was raised to the highest pitch. Two eminent astronomers, Dr. Johnstone Stoney, F.R.S., and Dr. Downing, F.R.S., the superintendent of the *Nautical Almanac*, did, it is true, put forth more than one paper showing how notable had been the perturbations of the stream since it crossed the Earth's orbit in 1866, and hence how relatively uncertain it was that anything approaching to the 1866 display would recur. But theirs were *voces clamantes in deserto*, and the general public were fed up to the last instant with assurances of a magnificent exhibition of celestial fireworks. It is quite needless to set down in detail what really happened, nor to what confusion the penny-a-liner would have been put had he had any conscience—which, happily for him, he has not. But if the display failed, as it did utterly, it was not without one amusingly sequent event; taking the form of the hoaxing of one of our contemporaries to an extent which involved the appearance in it of a sub-editorial article gravely written to show that the meteorites did arrive, and were seen after all. The evidence (?) adduced was embodied in a cock-and-bull narrative of the observation on the afternoon of November 15th, by two girls and a lad, of a tremendous shower of luminous objects through a thick mist, a shower lasting from 1h. 30m. p.m. to about 2h. 30m. This apparition was also visible to, and corroborated by, a washerwoman. It was alleged to have occurred in Wiltshire; but it was supplemented from Essex by a gentleman who professed to have seen (after luncheon, between 3 and 4 p.m.) "stars working in and out and round about." Unfortunately for the reputation for acumen of the scientific man who made all this public, this little piece of idiocy was utterly exploded and demolished by that unimpeachable authority, Mr. W. F. Denning, F.R.A.S., who has probably forgotten more about meteorites than the author of the paper itself ever knew. After what he has said we have probably heard the last about daylight meteorites.

In the stellar vault, one of the most important observations to be noted is that of Prof. Campbell, at Lick, of the variable velocity of Polaris in the line of sight. Observing this star with the Mills' Spectograph last August, he found velocities of approach varying between 5·34 miles and 9·44 miles per second, thus indicating that the Pole Star is a spectroscopic binary, having a period of very nearly four days. Prof. Campbell had measured this spectrum in 1896, and then deduced a motion of approach of 12·18 miles per second. Unfortunately, his observations were then made practically at multiples of the period, so that the variation was undetected. During August and September Prof. Campbell's discovery was confirmed by Mr. Ellerman, whose velocities of approach ranged between 6·59 miles and 11 miles per second, with a probable error of only ± 0·31 mile.

We may add that the same most diligent observer had also previously determined that in the case of γ Pegasi the velocity relatively to the Sun was on Aug. 27, 1897, one of 0·66 of a geographical mile per second of approach, and on the suceeding Sept. 8 one of 0·64; while in Aug. 25, 1898, the same star was receding from the Sun at the rate of 2·29 geographical miles per second, and on Sept. 17 at one of 2·26. The Rev. T. E. Espin, following up Dunér's researches, has shown

that of his stars of type IV., 55 per cent. are found within 10° of Galactic latitude, and 74 per cent. within that of 20°, thus indicating a fairly obvious connection between the two.

In connection with celestial spectroscopy, Prof. Keeler would seem to have shown that the spectrum of the Great Nebula (42 M) in Orion is unquestionably variable. The usual attempts have been made to determine the parallax of certain stars—with the usual results.

Celestial photography advances at a surprising rate, and the sensitised plate is taking the place of the human eye in numerous directions. The Astrographic Chart and Catalogue proceed apace, and the Sun is photographed whenever he is visible at Greenwich. Dr. Roberts's superb photographs continue to be taken with undeviating regularity, and we hear that a second of the invaluable volumes issued from the Crowborough Observatory is to appear immediately. Perhaps there is no more curious story in reference to the photography of the sky than that of the Crossley reflector, now at Lick Observatory. Purchased originally from Dr. Common by Mr. Crossley, the 3ft. reflector never did any good in its new possessor's hands; nor even after he had had it refigured by one of our most eminent opticians, were its capabilities to any extent developed. Now at Lick, it seems to have found its métier, and in the hands of Prof. Keeler to have produced results of the highest value. Mr. Keeler's photographs of the Ring Nebula in Lyra, and the Annular Nebula H IV. Cygni, together with that of the famous Cluster 13 M. Herculis (discussed by Mr. Palmer), have revealed much that is entirely new in the physical structure of those objects respectively. Many of the very beautiful slides printed from the Lick negatives have been exhibited at the Royal Astronomical Society. We grieve to record that Dr. Roberts's persistent attempts to photograph the Leonid stream have proved futile.

To Astronomical Literature about the average number of contributions have been made during the past year. Without any attempt at classification, we may mention among them Prof. Newcomb's new Tables of Mars, completing the series for the four inner planets; as also the same author's Catalogue of Fundamental Stars for 1875 and 1900. From the other side of the Atlantic, too, we get an admirable little work for the beginner under the title of "A Laboratory Manual of Astronomy," by Miss M. Byrd; and for the more advanced student, Prof. Campbell's "Elements of Practical Astronomy." In England we have had Mr. MacClean's splendid monograph, "The Spectra of the Brighter Stars," Monck's very important and interesting "Introduction to Stellar Astronomy," and last, but not least, the Eclipse volume of the British Astronomical Association. From Germany there reaches us Dr Ambronn's "Handbuch der Astronomischen Instrumentenkunde," an absolutely exhaustive treatise on the subject to which it is devoted, describing, as it does, practically every astronomical instrument that has ever been used in an observatory—or out of it. Even to those incapable of reading German, its 1,185 illustrations must perforce convey a wealth of information.

There is nothing special to chronicle in connection with astronomical instruments. The monstrous telescope of 328ft. focal length, at present being constructed as one of the attractions of the Exposition in Paris next year, is intended to cast an image of the moon 52½ft. in diameter on to a screen in a hall built to contain 4,000 spectators. It has been previously illustrated in these columns. What the definition is likely to be in the atmosphere of a city we would rather not speculate. Messrs. Trübner, the Leipzig publishers, have issued a work, entitled "Die Medial Fernrohre," by Herr Schupmann, describing a new form of combined reflecting and refracting telescope. We are in doubt whether this instrument has yet got beyond the descriptive stage.

Among matters of general astronomical interest, we may refer to the continued admirable munificence of Miss Catherine Bruce in subsidising astronomical research, her latest gift to the Columbia College University taking the form of a photographic telescope. She has further made a money gift to aid the computing work. In this country the gold medal of the Royal Astronomical Society was awarded to Mr. Frank MacClean for his splendid services, both personal and pecuniary, to celestial spectroscopy. As we write, the muster-roll of the Royal Astronomical Society contains the names of 691 fellows and associates, while the names of no less than 1,181 members are inscribed on that of the British Astronomical Association. We are further glad to learn that the Leeds Astronomical Society and the Astronomical Society of Wales both flourish.

Death has, happily, been less busy among astronomers of note than it has during some immediately previous years. The first one to be taken was good, kind, genial Miss Elizabeth Brown, whose purse and person were alike ever at the service of Astronomical Science, and who was known far and wide as an earnest student of Solar phenomena, and the head of the Solar Section of the British Astronomical Association. On three separate occasions did she, a delicate woman, undertake long and toilsome journeys to observe the phenomena of a total eclipse of the sun: once to Russia, then to Trinidad, and finally to Lapland. Her munificent legacy to the British Astronomical Association is very familiarly known. She died, after a very short illness, on March 5. She was followed on April 23 by Mr. Chas. Leeson Prince, F.R.A.S., who was, however, rather known as the leading authority on the meteorology of the south-east of England, than as having done any striking astronomical work. He was, however, the possessor of the historical Pearson refractor, and in conjunction with Mr. Lynn, exploded the figment that the principal division in Saturn's ring was discovered by William Ball, an error which had been copied from one astronomical work to another by rote. Mr. Prince possessed a fine library of Mediæval and later astronomy. On Aug. 16 died Prof. Bunsen, to whom, in connection with Kirchhoff, we owe the science of spectrum analysis. Mr. James Carpenter, whose decease occurred on Oct. 17, will be probably best remembered as the joint author, with the late Mr. Nasmyth, of a book on the Moon, which was long regarded as a work of very high authority. He was for some years an assistant in the Royal Observatory at Greenwich. He latterly took but little active part in astronomical pursuits. There was something sad in the death, on the 27th of October, at the age of 86, of the Rev. E. L. Berthon, seeing that he had only been readmitted as a Fellow of the Royal Astronomical Society on the previous 9th of June. To the world at large, his fame will probably largely rest on his invention of those collapsible boats which are now universally carried by passenger-ships and others all over the world. To the astronomer his name will be familiar as the inventor of the Romsey Observatory, the Equestrian Equatorial, and a multiplicity of other devices for assisting in astronomical observation. At the very meeting of the Royal Astronomical Society of which we have just spoken, he exhibited an ingenious device of his own for graduating the circular limb of an instrument and yet another form of equatorial mounting that he had invented. Only a fortnight later, on November 10th, there passed away, in the person of Mr. Nathaniel E. Green, F.R.A.S., one of the most brilliant and accurate astronomical draughtsmen that this country could boast of, and one whose drawings of Mars, Jupiter, and Saturn must always be classical, rivalling, as they do, the best photographs in fulness and minute accuracy of detail. His famous map of Mars, published in the R.A.S. *Memoirs*, must always remain the standard authority on the aspect of that planet at the time when the chart was drawn. He was President of the British Astronomical Association in 1897-98, and had sat for one year on the council of the Royal Astronomical Society. He died at the age of 76.

STANDARDISATION OF THE SUB-STAGE, AND OF THE INTERNAL DIAMETERS OF THE DRAW-TUBES OF MICROSCOPES.

THE following resolutions were adopted by the Council of the Royal Microscopical Society on Dec. 20, 1899:—That the standards by the Council in 1882 be withdrawn; that the standard size for the inside diameter of the sub-stage fitting be 1·527in. = 38·786mm.; that the gauges for standardising eyepieces be the internal diameters of the draw-tubes, the tightness of the fit being left to the discretion of the manufacturers; that the following four sizes of the internal diameters of the draw-tubes be adopted:

R.M.S., No. 1,	·9173in.	=	23·300mm.
R.M.S., No. 2,	1·04in.	=	16·416mm.
R.M.S., No. 3,	1·27in.	=	32·258mm.
R.M.S., No. 4,	1·41in.	=	35·814mm.

That a set of plug and ring-gauges of all the above sizes be kept in the Society's rooms, and that the public on payment of a small fee be allowed to inspect them; that the Society acknowledges with thanks the assistance it has received from many firms in reply to the circulars sent out.

Notes.—The substage gauge adopted is that which has been used by the English trade for many years past, the variation among different makers being not more than a few thousandths of an inch; R.M.S. No. 1 is the Continental gauge; R.M.S. No. 2 is the mean of the sizes used by the English trade for student's and small microscopes; R.M.S. No. 3 is the mean of the sizes used for medium-sized binoculars and other microscopes of a similar class; R.M.S. No. 4 is the maximum size for long tube binoculars. In all probability the eyepiece cap and apparatus to be used above the eyepiece will be standardised in a few weeks.

RESHARPENING OLD FILES.

APROPOS of a recently-proposed electrolytic method of resharpening old files, we are reminded of the statement once made that, after all, the best thing to do with an old file is to throw it away and buy a new one. This has been the conclusion arrived at by a great many whose experience has extended over the once much-talked-of sand-blast file-sharpening process, and the methods of etching and recutting, all of which have been practised with more or less success. Sand-blasting files have been claimed by some to be quite useless, as it makes the teeth shorter and simply raises an edge which has no durability. In recutting, the temper must be drawn, and the quality of steel used for files, or at least some of them, has been stated to be such that it deteriorates rapidly when rehardened. Right here, however, the point may be made, as, indeed, it has been by the advocates of recutting, that it all depends upon what grade of file one buys in the beginning. True economy ought to commence by purchasing that file which will yield the largest return for the outlay, and with this style of file recutting has been claimed to pay. The grade which will not stand recutting is the cheap, common kind, and buying this has been characterised as a waste of money at the outset. Whether, with the best kind of file that money can procure, etching, too, is an economical sharpening process remains yet to be definitely decided.—*Cassier's Magazine for January.*

FRUIT is now being shipped from New South Wales packed in the bark of the ti tree and the outer bark of the Melaleuca leucadendron, which is shredded into a sort of coarse chaff. These barks seem to have some peculiar power of preserving oranges during carriage. This may be owing to the elasticity of the packing and the fact that it permits of ventilation. Unless the bark is cut too fine, there is no sweating possible. The bark costs only 20dol. per ton.

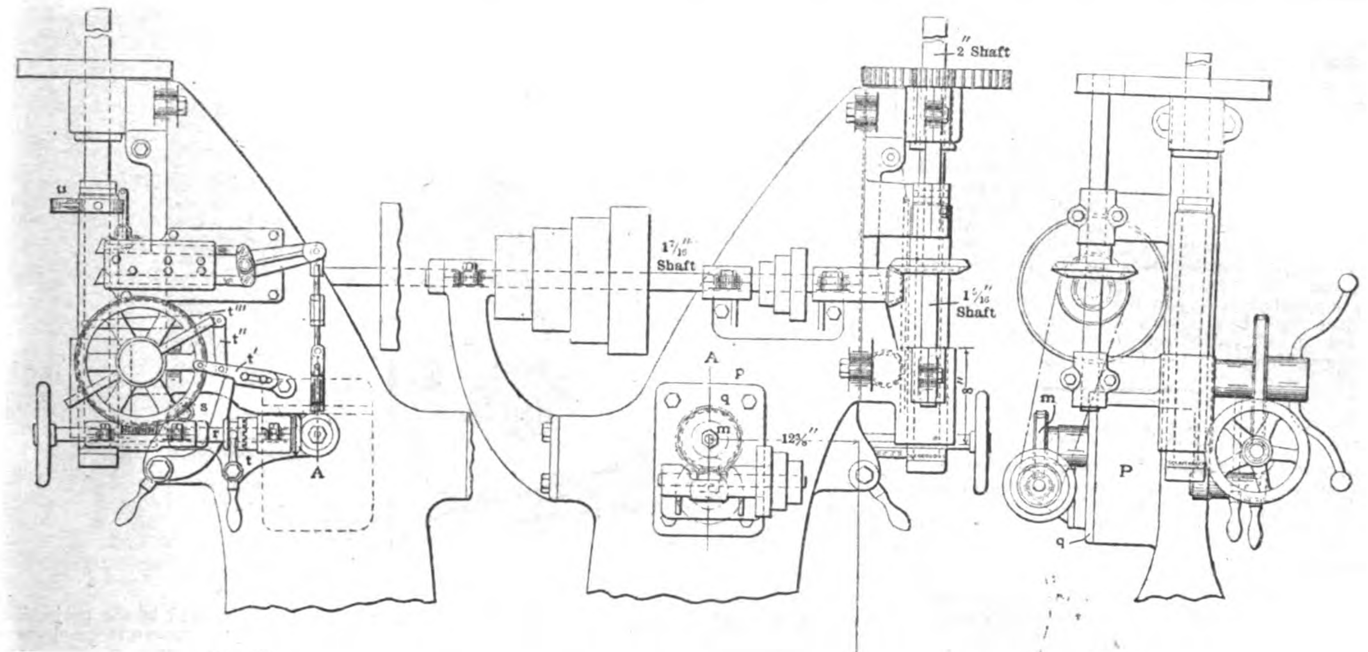


Fig. 1

Fig. 3

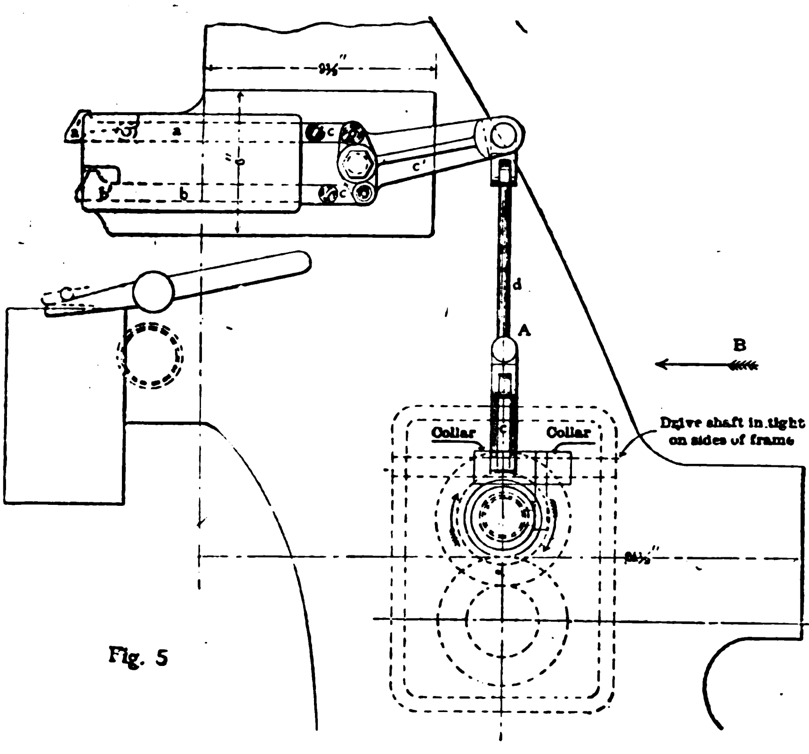


Fig. 5

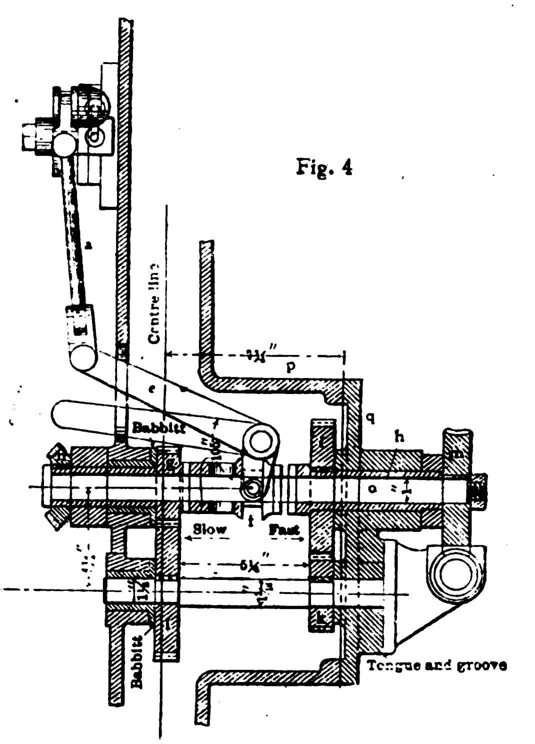


Fig. 4

AN AUTOMATIC VARIABLE-FEED DRILLER.

THE engravings herewith presented show the general appearance and construction of a drilling machine with a feed that is not only automatic but which at a given point automatically increases to four times its normal rate, and then changes back again, and proceeds until the piece of work is done, when it automatically releases.

This feature of an automatic variable feed was added to the regular drilling machine for the purpose of adapting it to a special purpose—i.e., the boring of malleable-iron hubs for the wheels of agricultural implements. These hubs have a bearing at each end, and are chambered in the middle by a core enlarged at that point. One man was to operate four machines on the job, and, of course, it is obvious that if he were required to release the feed, move the spindle downwards through the chamber, and again throw in the feed for each piece, he would be too busy; while, if the feed were allowed to run all the way through at the same rate, too many machines would be required for the given amount of work.

Referring to the drawings, Fig. 1 is a vertical side-elevation of the upper portion of the machine; Fig. 2 shows the opposite side; Fig. 3 is a front elevation; Fig. 4 is a sectional view on line A, viewed in the direction of arrow B. The feeding mechanism is as follows:—

On the horizontal upper cone pulley-shaft is the small three-step cone pulley, which drives the corresponding cone pulley on the worm-shaft below. On the latter shaft is a worm which drives the worm-gear *m*, which is keyed to the shaft *o*. To make room for the mechanism an extension or box-like receptacle, *p*, is built out on the side of the frame. A removable plate or cover, *q*, Figs. 2 and 4, is fitted to the extension *p*, forming a protection for the mechanism, and also having a bearing for the clutch-sleeve *h*. The sleeve *h* is keyed to the spur-gear *i*, and *h* also forms a bearing for the shaft *o*, which is fitted to turn freely in it. On the opposite side of the main frame is another bearing for the clutch-sleeve *g*, which has at one end a pinion, forming an integral part of it. At the opposite end is keyed the mitre-gear *n*, and this gear meshes with a similar gear on the worm-shaft *r*, Fig. 1. This latter shaft revolves in suitable bearings in the tipping-frame *s*, and the worm keyed to the shaft *r* engages with the large worm-gear, which is keyed directly to the stud carrying the pinion which feeds the main spindle. The lever *t* has a projection which bears against the tipping-frame *s*, and when it is in position, as shown in Fig. 1, the worm is in mesh with the worm-gear and the feed is going. The lever *t* is held in position by the latch *t'*, and link *t''* connects *t'* to another lever *t'''*, which is pivoted to the frame above.

When the trip-collar *u* engages with the end of *t'''*, the latch *t'* is lifted and the lever *t* is allowed to fall, releasing the feed. The spindle is returned to its starting point by means of the handles on the large worm gear shaft.

Between the two clutch-sleeves *g* and *h* on the shaft *o*, Fig. 4, is fitted a sliding clutch-collar, *f*; it is splined to *o*, so that the collar and shaft must always turn together. With this collar engaged with the clutch-sleeve *g*, the normal rate of feed is obtained; but when the collar is shifted so as to engage with the sleeve *h*, then the movement is carried to the clutch-sleeve *g*, through the medium of the gears *i*, *k*, *l*, and *g*. The gearing is arranged so as to obtain an increase of feed equal to four times the normal feed.

On the side of the frame, Fig. 5, is secured a bracket which forms a bearing for the sliding rods *a* and *b*. Rocker arm *c'* is connected to the rods *a b* by two short links and to the bell-crank *e*, Fig. 4. This bell-crank throws the clutch-collar *f* in either direction.

On the end of *a* is an extension *a'*, which is pivoted in such a manner that it will lift upward, but it cannot be pressed downward beyond the horizontal line. The extension on the trip-collar *u* engages with bevelled edge of *a'* and forces it back-

ward. This moves the clutch-collar f to the right, and thus puts on the fast feed. A spring not shown in the drawing, but attached back of c', assists in this movement. The spindle will now feed four times as fast as before, until the trip-collar comes in contact with the sliding rod b (which has been thrown forward by the previous movement), and this throws the clutch-collar back again and restores the working rate of feed. The spindle then continues to feed until the collar contacts with lever t''', when the feed is stopped automatically. The end a' attached to a is lifted by the upward movement of the collar, and by means of a spring it immediately snaps back into position ready for the operation, as described. In the machine described the total feed of the spindle is 14in., and the length of the intermittent rapid feed is only 2½in., but this can be varied to suit conditions. It is built by Baker Brothers, Toledo, Ohio.—*American Machinist.*

DIAGRAM SLIDES.*

IN these days of technical schools, where demonstrations by means of the optical lantern play such an important part, the lecturers, no doubt, often require diagram slides, so probably a few remarks on this subject may not be amiss. Most amateurs in the course of their photographic career have a number of light-struck plates which, I suppose, are generally consigned to the dustbin. Fortunately, I saved mine, and collected a great number of all makes and all sizes. Well, one day last week I wanted a few diagram slides, and commenced coating the glass plates with some wretched black stuff of the Brunswick black genus; however, the varnish did not work satisfactorily, and then I thought of these aforementioned light - struck plates. So I mixed up a strong pyro-ammonia developer, and developed, or more correctly, blackened them in full daylight. They were then plunged directly into a solution of ferrous sulphate. This formed, with the pyro-gallol already in the film, a black ink-like substance, intensifying the already blackened plate. They were then washed for a few minutes and dried. When thoroughly dry, they were cut with a glazier's diamond to the standard lantern size, and by means of a sharp needle and a ruler I scratched my diagrams upon them. These slides show upon the screen as brilliant white lines upon a black ground.

These white lines can be coloured with the greatest ease by painting on alcoholic solutions of aniline dyes, to which has been added a little dammar, mastic, or other similar gum-resin; this forms a dye-varnish and dries rapidly. One of the principal advantages to be gained by making white lines upon a black ground is that, if by chance any of the dye-varnish exceeds the place which it should occupy, the smudge is not visible on the screen, being obscured by the dense black ground.

The black line on white ground slides are most conveniently made by drawing with pencil on fine ground glass, or even plain glass coated with matt varnish, and subsequently coating with ordinary crystal varnish, which renders the whole matt surface perfectly transparent.

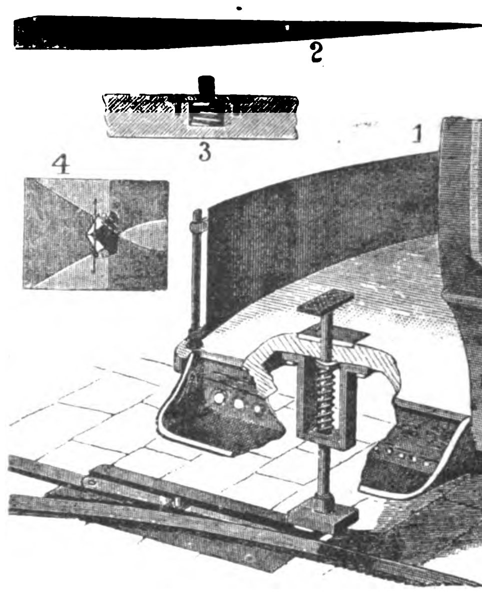
Coloured diagrams on white ground are best made on plain glass by means of a pen and inks composed of aqueous solutions of aniline dyes mixed with a small quantity of gum arabic. However, for my own part I prefer the previous process, which, I believe, is unequalled for the extempore projection of coloured spectra.

There is one little point which may be interesting, not being universally known: that is, if one makes a fine scratch or slit across one of these blackened plates with a very sharp needle, and holds this plate close to the eye, looking through the slit at a distant candle or gas light, most beautiful spectra are seen, extending on both sides of the light in a position at right angles with the slit.

Sometimes a diagram in a book is required to be copied to illustrate a lecture. This should be done by means of the copying camera, placing the book to be copied in a large printing frame with the diagram pressed into close contact with a clean sheet of glass. The object should be lighted from one window only, no side lighting being allowable, as it casts a sheen on the glass in the printing frame, and accentuates the grain of the paper. A small stop should be used in order to obtain better definition. The plate employed should by preference be a slow lantern or process plate, for these give density *ad lib.* The best developer is ferrous oxalate, which has least tendency to reduce unexposed bromide of silver, and thus keeps the lines clear, only I ought to mention that more patience must be exercised during development on account of its slow action.

THE "MECHANICAL WORLD" POCKET DIARY and YEAR BOOK for 1900 (Manchester: Emmott and Co., Ltd.) is, as usual, a very useful collection of tables, rules, &c., for engineers and craftsmen.

* By "WAYNFLETE," in the *Photographic News.*

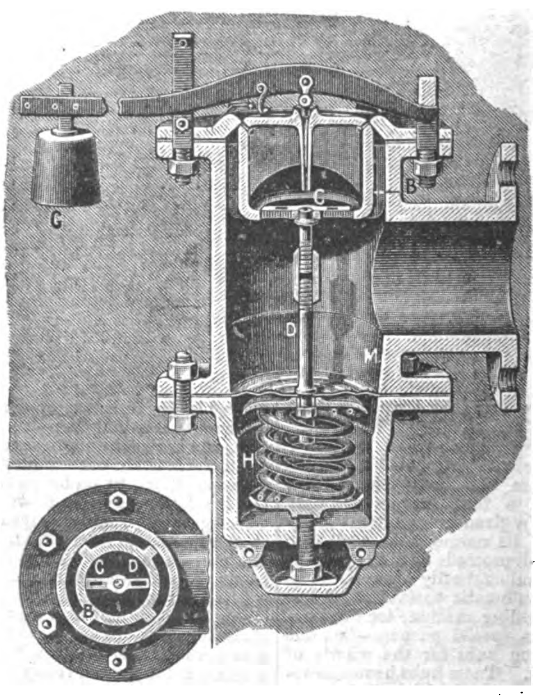


PARSON'S SWITCH - THROWING DEVICE FOR CARS.

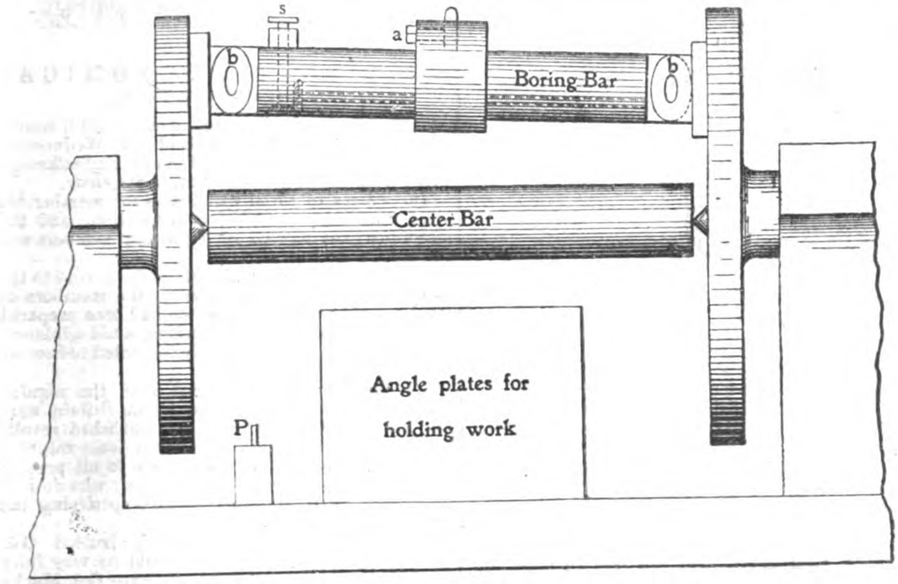
THE illustrations represent, in perspective, section, and plan, a new form of switch-throwing mechanism, which is operated by the motorman or driver of a car. The device is the invention of Swan Parson, New Britain, Conn. In the platform of the car a foot-rod is vertically mounted in a bracket and provided at its lower end with a switch-operating plate. The foot-rod is normally held in raised position by means of a coiled spring. The switch-operating plate, as shown in Fig. 4, representing an inverted plan view, comprises two guides having obliquely-disposed edges converging towards the rear of the car. Two spring-pressed guide-fingers are pivoted in a depression at the rear ends of the guides. A pointed central guide is located in the rear of the oblique guides, and is adapted for contact with pivoted fingers. When in contact with the pointed guide, the fingers and corresponding oblique guide form a straight line. The switch-tongue is provided with a projection (Figs. 1 and 3) normally spring-pressed outwardly and designed to engage the switch-operating plate on the car. In order to throw the switch the foot-rod is depressed, so that the projection on the switch-tongue engages one of the oblique guides. Let it be supposed that it engages the upper guide in Fig. 4. The oblique guide will throw the switch towards the central position until the projection comes in contact with the upper spring-pressed finger in Fig. 4. The finger will thereby be pushed back until it assumes the position shown by dotted lines and forms a continuous guide for the switch-tongue projection, with the upper oblique guide and lower edge of the rear guide. The tongue is hence gradually thrown. If the other finger were engaged by the projection, the switch-tongue would be thrown in the opposite direction. The device, it is evident, will throw the switch in either direction, without any difference in the operation. Even if the projection were not engaged by one of the oblique guides, the switch would still be thrown by a finger and the rear guide. The device cannot, therefore, fail in action. —*Scientific American.*

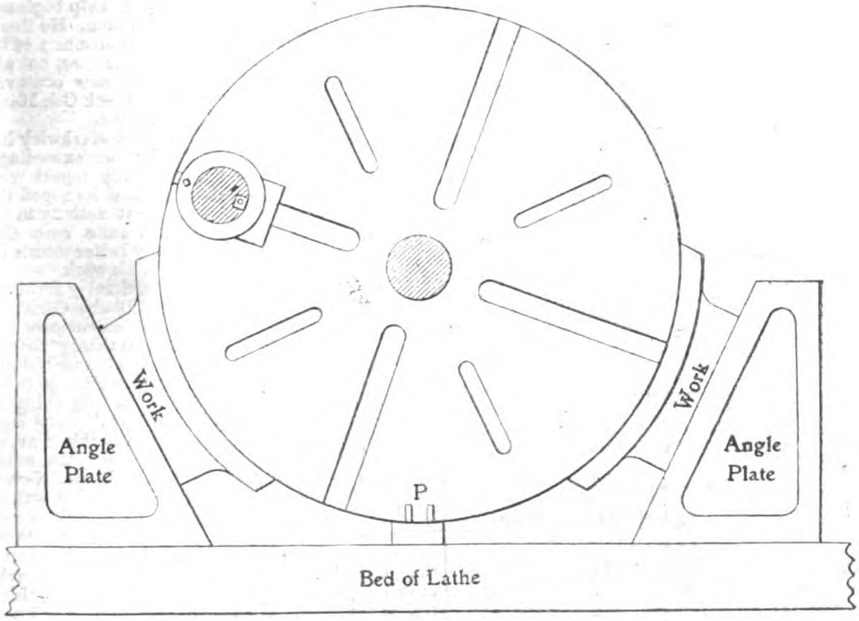
A NEW SAFETY-VALVE.

THE sectional and plan views of a "new" safety-valve are given by *La Nature.* The plate submitted to the action of the lever that carries the counterpoise D rests upon the top of a small cylinder, B, movable in a vertical direction in the valve-box. This cylinder carries at its lower part a transverse piece, C, provided with two apertures, and into which is screwed a vertical rod. This latter is connected through a nut with another rod, D, which is fixed to a thin metallic disc, M, of which the circumference is clamped between the flanges of the valve-box. Beneath the disc M there is a double



spiral spring, H, which rests upon a disc that can be manœuvred by means of a screw protected by a cover hinged to the bottom of the box. The base of the latter is provided with an aperture for the purpose of revealing the existence of any leakages of steam that might take place through the disc M. The surface of the disc M is such that the pressure exerted upon it by the steam is equal to that exerted upon the cylinder B and the rod C. Such pressure is obtained by regulating the tension of the spiral spring by means of the screw at the bottom. By acting upon the nut that connects the





rods D, the cylinder B may afterwards be brought into contact with the plate submitted directly to the action of the lever carrying the counterpoise. Such regulations will remain in force for pressures up to an amount determined by the conditions of equilibrium adopted; but it will no longer exist if the weight G be changed or the lever rendered stationary. In fact, if the weight be increased, the cylinder G will immediately descend, and the steam will escape. In like manner, if the lever be fixed, the pressure will cause the disc M to yield and carry along the cylinder B through the intermedium of the rod D.

A TAPER BORING RIG.

WHEN designers put the dome on the taper course of a waggon-top boiler they evidently do not think of the shaping of the reinforcing ring, which must fit the sheet, or that a special boring rig may be necessary.

These rings are usually planned out on a planer having a special head with a circular movement; but the taper has to be treated differently. At the Baldwin Works we recently saw a big wheel lathe doing duty as a boring mill for this work in a manner that was both ingenious and extremely practical. A heavy centre-bar or distance-piece was between the centre as a brace, and the boring-bar bolted by special foot-pieces to the face-plates at the proper distance for the radius and at the correct angle. The work—and two rings were being bored at a time—was held on angle-plates, as shown by end view, and fed into the proper distance. The foot-pieces for the bar had two ears or lugs, between which was bolted the flattened ends of the bar *b b*, so that any desired angle can be obtained. The boring-bar is of the usual type, although with slight modifications, and the star wheel *s*, striking pins P, feeds the tool-head along in the usual manner.—*Locomotive Engineering*, N.Y.

FORMALIN AS A PRESERVATIVE.

ALTHOUGH as a preservative medium for perishable zoological specimens, formalin has scarcely realised all the expectations entertained on its introduction, yet there can be little doubt that it has a great future before it, and that for certain purposes it is likely to prove invaluable. It has, however, many undoubted disadvantages, and in the minds of some museum officials these disadvantages appear to outweigh its manifest valuable properties, so that an unfavourable opinion is entertained of it in general. On the other hand, those who weigh more carefully the *pros* and *cons.*, realise that, under proper conditions and restrictions, its value is really very great.

As regards its disadvantages, it must be admitted that it is unsuitable for the permanent preservation of specimens that are likely to be manipulated, as not only are its effects on the hands of the worker most unpleasant, but in many cases it renders the tissues of the specimens themselves so hard that they are practically unworkable. Then, again, it is quite unsuited for all specimens containing calcareous matter, such as molluscs, echinoderms, and crustaceans; while unsatisfactory results appear to have been obtained in the case of certain insects and myriapods. Moreover, it does not seem to be well suited for the preservation of reptiles, and it is said to deteriorate the colours of bird-skins.

Turning to its advantages as a permanent preserving fluid, it is acknowledged to be unrivalled for specimens of watery and "flabby" animals, such as jelly-fish, rendering them more coherent and less likely to disintegrate than any other known medium. Apart from this group, it does not, however, appear to be at present used to any great extent in the exhibition series in the British Museum; although we have reason to believe that its possibilities are occupying the serious attention of the officials. In the series of worms, all the more valuable specimens that were received in formalin have been transferred to spirit, and only the commoner forms left in the original medium. Of the six specimens of eggs, embryos, and larvæ of Lepidosiren paradoxa recently added to the exhibition series from Mr. Graham Kerr's Paraguay collection, three are in alcohol and three in formalin; the latter having been sent home in that fluid, and it being thought not advisable that the medium should be changed. If these six specimens are carefully watched, they will afford a test-case of the comparative value of the media. At present, we believe, none of the exhibits in the "Index Museum" are in formalin.

For sterilising freshly-killed specimens of mammals and birds, as well as eggs, that have to be sent some distance to a museum in the flesh, there can be no doubt that formalin is invaluable. And it is no less valuable to the field collector of mammals, not only on account of the small bulk a sufficiency of the fluid occupies, but also from the marvellous preservative power of the fluid itself. According to Mr. O. Thomas (who reports very favourably of it for this purpose), commercial formalin, which is itself 40 per cent. under proof, must be diluted with no less than twenty-five times its own bulk of water before use. Moreover, whereas when mammals are preserved in spirit it is necessary to allow a very large amount of fluid to each specimen, when formalin is employed the vessel may be crammed as full as possible with specimens, which are preserved without exhibiting the slightest traces of putrefaction. When received at the British Museum all such specimens are, however, immediately transferred to alcohol, on account of their unsuitability for handling when in the original medium.

The foregoing instances suffice to show that for certain specific purposes formalin has advantages as a preservative medium not shared by alcohol. But, as many of our readers are aware, another application of formalin has been recently proposed by Dr. G. de Rechter, of the Brussels University, who, in the twelfth volume of the *Annales de l'Institut Pasteur*, 1898, has advocated the use of currents of formalin vapour for the preservation of animal specimens. The advantages claimed for this method are that it preserves the specimens in practically the same condition as they were left at death; the tissues not being hardened, while hair and feathers are uninjured alike in texture and in colour. Experiments in this method have been recently undertaken in Mauritius by Mr. Camille Sumeire, of the Albion Dock Company, who has constructed an apparatus on the general lines of one suggested by Dr. de Rechter, in which specimens can be subjected to constant currents of formalin vapour. And it appears from an illustrated report published in the *Bulletin de la Société Medicale de l'Ile Maurice* for July 18 that the results of these experiments have proved eminently satisfactory.

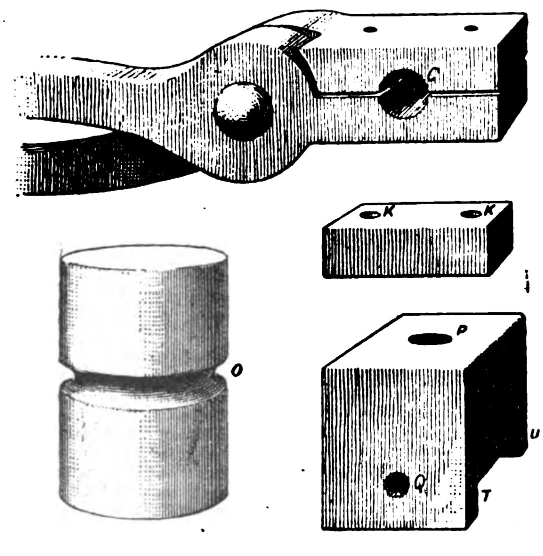
A freshly-killed guinea-pig placed in the apparatus for a period of twenty days was found to be a perfect state of preservation, and when exposed in the open in the museum for a further period of eight days, was likewise found to be intact. Moreover, a culture of bacilli exposed in the apparatus at the same time as the guinea-pig was found to have become completely sterilised.

As was well remarked by Dr. de Grandprè, superintendent of the Port Louis Medical Museum, the potential advantages of such a method of preservation are likely to prove very important. And it is urged that the process may be specially valuable in cases of suspected poisoning, as bodies can be preserved for any length of time in a state suitable for examination. From a natural history point of view the invention has likewise almost unlimited possibilities; and Mr. Sumeire hopes to be able shortly to supply the museums of Europe with examples of the mammals of Mauritius as fresh as when alive, instead of in the condition of ordinary spirit-specimens. Indeed, negotiations are already opened with the director of the Paris Museum for the transmission of such formalined specimens to the institution under his charge. We wish all success to the new venture.—R. L., in *Nature*.

AUTOMOBILES IN FRANCE.

THE early development of the modern automobile vehicle in France has naturally led other countries to look thither for the results of experience. This is the more natural because there has been much competition, besides various trials, exhibitions, and reports, while the freedom which has been permitted in the use of all kinds of motor vehicles renders the information thus obtained of a most practical nature.

The general reports of the competitions of 1898 and 1899 have appeared in various publications, and have been reviewed from time to time in these columns, but now we have a critical discussion of the engineering side of the information obtained from these trials in the form of a paper presented before the *Société des Ingénieurs Civils de France* by M. G. Forestier, the well-known inspector-general of Ponts et Chaussées.



So far as automobilism as a sport or recreation is concerned, M. Forestier regards the question as entirely settled, and hence devotes himself entirely to the practical side of the problem of commercial mechanical traction on public highways.

The trials of 1898 were of heavy road vehicles, and for this service the only motive power attempted was either steam or gasoline.

The steam vehicles were fired with coke, with heavy oil, and with gasoline, while in a number of instances internal combustion motors were used, the gasoline acting directly in the cylinders.

For tabulated details of the tests, reference must be made to the paper of M. Forestier, but the general conclusions are that steam power is the best where sudden demands for power are made, such as steep grades or starts on ascending inclines, while an internal combustion motor is satisfactory for fairly level roads, and is much lighter in weight. Both classes of motors showed a notable advance in economy over similar vehicles tested in 1897, and there is prospect of further improvement in this respect.

Deducting the weight of the vehicles, the cost of hauling merchandise on common roads by steam motor vehicles is given as 0·373fr., 0·200fr., and 0·140fr. per ton-kilomètre, according as they are operated with one-third, two-thirds, or full load; while for the internal combustion motor the corresponding costs per ton-kilomètre are 0·673fr., 0·369fr., and 0·268fr.

Since the average cost of animal traction under similar conditions is about 0·25fr. to 0·30fr., it is evident that mechanical hauling of merchandise can only compete successfully with horses when full loads are carried. When unbroken loads of 9 to 10 tons are to be transported at speeds above 4 kilomètres per hour, the motor vehicle is the only one which can be used, and it is believed that the improved merchandise trucks will prove capable of speeds up to 6 kilomètres with heavy loads as a consequence of the experience gained from these trials.

The details of the trials of the light vehicles are too voluminous to be discussed at the present time, but the following tabulation of costs per day for the operation of cabs and delivery waggons will be of interest:—

	Cost per day.		
	Horse.	Gasoline.	Electricity.
Cab	19·26f.	16·27f.	18·48f.
Delivery waggon.	16·72f.	12·80f.	14·80f.

The figures include interest, depreciation, and, in the case of the electric vehicles, maintenance of accumulators.—*Engineering Magazine.*

SWAGE FOR USE WITH A STEAM-HAMMER.

ONE of the contributors to the *Blacksmith and Wheelwright* says that he has to work a steam-hammer and make with it a thousand and one things. He says:—It is not an easy matter to change tools and dies. Not long ago I had some bolts to make out of 1⅛in. round iron; the bolts were to be 1in. in diameter. To draw down the bolts, cut off, reheat (after I had changed the tools), and swage was just a little too much trouble. I finally hit on a novel idea, which I now give to you to show to others; perhaps the tool may have been made before, but as the hammer I am working is the only one I ever saw, I am not at fault in telling you what I have done, more especially when I have done a good thing. The novel idea is simply a swage which opens and shuts, or a swage made like a pair of tongs.

The jaws are made of steel, to prevent the same becoming injured. I made two iron cushions ⅜in. narrower than the swage and ⅜in. shorter, 1in. thick, with counter-bored holes, K K, so as to bring heads of screws below the surface. Two of these cushions are necessary—one top, one bottom—screw them on to the jaws as per holes marked in the same; make the jaws 4in. long, 3⅜in. wide, hole to suit. After the bolt is hammered enough stick in swage and swage, by having the hammer come down on the same. After the bolt is swaged I cut it off and throw it in the fire with the other piece. While it is heating I lift the heading block and place it on the anvil; the top P with hole Q outside, with lug T to hold it on anvil, U corresponding lug forming the recess which straddles the anvil. When hot the bolt is inserted in the hole and gets one light tap with the hammer; then I place on the heading tool and give it a couple of raps with the hammer, and the job is done. This header is shown in lower part of sketch, O being sunken for an iron gad handle; the bottom is cupped out to suit head; make in length and swage to suit, and of mild steel.

ERRATUM.—Column one, page 438, last line, 18h. 42m. 46·60s. should quite obviously be 18h. 42m. 46·80s.

USEFUL AND SCIENTIFIC NOTES.

COAL is widely distributed throughout India, except in Bombay and Sind, the North-West Provinces, and Oudh, Rajputana, and Mysore, where the mineral is either scantily distributed or entirely absent. The seams in Bengal and Assam are frequently from 50ft. and 80ft. to as much as 180ft. in thickness. The pits are often of considerable depth; at present the deepest appears to be about 700ft. In many cases the working of the seams leads to the escape of little or no fire-damp, so that the miners are able to work with naked lights. In 1895, 235 collieries were at work, but in 1896 only 172 were in active operation. At the present time Bengal produces more than three-fourths of the coal mined in India.

THE Royal Agricultural Society of England has issued the prize sheet for the meeting to be held at York from the 18th to the 22nd of June next. The total value of the prizes offered — exclusive of champion prizes and medals given by the leading breed societies—is £6,820, of which £1,676 are contributed by the York Local Committee. In the implement department the Society will offer prizes of £40 and £20 for general purpose horse-power cultivators, prizes of the same amounts for self-moving steam diggers, a prize of £50 for milking machines, and prizes of £20 and £10 in two classes for sheep-shearing machines, to be worked by power and by hand respectively. The entries for these classes close on March 15.

INDIAN COAL varies much in composition and quality. Most of it is quite suitable for ordinary purposes, while some of the samples—e.g., certain of those from Bengal and Central India—are of excellent quality, equal to that of some of the best British coals. Though the coal in Bengal varies greatly in quality, much of it is excellent, the fixed carbon ranging between 50 and 60 per cent., and the calorific value exceeding 6,000cals.—equal to about ten British thermal units—while the ash often does not much exceed, and in some instances falls below, 10 per cent., and the sulphur is frequently present in but very small proportion. A great deal of the Bengal coal is serviceable steam coal. Many samples cake well and contain little sulphur, and the coke is, therefore, suitable for iron smelting.

SCIENTIFIC SOCIETIES.

BRITISH ASTRONOMICAL ASSOCIATION.

THE second ordinary meeting of the 10th session of the B.A.A. was held on Wednesday, Dec. 27, at Sion College, Thames Embankment, Mr. W. H. Maw, the president, in the chair.

The names of seven candidates for membership were read and passed for suspension, and the election by the council of eight new members was confirmed.

The President asked Mr. Maunder to read to the meeting an inaugural address to the members of the Variable Star Section, which had been prepared by Colonel Markwick. He added, amid applause, that Col. Markwick had kindly consented to become the director of the section.

Col. Markwick pointed out that the regular observers of variable stars in Great Britain were few and far between, and the published results correspondingly small. He offered some valuable advice to observers, and appealed to all present members of the section, as well as any who desired to join, to send him their names, specifying the instruments available.

Mr. Maunder said he sincerely trusted Col. Markwick's appeal for names would be very fully responded to. He was perfectly sure Col. Markwick would do everything in his power to make the section a success, and especially to help beginners in the work of variable-star observation. He therefore hoped that not only all the old members of the Section would send in their names at once, but also there would be a large number of new observers who would enter on this work, and seek Col. Markwick's aid, and give him their support.

The President remarked that Col. Markwick had inaugurated his directorship by an exceedingly practical address, and he could only repeat what Mr. Maunder had said—namely, that he hoped this would mark the beginning of great activity in the Variable Star Section. He was quite sure Col. Markwick would not wish for any better return for his trouble than ample support in his work.

Mr. Petrie read a paper by Mr. Stanley Williams entitled "Considerations on the Double Canals of Mars." The writer said his recent experiences had not been favourable to the "optical theory" of the duplicated canals, the theory which ascribed observed duplications to the telescopic image being out of focus, whether directly by bad focussing or by what had been termed "diplopia." The conditions were seldom quite satisfactory this year, as regarded steadiness of definition and the small apparent size of the planet was also adverse. Nevertheless, on two or three nights the seeing was so good that the results appeared to him conclusive on the subject. The Canal Cerberus, for instance, appeared continually double for half an hour at a time, except when a wave of atmospheric disturbance swept over the planet and made everything appear confused. No change of focussing had any effect beyond making the double canal appear indistinct, and ultimately to disappear. Also by no change of focussing was it possible to make a single canal appear double. Having enlarged upon an opinion expressed by himself in the *Observatory* for June, 1899, that the double canals of Mars were due in reality merely to two ordinary single canals being seen apparently close together, Mr. Williams proceeded: "For these and other considerations, the fact of particular canals being described as double at one observatory and only single at another, would really have no bearing upon the reality of the observed duplication of canals, especially since the personal element enters so largely into all observations of delicate planetary details, the visibility of which is moreover dependent so greatly upon the conditions of seeing, which are seldom the same at two different observatories at the same time. . . . It would seem that even the supporters of the optical theory regard the duplicity of one canal—the Nilokeras—as real. Yet there is absolutely no difference in appearance between the duplicity of this canal and that of many others! There is a double bay on Mars well known under the name of 'Dawes' Forked Bay,' the reality of which has never be questioned. There is also a double canal—the Gehon—the two components of which run from the two inlets of Dawes' Forked Bay. It seems hardly logical to admit the duplicity of the bay whilst refusing to acknowledge that of the canal. . . . In every theory of the kind now in question, the really crucial test must always be actual experiment upon the object itself, and it will be clear, I think, from the foregoing that the optical theory of the duplication of the canals of Mars breaks down altogether under such crucial test."

M. Antoniadi contributed some notes on this paper, contending that it was not possible to "experiment directly on Mars," pointing to what he regarded as incongruities in the paper, and urging that in considering the double canals as objective realities, Mr. Williams was, of course, unable to account for the fact that they appeared

at one and the same time single and double to different observers.

Father Cortie said he was not a Martian observer, but there was one point in Mr. Stanley Williams's paper that struck him—namely, the analogy the writer drew between observing the canals of Mars and double stars. He (the speaker) did not think the argument held, because in observing double stars they were observing two distinct bright points upon a black sky. In observing the canals of Mars they were observing on a background which, of itself, was a very difficult object to see, and was continually changing in definition. They could not very well compare photographs of stars with those of planets. The former were perfectly clear, but no one had yet been able to obtain a good photograph of a planet. Even Prof. Pickering's photographs of Saturn and Jupiter, for instance, were very blurred. Therefore, he did not think that this particular argument for the objective reality of the doublings of the canals of Mars held. With regard to the doubling of canals he had no theory on the point; but, from experience in observing the spectrum, he could say that when the eye became tired the lines began to double. It then became necessary to alter the focus, and after a short rest the lines were seen to be single. Perhaps this had something to do with the doubling of the the canals on Mars; he did not know—he only threw out the suggestion.

Mr. A. J. S. Adams said that the eye could often be focussed so as to double a line, but it so happened that one line was always darker than the other. He wished to know whether the Martian doubles were equally dark, or whether one was slightly lighter than the other.

Mr. Goodacre, speaking as to Mr. Stanley Williams's remark concerning the duplicity of lunar rills, said that on one occasion, when observing Petavius, which contained a very coarse rill, it suddenly appeared to him to be doubled; but, testing the telescope, he found it to be slightly out of focus, and when he got the focus right the rill returned to its single condition again.

Capt. Noble said it was noteworthy that the most wonderful things ever seen on Mars had been seen, perceived, or imagined—whatever they chose to call it—when the planet was a long way from the earth, and unfavourably situated. During the opposition of 1877—that most favourable opposition, when those superb drawings which would be always classic by the late lamented president of the association, Mr. Green, were made at Madeira—none of these marvels were visible; but when they had the planet a very long way off the sun and earth, and perhaps showing gibbosity, in fact, in a generally unfavourable position for observation, it was surprising what could be seen upon it.

Mr. Holmes remarked upon what Capt. Noble had said about the markings on Mars being more visible when long past opposition. He himself had made some remarks upon the point before; but upon reflecting on what happened in case of the moon, he could not help seeing that there might be something that might cause the markings to be more visible at quadrature than when in opposition. For instance, dark markings on the moon were very much more easily seen at other times than full; when the moon was full they did not see them. When it was some distance from full the markings were very much more perceptible. He did not see why something of the kind might not be quite analogous to that in the case of Mars; but at the same time he had not the slightest faith in the duplicity of the canals. As to the point Mr. Stanley Williams raised about double stars, no one could have looked at them very much without knowing they very often did double. He had spent some time observing particular cases, and had been quite unable to tell whether he saw two or four. That was largely owing to the state of the atmosphere, and what would double a star in that way would also double other objects. Mr. Williams seemed to raise a distinction between a double canal and two single canals side by side. He (Mr. Holmes) did not quite follow the distinction. Two single canals side by side would be apparently much the same thing as a double canal.

Mr. Newbegin desired to be allowed to corroborate a remark made by Father Cortie, who mentioned having seen one of the lines of the spectrum doubled. He himself had seen the C line doubled, and he did not know whether it had been through the fault of the eye or the fault of the light. Mr. Thwaites had seen the same thing. Until that gentleman drew his attention to it, he had never seen such doubling, but since that time he had on one or two occasions seen the C line in the spectrum of the sun doubled.

Mr. Saunder said he had made some experiments on the duplication of lines in the telescope with the micrometer. The webs of the micrometer could very easily be seen double by putting the eyepiece a little out of focus. He discovered in that way what he had a suspicion of before—namely, that he had a slight amount of astigmatism in his eye. It was such as to require a cylindrical lens of 50in. focus to correct it; but this was enough to cause the lines in one direction to go out of focus very much before those at right angles to them, showing that a slight error of focus would effect a sensible duplication. He did not quite follow what Mr. Holmes said about the dark markings on the moon disappearing at the time of Full. What markings disappeared?

Mr. Holmes: The shadows.

Mr. Saunder: The shadows disappear because they are not there when the sun is high.

Mr. Holmes: Would not the same thing follow in the case of Mars?

Mr. Saunder: That is, supposing the canals are shadows.

Mr. Holmes did not suggest that, but merely thought, as we do not know what the nature of the markings is, they should not condemn their existence because of non-visibility at times of opposition as compared with other times.

Mr. Crommelin could corroborate what Mr. Saunder said about it not being difficult to make a spider line in the telescope appear double when out of focus. He noted it independently long before M. Antoniadi suggested this interpretation of the duplication of the canals. He also noticed, as Mr. Saunder said, that the ease with which they could duplicate the line depended on its inclination to the vertical. Of course, that was the question of the astigmatism of one's eye. With him a horizontal line was much easier to duplicate than a vertical. He did not think M. Antoniadi was quite fair in taking Mr. Phillips's observation, when Mr. Phillips saw the canal doubled for a few seconds, for, as Mr. Phillips said, it was obviously only the effect of atmospheric unsteadiness. Mr. Stanley Williams was talking of canals that appeared double during the whole evening; so that it was scarcely fair to compare the two things. Mr. Stanley Williams' point was a strong one about the two canals from the two portions of "Dawes' Forked Bay." No one had ever questioned the real duplicity of that bay, and the two canals that went from the two heads of the bay would certainly seem to be real. It was only some canals Mr. Williams was contending for. There were some instances which he would allow to be caused by optical illusion. If they could get any real instances of duplication it would be an interesting result, and this he (Mr. Crommelin) thought Mr. Williams had established as regards the instance mentioned and a few other canals.

Mr. Fletcher said that, in the case of astigmatism, part was muscular and part structural. That which was structural was permanent; that which was muscular was variable. This would explain why a line might appear single one moment and double the next. He desired to know whether those canals which were at right angles to the sun's rays at any particular time were more distinct than others so placed that at the same time the sun's rays shone along rather than across them, which should be the case if the canals were due to shadows caused by inequalities of level.

The President said they were very much indebted to Mr. Stanley Williams for his very interesting paper, and also to M. Antoniadi for his note upon it, which had aided the discussion very much. He (the President) could quite confirm what Mr. Holmes had said, that there were many cases in which it was very difficult to see whether a star was single or double, or whether a double-star was four stars, as Mr. Holmes put it. The duplication of the micrometer wires also was a very common phenomenon. Anyone who had done much double-star measuring must have had hundreds of experiences of that kind. It was also noticeable that occasionally, when they had been at work some hours, they would get a duplication without a change of focus; that was that the focus that suited their eye when they started work did not suit it after a long spell of work on a particular pair of stars. They would then naturally refocus; but before doing that, they certainly did get duplication of the webs. He personally had never noticed any difference in the duplications of horizontal and vertical wires. That was purely a personal matter; but they would find sometimes, in using high powers, that the very small difference of focus they required for the nearer of the movable webs as compared with that for the more distant web was quite sufficient to give duplication of one and not of the other. Of course, with moderate powers that was not noticed; but with high powers, the very small difference in the plane of the two webs was quite sufficient to determine the duplication of either the near or far web, as the case might be.

The President called upon Mr. Maunder to make an announcement respecting the arrangements made for the eclipse expedition of next year.

Mr. Maunder read the circular which had been drawn up. This stated that, subject to a sufficient number of passages being actually taken before Jan. 31, the Royal Mail steamer *Tagus*, or a sister vessel, would be engaged. The vessel would start from Southampton at six p.m. on Friday, May 18, calling at Cadiz and Alicante, and arriving at Algiers at six a.m. on Thursday, the 24th. Leaving Algiers on Tuesday, the 29th, at six p.m., the vessel would call at Alicante, Gibraltar, and Lisbon, being timed to arrive at Southampton at seven a.m. on Monday, the 14th of June. It was hoped that the members of the Association would divide themselves into three principal groups: Those observing the eclipse (1) in the interior of Spain, (2) at Alicante or neighbourhood, and (3) in Algeria, where the ship would act as an hotel for all those who wished to use it in that capacity. The first party would, it was expected, break up into two chief sections: those who would alight at Cadiz and rejoin the ship at Alicante, and those who would rejoin the ship at Gibraltar. The scale of charges was given, and it was requested that applications for berths be at once made to Mr. Thomas Frid Maunder, 26, Martin's-lane, Cannon-street, E.C. The entire party would, from the arrangements made, have the opportunity of visiting Gibraltar and Lisbon. The latter port would, however, only be visited in case it was quite free from plague infection. Mr. Maunder emphasised that these arrangements would necessarily fall through unless a sufficient number of passages had been definitely engaged on or before Jan. 31, immediately after which date they must close their contract with the Royal Mail Steamship Company. If they carried out the proposed arrangements, he thought they would be able to organise a very successful and very cheap expedition to observe the eclipse.

Father Cortie presented the eighth report of the Solar Section, which dealt in detail with the sun-spots observed during the year 1898.

Slides to illustrate the great spot of September, 1898, of drawings made by Mr. Astbury, and at Stonyhurst, were thrown upon the screen.

Father Cortie said that now that we had almost reached the time of the minimum of solar spots, observers of the sun might very profitably turn their attention to observing the solar surface, and the wonderful changes that took place upon it, even at times of minimum. It was only rarely that the granulated structure could be seen, when the conditions for observing were exceptionally good. Generally the sun's surface appeared to be mottled, but when the seeing was above the average the bright mottling was broken up into distinct grains, as if handfuls of rice had been scattered over the surface. In the spectroscope on such occasions he had seen the spectrum crossed lengthways by a succession of light and dark lines, as if the dark spaces of the réseau were miniature spots. Then, again, there was the subject of "veiled spots," which, so far as he was aware, had only been studied by Trouvelot and at Stonyhurst. These "veiled spots" differed from the "penumbral markings," which sometimes persisted for several days in the neighbourhood of a spot group, and were either the first beginnings or the remains of a spot group before it became merged in the photosphere. The "veiled spots" were continually changing. A series of slides was thrown upon the screen from the Stonyhurst drawings, illustrating the "veiled spots," and showing their rapid developments. The genesis of the "blurred patches" in M. Janssen's photographs of the solar surface was most probably due to the change of "veiled spots" from the form in which they first appeared, round and perfectly distinct, until they became diffused, and extended over a larger area. These changes took place in a very few minutes. One slide exhibited the change as taking place in four minutes. The "veiled spots" were best seen in the early morning, before the telescope had become heated. A series of M. Janssen's photographs were then shown, to illustrate the granulated structure of the solar surface, the dark network or réseau, and the blurred patches. In conclusion, he would wish to call the attention of observers of the Solar Section to the remarks made by the President in his inaugural address for the present session as to the drawing up of observations. Frequently drawings were sent on half-sheets of notepaper, and the drawings were mixed up with descriptive matter. He would suggest that all drawings should be made upon a separate sheet of drawing-paper of the size of the *Journal*, and should bear upon them the date and time of observation, the observer's name, and the scale—so many inches or millimètres to the solar diameter. Enlarged drawings were preferable to those on a small scale. The descriptions, notes, and measurement of positions should be on paper of ordinary foolscap size, unless observers had printed forms for this purpose.

Mr. Maunder showed a number of slides from negatives taken at the Royal Observatory, Greenwich, illustrating the life-history of the great group of spots of September, 1898, during its second and third apparitions—viz., those beginning September 3 and September 30. Mr. Maunder wished to take the opportunity afforded by the presentation of the admirable report Father Cortie had made on the work of the Solar Section, to point out a rather curious circumstance with regard to the solar spots of 1897 and 1898. Directing attention to a diagram, Mr. Maunder said that in 1874 the mean spotted area was about 1,400 millionths, or one in 700 of the surface of the visible hemisphere of the sun. In the following years it declined rapidly, and in 1878 it had come nearly to zero. From 1879 it increased very rapidly indeed until 1883, each successive year showing a spotted area

very greatly in excess of the preceding one. Then from 1883 it came down somewhat more gradually until they got to the next minimum in 1888, 1889, and 1890. Then there was a straight run up to the time of maximum in 1893. From 1893 to 1896 there was just as rapid a decline, but in 1897 there was a check; and the mean area for 1897 was practically the same as for 1896; but in 1898 the fall was resumed, and in 1899 the areas still continued to rapidly decrease. But in 1897, when there was this curious check in the diminution of the sunspot area, there was at the same time a curious alteration in the locality in which the spots were seen. In 1874, when the record commenced, the spots were mostly in latitude 10°. Then they approached the Equator somewhat, until just before the time of minimum, they found the spots in latitude 7°. Then at the actual minimum, and just before the rise towards maximum began, there was an immense change in the latitude of the spots, and their mean position was in latitude 22°. From that time forward the mean latitude of the spots began to shift towards the Equator until, at the time they had most spots, they found the mean latitude was about 14°, and the latitude went on decreasing again until, just a little before they reached the spot minimum of 1889, they obtained the minimum of latitude at about 7°. The same process was repeated in this present cycle. There was a rapid run up to 21° latitude at the time of minimum in 1889, and before the increase in area began, followed by a steady movement towards the Equator as maximum was approached, and the mean latitude at the maximum of 1893, like that of the maximum of 1883, was about 14°. For three years there was very little change in the latitude; then in 1897, whilst the spotted area was abnormally maintaining its extent instead of diminishing, there was a most astonishing change in the latitude—a drop, in fact, to 8°, as if the minimum were already reached. This seems to have been due to the occurrence of several great groups in very low latitudes, close to the Equator, which was not at all usual at that period of the sunspot cycle. In 1898, however, there seemed to have been a return very nearly to the normal state of things, both as to the mean area of the spots and their latitude, and it reproduced in both particulars very nearly the state of things observed in 1886, so that if the present cycle went on according to the precedent shown in the last cycle, they might expect the dead minimum of the present sunspot cycle would follow about the middle of 1901.

Mr. Newbegin said the groups shown took him back to old times, for he had the pleasure of bringing some of them to the Association, and it was a great gratification to look over them again. The granulation of the sun shown by M. Janssen's photographs was of a most striking character, being only seen at intervals during a long period of observation. There was one question he wished to ask, more particularly for the sake of finding out whether he had been misled or taken in, or whether other observers had seen the same thing. He had on two or three occasions detected in the penumbra of a sunspot what he might call the weatherhead effect—prismatic colours forming a section of a cycle something like the little rainbows seen when bad weather was about, commonly called weatherheads. On two or three occasions he had seen this effect. The colours seem to belong to the sun, because they moved with the spot as it moved in the polariser. He wished to know if anyone else had seen the same phenomena.

Mr. Thwaites said he had never really observed prismatic colours as mentioned by Mr. Newbegin. He had not used a polarising eyepiece, except occasionally with a friend's telescope. The solar eyepiece he generally observed with was formed of two prisms of slight angle, which reflected the image from their outer surfaces, and did not give colour. Occasionally he had seen colour on the sun, but he had satisfied himself it had been due to want of focus. He had seen what some had called the "rice grains," but on very rare occasions—perhaps once or twice in a year, at the times of very best definition, and then only for a very short time. He had also noticed the areas of confusion—bad focus as it were of portions of the disc—which had been referred to, and was much struck with their appearance. They presented a marked difference to the other portions of the field, which were sharply defined.

Mr. Evershed asked Father Cortie if he had studied the solar surface with monochromatic light. He himself had recently taken many photographs with monochromatic "K" light. He could not say for certain he had got veiled spots, but he had obtained very curious markings, evidently very much larger than the veiled spots. Occasionally he got a perfectly straight dusky marking, apparently radiating from a disturbed region.

Mr. Adams asked how much of the peculiar solar grain on Father Cortie's photographs were due to solar granulation, and how much to the ground glass. He did not recognise the usual appearance of the solar surface in these photographs.

The President inquired whether Father Cortie had seen any colour in the sunspots. On one occasion only had he himself seen colour, and that was just as a bridge was forming, and that piece of the bridge, extending about one-third of the way across the nucleus, was a very bright red. He tried a Dawes eyepiece, a first-surface reflecting prism, and a polarising eyepiece, and the colour was the same in all of them. It was a very remarkable experience. Another question he wished to ask Father Cortie was: What form of eyepiece he, on the whole, recommended for direct visual observation of the sun? Personally, he had rather a partiality for the Dawes eyepiece; but Father Cortie had had very large experience, and members present would doubtless be glad to have his views upon the matter.

Father Cortie, in reply, said he had not had much experience in observing directly—it was mostly by projection that he had observed. The eyepiece he had used, and found to be excellent as long as it lasted, was one made by Mr. Hilger, and described by him in the *Monthly Notices*, R.A.S., some years ago—a prism partially of glass and partially of Canada balsam; but he found it difficult to keep the latter without air-bubbles getting in; otherwise, it gave most magnificent definition upon the solar surface. He was now thinking of getting a polarising eyepiece constructed, because many observers seemed to prefer that form. With regard to the other question of the President, the red veils in spots were frequently seen, at times of maximum, by projection on the drawing-board. Once at Stonyhurst they had seen a yellow veil corresponding to the wave-length of D^3. With reference to the other colours Mr. Newbegin and Mr. Thwaites referred to, he had never seen those, unless, indeed, they were caused by the chromatism of the telescope used. Employing a very high power for projection upon a drawing-board, they would see a coloured fringe round the spots, due to the chromatism of the object-glass, and not to anything on the surface of the sun. In reference to Mr. Adams's question, he reminded that gentleman that the illustrations were not photographs, but drawings on ground glass.

The President said he happened to have a special solar eyepiece which was made by the late Mr. Thomas Cooke for the late Rev. W. R. Dawes, some thirty years ago. He found this a particularly useful eyepiece, if it was desired to take micrometric observations of the sun. It consisted of an ordinary first surface, reflecting prism, the rays from which fell on a second first surface reflecting prism, so that the light was reduced enormously; not only so, but the image was exactly the same as if seen through the telescope direct. The definition did not appear to be at all marred by the double reflection. Between the two prisms was a coloured graduated wedge which could be used to further reduce the light. So far as he knew, it was the only such eyepiece ever made. Mr. Dawes read a paper upon it before the Royal Astronomical Society in the late "sixties" or early "seventies," but speaking from memory he could not give the exact date.*

Mr. Mark Wicks said he watched the progress of the large group of spots across the sun's disc in September, 1898, and had splendid seeing by the aid of a specially-designed apparatus attached to his 4in. Gregorian, which he described. The amount of detail seen was such that the photographs of the same group of spots taken at Greenwich, which had been thrown upon the screen, seemed to him very disappointing, as he assumed that a much larger ins'rument than his was used there.

Mr. Goodacre, the director of the Lunar Section, presented a preliminary report regarding the recent lunar eclipse, stating that the reports already received from twelve members unanimously expressed the opinion that the eclipse must be regarded as a bright one, and that it bore a great resemblance to that of December 27, 1898. At the time of the greatest phase the shadow was not dense enough to hide any of the larger formations, either ring plains or seas. A few occultations occurred.

Mr. J. Milton Offord exhibited a series of twelve lantern slides from photographs of the recent lunar eclipse, showing the progress of the earth's shadow at intervals of a quarter of an hour. The telescope employed was a 12¼in. reflector, the lunar image being enlarged to over 2in. diameter by a negative lens. At the time of greatest obscuration, the small portion of the moon remaining was readily photographed. In addition to the series on an enlarged scale, Mr. Offord also showed two photographs taken near the time of central eclipse, to which exposures amounting to 600 times the normal for the full moon had been given; these negatives exhibit most of the seas on the eclipsed portion of the disc, nearly the whole of the moon being visible, the light gradually fading away as the deeper parts of the shadow were reached. When these photographs were taken the limb of the moon appeared lighter than the centre to the naked eye, an optical illusion arising from the darkness of the surrounding sky.

The meeting adjourned at 7 p.m.

* The Rev. W. R. Dawes' paper was read before the Royal Astronomical Society in 1865, and will be found in the *Monthly Notices*, Vol. XXV. p. 218.—W. H. M.

SCIENTIFIC NEWS.

It is somewhat satisfactory to learn that some of the prizes of the Paris Academy of Sciences have been awarded to foreigners. Mr. W. R. Brooks receives the Lalande prize for his discoveries in connection with comets, and M. Nyrén, of Pulkowa, is awarded the Valz prize for his work in sidereal astronomy. The Arago medal was awarded to Sir G. G. Stokes, on the occasion of his jubilee at Cambridge University.

The Wilde prize is given to Dr. P. Zeeman, for his important discoveries of the relations between the magnetic field and the nature of light rays.

In the section of Mechanics the prize of 6,000 francs is awarded to M. Bailles, for his treatise on the geometry of indicator diagrams; and the Plumey prize to M. Bonjour, for inventions in connection with the steam-engine.

The Bréant prize for a method of treating Asiatic cholera has not been awarded, but the sum accummulated (6,000 francs) has been divided between three investigators of the pathogeny and pathology of tetanus.

Sir James Paget, Bart., D.C.L., LL.D., F.R.S, who died on Saturday last, was one of the most distinguished surgeons of this century. He was born at Great Yarmouth on Jan. 11, 1814, and studied at St. Bartholomew's, rising steadily in his profession until he obtained the highest honours. He was elected a member of the Royal College of Surgeons in 1836, and a Fellow in 1843, and was from 1847 to 1852 professor of surgery and anatomy there. In 1865 he became a member of the council, was appointed president of the college in 1875, and Bradshaw lecturer in 1882. Among other positions he held were those of Serjeant-Surgeon to the Queen, Surgeon to the Prince of Wales, and consulting surgeon to St. Bartholomew's Hospital. For many years he was a member of the Senate of the University of London, and in 1884 he became Vice-Chancellor. Honorary degrees, in recognition of his high professional attainments, were showered upon him by Oxford, Cambridge, and Edinburgh. In the profession he was perhaps more highly regarded than by the general public. His published lectures on surgical pathology brought him world-wide fame; and those, as well as his "Clinical Lectures and Essays," became standard works. He was created a baronet in 1871.

Mr. James Dens, engineer of the Clyde Trust, died suddenly last week from heart disease, at the age of seventy-two years. After a period of railway service, in 1869 he succeeded Mr. Andrew Duncan as engineer to the Clyde Trust, and all the great improvements that have been made recently on the Clyde were directed by him. The most important of the structural improvements made under Mr. Dens's direction were the Princess Dock and the graving dock at Govan.

The death is reported from Berlin of Prof. Karl Rammelsberg, the well-known mineralogist, and Professor of Inorganic Chemistry in the University of Berlin, aged eighty-seven.

To students of meteorology, the following note on barometric pressure may be suggestive. Mr. G. J. Symons, F.R.S., writes:—Inasmuch as a barometer on Hampstead Heath would read considerably (nearly ½in.) lower than one on London Bridge, meteorologists have long adopted the plan of correcting the readings at any station to what they would have been if placed at the level of the sea. The record here (Camden-square) now covers more than 40 years, but in that long period the pressure has been only three times lower than this afternoon, Dec. 29; therefore, the following few figures will be of interest. Minima of barometric pressure reduced to sea level:—1872, Jan. 24, 4.47 a.m., 28·332in.; 1876, Dec. 4, 11 a.m., 28·364in.; 1886, Dec. 9, 4.45 a.m., 28·295in.; 1899, Dec. 29, 5 p.m., 28·427in.

The "juvenile" lectures at the Royal Institution delivered by Mr. C. Vernon Boys, F.R.S., commenced with some elementary facts which, however, are not always remembered by the "juveniles" who attend the Christmas lectures. The experiments, for the most part, were as elementary as the principles they were meant to illustrate. The law that a liquid finds its own level led to an explanation of the principle of the spirit level and the delicacy of the work it

did. Pressure was illustrated by pouring varying quantities of water into vessels of different shapes, to show that the pressure did not depend upon the shape of the vessel but upon the depth of the liquid from the top. That liquids were of different densities was shown by a small quantity of one balancing a great quantity of another, by a lighter fluid being made to float on a heavier, and by an egg being dropped into some liquids in which it sank, and into others on which it floated. One of the most interesting experiments in this connection illustrated the testing of diamonds, emeralds, sapphire, ruby, and topaz, which sank or floated respectively, according to their genuineness or spuriousness. That air had weight was shown by sending up a small balloon; that its weight might be decreased was shown by heating the air within the balloon. The hydraulic press and the hydraulic engine were explained, with the view of showing the enormous pressure exerted by water, a practical proof of which was given by the breaking under the press of an iron bar. A diagram made the causes of the circulation of hot water for baths and heating purposes clear.

At the Royal Institution on Jan. 16 Prof. E. Ray Lankester, M.A., F.R.S., commences a course of twelve lectures on "The Structure and Classification of Fishes." On Jan. 18 Mr. W. H. R. Rivers, M.D., will commence a series of three lectures on "The Senses of Primitive Man."

Dr. E. T. Jones has been appointed professor of physics in the University College of North Wales in succession to Prof. A. Gray, F.R.S. The Drapers' Company has made the college a grant of £200 annually for three years towards the maintenance of the department of electrical engineering, pending its permanent establishment.

The London Technical Education Committee have arranged for a second conference of science teachers to be held during the Christmas vacation. Meetings will be held on Jan. 10 and 11, 1900. On the first day the meeting will be held at the Imperial Institute, under the presidency of Sir John Lubbock (now created a peer) in the morning, and of Sir Henry Roscoe in the afternoon. The second day's proceedings will take place at the Shoreditch Technical Institute, Hoxton. Addresses will be delivered on "Teaching of Botany in Schools," by Prof. L. C. Miall, F.R.S., and "Object Lessons in Botany," by Miss Von Wyss. Prof. Armstrong will lecture on "Juvenile Research," and Prof. Hutchinson will read a paper on "Teaching of Natural History in Schools." Addresses will also be given on "Object Lessons in Natural History," by Mr. J. W. Tutt; "Metal Work as a Form of Manual Instruction in Schools," by Prof. W. Ripper. Free admission will be granted to as many teachers as the conference rooms will accommodate.

At a recent meeting of the Physical Society, Prof. W. E. Dalby exhibited a friction dynamometer in which the torque to be measured produces a twist in a spiral spring, the amount of which has to be determined. On the shaft of the apparatus, side by side, are two pulleys, one keyed to the shaft, and the other fastened to the end of the spring. The lead of one pulley upon the other, therefore, measures the twist. Two other pulleys are mounted upon a slide, and are joined up to the first ones by means of a continuous band similar to a Weston's differential pulley block. When the shaft is at rest the two pulleys on the slide are touching, but any motion of the shaft produces a twist in the spring, and therefore a lead of one of the shaft pulleys on the other. This produces a separation of the slide pulleys which is proportional to the lead, and therefore to the torque, and so, from a knowledge of the constants of the dynamometer and its number of revolutions per second, the power transmitted is at once determined.

At the Royal Victoria Hall, Waterloo Bridge-road, on Jan. 16, a lecture will be delivered by Mrs. Lemon on "Birds at Home and Abroad," and, on Jan. 23, Mr. A. Seward, F.R.S., will lecture on "Plants of Long Ago." On Jan. 30, Mr. F. W. Rudler is to lecture on "The Fathers of Geology."

It is estimated that the Great Salt Lake, Utah, U.S.A., contains about 400 million tons of salt, and although about 42,000 tons of commercial salt are removed annually, it appears that something like 14,000 years must elapse before the water of the Lake will become like ordinary sea-water. The evaporation is greater than the rainfall can supply, and it is possible that some means of utilising the salt may be devised. Similar ideas have been put forward with regard to the Dead Sea. The question is, Can the schemes be made commercially profitable?

One of the latest ideas in submarine boats is that of an engineer named Rogers. It is a telescopic boat, so that when the after part is drawn in or pushed out by means of hydraulic mechanism provided for the purpose, her displacement is altered, and so she rises or sinks as required. She is fitted for the discharge of Whitehead torpedoes, and has another peculiarity, in that her conning-tower is, so to speak, a complete boat in itself. Should any untoward accident befall the vessel, all the captain and his crew, who are together in the conning-tower, have to do is to leave the sinking ship. They disengage the tower from the foundering hull and float away, perchance to safety. It is not quite clear about the alteration of displacement, and it is not stated that the boat has been tried on the scale of twelve inches to the foot.

USEFUL AND SCIENTIFIC NOTES.

CALVERT'S MECHANICS' ALMANACK for 1900 is the twenty-seventh year of publication (London: John Heywood), and contains many readable and valuable notes, and is what it purports to be, a "workshop companion."

THE imports of coal, now so largely carried to Hull by the various railway companies, will, it is expected, this year exceed any of its predecessors. The total entry of coal for the year 1898 reached 3,458,418 tons, against 2,655,744 tons in 1897, 2,420,416 tons in 1896, and 2,190,016 tons in 1895. Up to the close of November in the present year the imports had reached 3,248,160 tons, compared with 3,142,836 tons in 1898, an increase of no less than 105,324 tons. During the month of December, 1898, 316,656 tons were sent, and as only 210,328 tons are required to be sent during the present month to reach last year's tonnage, it is but fair to assume that the total imported will be reached, if not exceeded.

A COMPLETE electric search-light apparatus is about to be added to the New York Fire Brigade. It will be mounted on wheels, and will accompany the brigade to fires. Its purpose will be to light up dark parts of the street, and aid firemen in laying hose, setting ladders, or other work. The machine will resemble a fire-engine in general appearance, and will use a similar boiler, but in place of the pumping machinery the engine will drive a dynamo, which will supply the lighting currents for the search-lights. There will be two search-lights, each with an 18in. projecting lens, and these will be carried on a platform behind the driver's seat. They can be used either from the platform, or removed and carried to any convenient place near by, their connection with the dynamo being kept by means of flexible cables.

THE power house of the Niagara Falls Hydraulic Power Company has recently received a new machine designed to give 5,000 ampères at 175 volts. This machine, which is for electrolytic work, has two commutators. The two sets of brushes are connected in parallel with each other. The load on the machine is divided between the two commutators, or rather between the two armature windings by an ingenious arrangement of varying the lead of one of the other set of brushes. This is done by means of ratchet gear in one side of the field frame. These ratchet-wheels work a brush-rocking apparatus by means of spur-gearing. The cross-shaft, on which the ratchets are placed, can either be worked as a whole, in which case the brushes on the commutators move together, or it can be split into two, so that one set may be worked separately to divide the load evenly between the commutators.

A SYSTEM of electric train lighting in use on the Paris, Lyons, and Mediterranean Railway has a dynamo provided on each carriage, arranged with its axis parallel to the rails. A friction wheel on a prolongation of this axis is pressed against one side of a running wheel. In this way the motion of the wheel is transmitted to the dynamo. Between the dynamo and the axle which drives it a friction clutch is provided, consisting of carbon brake blocks pressing on a bronze disc. The pressure of these carbons on the disc is such that slipping only commences when a current of 28 ampères at about 16 volts is being generated by the dynamo. This corresponds to a speed of about 30 miles per hour. At any higher speed slipping occurs, the idea being that the speed of the dynamo shall not increase, as an increased speed would also correspond to an increased torque. The dynamo is used to charge a battery of accumulators, which supply light to the train when it is stationary or only going at a slow speed.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

VARIABLE STAR OBSERVATIONS, DECEMBER, 1899.

[43159.]—S CASSIOPEIÆ has varied but little from 12·5 magnitude during the ten months January to October, 1899, and was often so faint as to be near the limit of vision with this telescope. A decided rise set in on October 30, and on December 27 the star was 8·7 magnitude, having risen four magnitudes in two months.

U Orionis passed a minimum, 11·8 magnitude, November 26. The interval since the previous minimum, November 18, 1898, was 373 days. The rise will probably be rapid, and this star will soon become an easy object.

R Lyncis has been gradually going down for the last five months, and is now a very faint star, 12·0 magnitude. The minimum will probably occur about the end of January, 1900, so that for the next two or three months this variable will be a very difficult object.

S Ursæ Majoris passed a minimum, 12·2 magnitude, October 30. The interval since the previous minimum, April 7, was 206 days. The rise has been rapid, and it was observed 8·5 magnitude December 27.

R Draconis passed a minimum, 13·3 magnitude, November 26, when it was a very faint point, and near the limit of vision with this telescope, this being a very faint minimum. The interval since the previous minimum, February 27, was 272 days. The star is now brightening, and was observed 10·6 magnitude, December 25.

The instrument used was the 6·4in. equatorial refractor. Weather was very unfavourable. Observations were made on ten nights, on some of which the cold was so intense that the dome was moved with great difficulty, and the equatorial clock ceased to work. C. E. Peek.

Rousdon Observatory, Lyme Regis.

THE LUNAR ECLIPSE OF DEC. 16, 1899.

[43160.]—THE morning of the 16th was fine, but the afternoon and early evening promised badly. However, at about eight o'clock the sky showed signs of clearing, and just before ten the clouds drifted away, and left the moon soaring in a clear sky.

I took my stand at the telescope at 10h. 45m., twelve minutes after the calculated time of first contact with the pneumbra:—

(1) 10h. 45m. The sky is beautifully clear, and the atmosphere chilly. With the telescope there seems to be a darkening on the limb of the moon between the positions of the craters Lavoisier and Gérard. It extends some little distance into the disc.

(2) 10h. 53m. Appearance much the same as in observation (1). I cannot decide whether the darkening is due to pneumbra or local causes. [After-observations lean to the side of the penumbra.]

(3) 11h. 5m. Appearance very similar to (1) and (2).

(4) 11h. 18m. The penumbra now extends into the bright region between Mairan and the Sinus Iridum, and there is a toning south of Grimaldi not previously noticed.

(5) 11h. 28m. The darkening first noticed [observation (1)] has now deepened, and is nearly as dark as the seas next it. It seems to have extended farther north, but it is here very faint. It can be traced in a southerly direction to a point 5° or 6° south of Grimaldi. The penumbra is easily perceptible to the naked eye.

(6) 11h. 38m. The penumbra is now plain to the naked eye on the N.E. limb of the moon. In the telescope it is visible over the eastern half of the disc, and can be traced as far westward as the Sea of Serenity on the north and to ray system of Tycho on the south. This crater and the bright region around it, however, are not at all affected by the penumbra.

(7) . . . . The surface east and south-east of Aristarchus is now much darkened.

(8) 11h. 46m. I should say the first contact with

the shadow occurred at about 11h. 45m. by my watch, set correctly to G.M.T. in the morning. The penumbra shaded off so completely into the shadow that it was very difficult to recognise the shadow until well on the disc.

(9) 11h. 52½m. The edge of the shadow passes through the eastern part of Sinus Iridum, and thence to a point 3° S. of southern end of Grimaldi. A line of light runs along eclipsed limb, widening out near Grimaldi. The shadow is very dark, almost black. Already a perceptible difference in the light received by terrestrial objects from the moon is noticed.

(10) 12h. 4m. Illuminated limb still noticed.

(11) 12h. 13m. The shadow-edge is very near the eastern border of Mare Serenitatis. Farther south there is a "bite" or "bay" in the shadow, evidently caused by the high ground of the Apennines. The portion of the shadow near the limb is lighter than the edge, and the limb is lighter still. The brightest portion of the shadow is on the limb near N. end of shadow.

(12) 12h. 34½m. Edge of shadow touched eastern ramparts of Tycho. On the limb of the moon, slightly E. of N. point, is a bright orange strip, shading off and disappearing a little north of east. The limb becomes bright again further on, but is not so bright as in the north.

(13) 12h. 41m. The "seas" are now plainly visible with low power of telescope. The strip noted in observation (12) has increased greatly, and is ruddier than before. The edge of the shadow is lighter in colour, and is now only of a dark grey tint.

(14) 12h. 55m. The edge of the shadow passes through Mare Fœcunditatis. The region round Mare Crisium, although in the shadow, is only of a golden yellow colour. This tract passes north and diminishes in breadth and deepens in colour to a beautiful deep coppery hue as it approaches the patch noted in observation (1).

(15) 13h. 13m. Only a narrow crescent left, running out along the S.E. limb as a narrow strip of half-tone. The lightest portion of the shadow is that around Mare Crisium. It passes north, becoming ruddier in colour on that strip N. of Maria Serenitatis and Imbrium. The stars, which have been gradually becoming brighter and more numerous, now shine brilliantly. Orion and Sirius to the south, Aldebaran, with the Hyades and Pleiades to the west, and β and ζ Tauri respectively north and south of the lunar disc, form a splendid framework to the imposing picture. Add to this the curious appearance of the moon, with its luminous crescent and copper-coloured disc, and the flight of some bright meteors, and one gets an idea of the beauty of the celestial phenomenon.

(16) 13h. 30m. The light received from the moon is just sufficient to throw a shadow on the snow covering the ground when the hand is held close to its surface. The successive appearances of the shadows cast on the snow have well shown the progressive diminution of the light received from the lunar orb.

(17) 13h. 50m. The crescent has increased, and its points are extended along the limb into the shadowed portion as two half-shaded strips or horns, the eastern one of which is the brighter. The portion of the moon diametrically opposite the middle of the bright crescent is the ruddiest portion in the shadow.

(18) 13h. 58m. Shadow becoming darker. The "seas" are now not so easily distinguished.

(19) 14h. 11m. Edge of shadow passes a little N. of the crater Ball. Aristarchus can be discerned within the shadow.

(20) 14h. 20m. The shadow is now much darker, its outer portion being of a dark drab tint. Aristarchus can be seen touching inner edge of the shadow.

(21) 14h. 34m. The shadow is very dark, and no *maria* are visible in it. Its edge passes through the north-western borders of the Mare Vaporum.

(22) 13h. 42m. There seems to be a dark, sea-green tint in the shadow (this has been before suspected). The shadow fades away through a belt of faint penumbra 10° or 12° wide, the rest of the moon not seeming to be affected by it.

(23) 15h. 4m. Shadow-edge touches N.W. ramparts of Mare Crisium.

(24) 15h. 7m. Observed last contact with shadow. Calculated time, 15h. 7·2m. Estimated, 56° N. towards W. Calculated, 59°.

(25) 15h. 11m. The penumbra is very strong N W. of Mare Crisium, and extends to the western borders of the Maria Tranquillitatis, Fœcunditatis, Serenitatis, and Frigoris.

(26) 15h. 20m. Penumbra still visible.

Remarks.—The Penumbra: This was first noticed at 10h. 45m. During its progress over the moon the region near the positions of the craters Lavoisier and Gerard seemed peculiarly affected by it. At first in avoided the Polar regions [obs. (5)], especially the N. Pole.

The Shadow.—The shadow at ingress was ill-defined. It afterwards became more clearly cut, but just before passing off again became diffuse, though not so much so as at ingress. The last contact was much more easily seen than the first.

The *colour* of the shadow was noted first as "very dark, almost black" (11h. 52½m.). At 12h. 41m. the colour of the shadow edge was dark grey. The interior of the shadow became very light-coloured at times, and was noted as "golden yellow" a 12h. 55m. The tint of the shadow then deepened, becoming dark drab and nearly black again, when it was thought to show at times a dark green tint. Instrument in use 2½in. refractor; powers 15—50.

Leicester, Jan. 1. A. King.

THE LUNAR ECLIPSE.

[43161.]—THE lunar eclipse was splendidly seen in Keswick. I was much struck by the ease with which the Leibnitz mountains could be seen standing out on the uneclipsed edge at about 2 a.m. Dec. 17. Did any other observer notice this? I had never seen them before, and was not looking for them. My instrument is an 8½in. reflector.

Eccleshall. A. C. Allen.

LUNAR SEAS AND RAYS.

[43162.]—I SEE a subject introduced in *Knowledge* November and December numbers which I would like to see discussed in "Ours," as I think it would interest several of our readers. Mr. Tepper suggests that the lunar seas are covered with a coating of carbon dust, the remains of the plants and animals of the moon which lived on it in former time before the moon became a *dead world*. Several questions may be asked just here, and what can be known should be made as certain as the nature of the case admits. I ask, first, What reason have we to think that the moon had living organisms of any kind on it in the past? Having no atmosphere and no water, it is not easy to see how plants or animals could exist; and yet I think that the time may have existed when our moon had both water and an atmosphere. Will your readers tell us what they think on this subject? The difficulty would be less than it is at present if the moon's rotation period was ever shorter than at present—that is, if it rotated on an axis several times in a lunar month; but the earth's attraction, which keeps the same side earthward now, would have done so in the past, for it is thought that G. Darwin has proved that the moon was at one time very near the earth, and at that time the attraction of the earth on the nearer half of the moon must have been greater than now, and its tendency to keep the same side earthward would have been greater than at present. Nevertheless, I have long thought that some fine loose powder or something like snow (possibly carbon dust) does exist on the moon's surface, in some places at least.

I think we have not given sufficient thought to the fact that the moon has no atmosphere, and that as a consequence all the meteoric matter which falls on the moon will reach its surface. Many tons of cosmic dust fall on the earth every year, but it is burnt up in rushing through our atmosphere, and never reaches the earth's surface; it is only very large meteors which reach the earth's surface. In the moon all will fall on the surface, and it may remain undisturbed until other meteors fall on it or sweep through it, scattering the dust on each side of its track. I think the fall of large meteors vertically on the moon into its dust-covered surface, would scatter the light matter from beneath and around it, and form the ring-plains, and the so-called craters, with radiating streaks, like Copernicus, Kepler, and Tycho, may have come into existence in this manner. And the meteors, passing nearly horizontally across the moon, would be likely to produce those rays which run parallel with each other, and do not diverge as if radiating from a centre. Such rays as the two which pass from near Tycho to Bullialdus, and the great sweep from Kircher to Lexell, in which the rays run parallel to each other are good examples.

There are many other features, which, I think, may be explained by this meteoric view, and I think Mr. Tepper's view of animal and vegetable life is not inconsistent with this view. I should like to see it discussed. A. Elvins.

ANCIENT ASTRONOMICAL CHRONOLOGY.

[43163.]—IT was not until after I sent you my letter on the supposed Chinese conjunction of planets that I met with Prof. M'Fairland's article on "Ancient Eclipses and Chronology," in *Popular Astronomy* for December, 1899. It does not deal with Chinese observations; but I think it will be found well worthy of the perusal of those who repose any faith in these early astronomical notices —which seldom came from the pen of an astronomer. One of the great supposed landmarks is thought to be the eclipse which Thales predicted, and which put an end to a battle between two Oriental monarchs. When did it occur? I gave the dates from Prof. M'Farland's article: Volney B.C. 623, Baily Sept. 30 B.C. 610, Ideler and Grote B.C. 610, Oltmann B.C. 610, Bayer and others B.C. 603, Usher B.C. 601, Lardner B.C. 597, Sir G. B. Airy May 28 B.C. 585, Grant (citing Cicero and Pliny) B.C. 585, Rawlinson B.C. 584, Bosanquet B.C. 583, Scaliger Oct. 1 B.C. 583, Clemens Alexandrinus B.C. 579. The difference between the extremes is 46 years, and there are strong authorities for both B.C. 610 and B.C. 585.

The professor's conclusion is that "there is no new light from old eclipses." The truth seems to be that in hardly any instance is the record definite enough to fix the date even approximately. The dates given are found by computing backwards from the data which are generally accepted at the date of the computation, and then it is assumed that the early eclipse proves the accuracy of our present theories. The same thing is true of early conjunctions. It may be that early observations are not wholly useless, but they should evidently be treated in a much more critical spirit than hitherto. We should inquire what the original writer has actually said, or is reported to have said, if we do not possess a copy of his works, in which latter case we should also inquire into the probable accuracy of the reporter, and if we compute backwards we should also examine what amount of variation either in the year or in the season of the year would be consistent with the original account. Unless this amount of admissible variation is small, I do not think the records of past eclipses, conjunctions, &c., afford any proof that our present astronomical tables are shown to have held good for thousands of years past by comparing them with these records. W. H. S. Monck.

SOLAR SPOT OBSERVATIONS, DECEMBER, 1899.

[43164.]—THE accompanying observations may be of interest:—

1889.		h.	m.	Total Spots Recorded.	Groups of Spots.	Groups of Faculæ.	Air.	Remarks.
Nov.	26	2	30	1	1	1	1	Def. good
,,	28	2	0	1	†1	2	1	,,
Dec.	2	2	30	1	1	void	1	,,
,,	4	2	0	6	†2	1	1	,,
,,	8	2	0	4	2	2	1	,,
,,	10	0	45	void	—	1	2	Def. poor
,,	14	2	0	10	†3	1	2	Def. good; hazy
,,	16	1	45	11	3	2	1	Def. good
,,	24	0	15	void	—	1	2	Def. poor
,,	25	1	0	void	—	2	1	Def. excellent
,,	27	1	20	void	—	void	2	Def. poor
,,	30	1	0	4	1	void	1	Def. good
,,	31	0	40	1	1	void	1	Def. excellent

In the table, the daggers in the fourth column indicate that on those dates a fresh group of spots were appearing on the east limb of the sun. Air 1 is good; air 2, fair. On those dates omitted observations were precluded by unfavourable weather. It will be seen that there is a break from the 16th to the 24th, during which time there was not a gleam of sunshine here, a circumstance the more annoying as the groups then visible were the most interesting of those recorded during the month. The instrument in use is a 2·85in. achromatic, no spot being recorded unless distinctly seen with a power of 60, the projection method being used except when haze renders that method impracticable. Silverplume.

THE CONJUNCTION OF CHINESE PLANETS.

[43165.]—As Mr. Williams's work on Chinese comets is unknown to many of your readers, I ask space for a few more remarks as regards the alleged conjunction of planets. The reference to it occurs in his "Introductory Remarks," which deal with Chinese astronomy in a more general aspect. The passage regarding the conjunction (pp. viii., ix.) runs thus: "In the Chinese annals it is recorded that in the reign of Chuen Kuh, the grandson of Hwang-Tē, in the spring of the year on the first day of the first moon, a conjunction of the five planets occurred in Ying Shih. Ying Shih (or, as it is more usually denominated, Shih) is one of the 28 stellar divisions, determined by α, β, and other stars in Pegasus, extending north and south from Cygnus to Piscis Australis, and east and west 17°, and comprising part of our signs Capricornus and Aquarius. The Emperor Chuen Kuh is said to have reigned 78 years from B.C. 2513—2436, and to have died in his 97th year," and then follows what I have already quoted. I may remark that Mr. Williams refers to B.C. 2737 as the 60th year of the reign of Hwang-Tē, the grandfather of Chuen Kuh. Consequently, 183 years elapsed between the commencement of Hwang-Tē's reign in B.C. 2696 and that of his grandson Chuen Kuh in B.C. 2513, when the latter was only 18 years of age. Subsequently, I find Mr. Williams described the reign of Yaou as lasting

for 100 years (p. xi.), and I presume this 100 years' reign was one of the data by which the dates and accession and death of Chuen Kuh were arrived at. I do not think many of your readers will rely on this kind of chronology, and, assuming that Chuen Kuh was a real, not a mythical, character, I should be disposed to ascribe his reign to a latter date than B.C. 2440, so that none of the alleged conjunctions would fall within it.

I am no authority on Chinese chronology, and should be glad to have the opinions of those who are. But the first comet recorded by Mr. Williams appeared in B.C. 611, and it seems strange that if the Chinese astronomers were so well acquainted with the planets in B.C. 2440 they should not have recorded the appearance of any remarkable comet for more than 1800 years afterwards. It will be noted, too, that in the computed conjunctions the most conspicuous of the planets—Venus—is conspicuous by her absence.

My impression is that the real recorder of this conjunction is some astronomer who lived 1,500 or 2,000 later, and arrived at it by computation, and, accepting the historical theories then current as correct, placed it in the reign of Chuen Kuh, and though the alleged conjunction of five planets did not take place, he probably showed considerable knowledge of their periods in computing it. Supposing, for example, that he made an error of six hours in the period of Venus, he would be wrong as to her position by more than a month if the computations were carried back for 2000 years.

Such questions ought to be dealt with entirely from the scientific or evidential point of view. When the theological element is once introduced, some people will swallow anything that tells on one side, and others will swallow anything that has an opposite tendency. "Balaam's ass has been too conspicuous on both sides of the controversy" is the remark of the Rev. E. J. Hardy in his last publication. The ass was not always Balaam's.

W. H. S. Monck.

SOME CORRECTIONS—THE LEONIDS—BLUNDERS—ACETYLENE.

[43166.]—I SHOULD like, by your permission, to correct two or three little errors which appear in letter 43119 on page 425 in the issue dated Dec. 22. In par. 2, line 1, "a power of 80 on 6in." should read "a power of 80 on 3in." In line 5, same par., "penumbræ" should be "penumbral." And at the very commencement of the middle column, "12h. 30m." should be "13h. 30m."

Like "W. T. N." in letter 43124 on the same page, I am rather astonished that the theory now advocated to account for the non-appearance in any quantity of the Leonids last month has not been more publicly advertised before; and that Messrs. Jupiter and Saturn should have developed a meddlesome disposition within the last forty years far in excess of anything they have done before for some centuries past. So long ago as November, 1895, I mentioned in letter 38231, page 313, in the issue dated 22nd of that month, that, in spite of the dictum of "authorities" on the subject, I was tempted to predict that for two or three Novembers following there would be no striking display of Leonids. Not that I was thinking anything about Jupiter and Saturn in connection therewith; but I found it difficult to persuade myself that the vanguard of the swarm could extend so far in advance of the nucleus. If the familiar influence of gravitation is in operation amongst these particles, I should fancy their mutual tendency would be to coalesce rather than to become more diffuse. And that, therefore, if anything like the densest part of the swarm was passed through by the earth in November 1833, a part three months in advance of that was traversed in November, 1866, and their orbit was crossed six months in advance last November. Viewing things thus, and shunting Messrs. Jupiter and Saturn, I am tempted to predict the next really grand display for November 16-19, 1966, especially as I believe the moon will not then be obtrusive. I certainly hope to see a great many more Leonids next November than I did this last; but as to counting them by thousands—I will freely forego the last cypher. Their failure to then and thus appear will go very far towards corroborating the conclusions of Drs. Johnstone Stoney, and Downing.

Books are turned out at a furious rate nowadays, and, "cheap and nasty" many of them may be. But there is one book annually published which has found a place on my shelf for many years, and which it is extremely disquieting to find manifesting any signs of nastiness or—in other words — inaccuracy. I refer to the enlarged *Whitaker's Almanack*. Two days ago I bought that work for 1900, and your readers may judge of my astonishment when in reading its remarks on the prospective Leonid display of November next, I was told that at the otherwise most favourable time to watch for them—the morning of the 15th—"the moon will unfortunately be nearly full." (!!) (see page 683.) Why the book itself informs us on page 57 that at the time in question the moon must be at least something like 22½ days old, or about a day past "last quarter."

Although a few more days added to her age would doubtless be some advantage, it is pretty clear that the writer of the paragraph in question was confusing in his mind the state of things prevailing on the 15th of last month with celestial conditions of next mid-November. If this is "really too bad," what are we to think of the arrangement of things on the next page (634)? The second paragraph on that page gives a number of dates on which "large meteors should be particularly looked for." Some of these dates are printed in heavier type than are others. The explanation of the reason for this is omitted here, and clapped in as a sort of appendix to the article on "Telescopic Powers Necessary for Observing Celestial Objects" on the same page, with which it has just as much to do as I have with the financial condition of Tropical Venus. "Carelessness," of course, may be considered a satisfactory explanation for the whole; but the unfortunate thing about it is that when you *know* a book is unreliable in some places, you cannot trust it in others.

For this reason I should be very glad of a little information on the subjoined subject from some *practical* contributor to these pages—not from a book-worm. On page 665 of the said *Whitaker's Almanack* for 1900 it is stated in the paragraph on Acetylene that "It is found better, not to employ the naked carbide of calcium to yield the gas, but to saturate it with petroleum, or a mixture of tar and petroleum residues, &c." Have any of "ours" tried this experiment? If so, what improvement has been experienced? Is the ordinary refined table lamp petroleum the thing meant, and is the carbide to be simply dipped in this before being placed in the generator? And, what is the improvement? As to tar (coal tar, wood tar, or what?) one might think if lumps of calcium carbide were very thickly coated with that material, they would thereby be protected from the action of water altogether. Of course, I might find out something about it by personal experiment, only the said carbide is not by any means a nice thing to play with, and I know that the brotherhood of "Ours" is not churlish. William Godden.

SODOM DESTOYED BY THE LEONIDS.

[43167.]—MR. WENHAM may be assured that Genesis rightly describes the plain of Jordan as "well-watered everywhere, before the Lord destroyed Sodom and Gomorrah, like the garden of the Lord." The most fertile and populous part of Persia is about Tebriz, draining into the only known lake that is salter than that of Lot—the lake Urumia. Wherever fresh streams descend to the Dead Sea, as at Ain Jiddi—the Scriptural Engeddi—there is fertile land with abundance of date palms. All the barrenness is caused by salt—not by bitumen or sulphur, which belong to the strata. No account describes any salt strata; but at the south end there is a hill of salt some miles long called Jebel Esdoom, or "Sodom Hill," out of a cave in which a stream of brine flows. It seems to appear, like that near Biskara in Algeria, as if fallen from the sky. Before it arrived, the stream was doubtless fresh like that of Engeddi.

The story in Genesis implies that though five cities were destroyed for their wickedness, only two —Sodom and Gomorrah—were *buried*. The Lord "rained upon them burning stone and fire." The other three were merely ruined by the earthquake shock, and all inhabitants driven away or killed, except Lot and his two daughters in Zoar; but these dared not remain in the ruins lest another fall of sky should overwhelm them. They moved into a bomb-proof cavern, and believed themselves the only human beings left on the earth. Nothing that Mr. Wenham describes implies the neighbourhood was not populous 4,000 years ago, even if the sea was as salt as Lake Urumia. Those who have examined the deposits find them not so deep under the lake as in the Jordan valley north of Jericho. That would imply that before the catastrope, the lake was about 50 miles further north, and the site of the present lake being watered by streams flowing northward was eminently fertile: hence Genesis calls it "the vale of Siddim, which is the Salt Sea."

E. L. Garbett.

NEPTUNE—GREGORIAN, BINOCULARS.

[43168.]—REPLYING to "Neptune," my observation of his satellite was on Nov. 12, 1899, at 11 p.m. and Nov. 18 at midnight. The satellite was estimated to be at 250°, being roughly, and about 12" distant, but no great accuracy is claimed. I have no ephemeris of the satellite, so that observation is independent of knowing where to look. When "Neptune" says the satellite has not previously been seen with so small an aperture, he forgets his instance of Ward with 4·3in. My aperture had an area larger than this as to 30 to 18. Power used 300± on 5½in.

Replying to "Hippalus," as I have said, the Gregorian has the flatter field, but otherwise I have noted the defects "H." indicated; but perhaps my instrument is too small to bring them into prominence. He is right about my inquiry re John Bird. It appears, then, the history is a hoax played off on the B.A.A.

I think "Hippalus" will find the polished plate discs the best for specula. The cast ones are seldom well annealed, and the steam acting like springs, as he so well puts it, also like springs alter with temperature, and so no figure is maintainable. The polished plate is much freer from bubbles and is softer to work.

What is the best binocular that is procurable irrespective of price? I should like a power of about 6, and a large field but, above all, definition. Which is the best defining opera or field-glass in existence, even if with small field? I am sure this will interest many. Would a higher power than 6 be advisable or presumable?

I join "Hippalus" in his congratulations to the Editor upon the publication of such letters as those of "H." I hope "H." will keep his promise to deal with the flat question shortly. Ell Hay.

THE NEWTONIAN-GREGORIAN OF "ELL HAY."

[43169.]—IN letter 43111, Dec. 15, "Ell Hay" tells us that since he wrote (his) last letter he has "been busily comparing the performance of (his) telescope as a Gregorian and a Newtonian." His star tests given there were made, he again informs us, "in August last." In 42669, August 11, he said (we remember): "We can see double stars just as well with it as a Gregorian as with a Newtonian, and *vice versâ*, and *there is no perceptible difference in light*" (italics mine). Now, however, he says, referring to these August observations, that with stars forming light tests, the two forms performed equally *only* when (in his case) the Gregorian had 1in. greater aperture.

The equality of light in the two forms (which by the way, I strongly questioned when first mentioned) *was as his personal statement*, however, quite easily understood in the light of past letters—even in errors there must be a certain amount of consistency. The inversion of Jamin's tables is not without meaning in this sequel, neither are previous references to the well known fact that metallic reflections as well as others lose by close approach to normal incidence; although in these references both the theory and its application to the Gregorian were given contrary to the circumstances. *Now*, however, in order to multiply if possible his instances of what he considers disadvantageous comparisons for the Gregorian, he contradicts his former statement, so that in letter 43111 we are told (in reference, be it remembered, to these so-called "observations" in August last), that with a light test, the two forms of reflector were far from equal. (Contrast in this respect 42669 and 43111).

In the latter of these letters, we are also, as stated, informed that the comparisons given were made *since* (he) wrote his last letter, whereas, since the epoch he mentions (August) he has written at least twice, once on Sept. 8 (42783), and again since that date; in respect of which letter the Editor saw fit to deprive us of the pleasure of reading it, for in his notes on p. 193, Oct. 6, he remarked, "When you have learned good manners, we shall be disposed to give you another hearing." In this way are the first three paragraphs of letter 43111 disposed of; with the exception of his rather incomprehensible imputation of "animosity" to myself.

On the contrary, in so far as I am concerned, I do not remember having put myself to so much trouble to serve and oblige any correspondent as I have done in "E. H.'s" case, to which fact others, such as "Balolo," have drawn attention (see letter 42684, Aug. 18). Besides, while feeling myself unable to pass over some of "E. H.'s" misstatements, especially those in reference to γ^2 Andromedæ, which, as "Halley" the second, he has taken under his special jurisdiction, I was careful to add, in 42844, Sept. 22: "I criticise only statements, *never the writers of them*." "Animosity" must, I fear, be looked for elsewhere.

But, after all, are we to take the letters of "Ell Hay" seriously, especially when he asks for such information as the last par. of letter 43111 seeks for? Is it intended that we should look for any serious meaning—not to use the word "veracity" which "E. H." so ostentatiously uses elsewhere — in a "person" who pretends to have measured five times over the diameter of a speculum hole to within the *hundred-thousandth of an inch?*—this in actual measurement, remember, not in mere theoretical quantities such as I introduced in my computations.

The same kind of assertion is made in letter 42579. From the impossibility of perfect equality in all the rotational diameters of the said hole mentioned in 42516, as well as from want of any likelihood of perfect parallelism on the plane of measurement, the measures given are, I venture to say, from these causes alone, mere pretence.

The almost daily measurements of even much larger quantities under the microscope and my experience of measurements off the microscopic

slide force me to the conclusion that without perhaps such appliances as those used by Prof. Turner, of Oxford, and even those unfitted for this purpose, the numbers given by "Ell Hay" are purely mythical—a state of matters speaking little for the "veracity" of one who elsewhere ridicules fine measurements when they really come within the sphere of possibility. Besides, while questioning the reality of the above measurements, one may notice the rather subtile attempt in 42421 to lead me to give *present* measures for γ^2 Andromedæ, for, of course, those given in that letter, as *made by "E. H." himself at that date*, are more beyond the possibility of his execution at the time than the measures of others, at which, for the same reason, he scoffs in another place.

But finally, respecting any real possible value which "E. H.'s" comparisons may have, we must remember first that these comparisons were *not made* between two telescopes equally perfect in their kind (which is everything in such comparative trials), but between a Newtonian which had suffered from a certain disturbing cause—perforation of the mirror subsequently to figuring—and a Gregorian, which had from the same cause suffered at least ten times as much. As pointed out at p. 65, Sept. 1, the long equivalent focus given to the telescope by the action of the small speculum of the Gregorian, renders any deviation at its focus as a Gregorian ten times greater than before, according to the numbers given—a fact which the most elementary knowledge of geometrical optics makes clear. As a Newtonian the disturbance may be so slight in this particular instance as to detract but little from its usual slightly imperfect definition, even when, as in "E. H.'s" case, the mirror may be from the hands of a maker of the first repute.

In addition to this insurmountable source of error in "Ell Hay's" ill-advised perforation of a good mirror to make a sorry make-shift Gregorian, remains the fact that we know nothing whatever about the matching of his small speculum. The testing of this speculum by his friend, by the use of a microscope, means nothing; indeed, with men who know, *this* statement classes along with those he gave concerning his own wonderful measurements.

Had both telescopes been perfect of their kind, and one of them at least not a miserable make-shift alteration, then perhaps we might have listened to "Ell Hay's" self-important dictum.

I thank "Hippalus" for his kind and sympathetic remarks concerning our particular "section."

H.

GRINDING AND POLISHING SPECULA.

[43170.]—In reply to "Speculum" (letter 43133) and "Astor" (query 97286), I shall endeavour to forward for publication on an early date a description of the machine figured on p. 383, so that any one interested in speculum grinding may be able to construct one without difficulty.

If "Astor" can refer to volumes XXXV. and XXXVI., he will find a great deal of information on figuring and testing glass specula. The shadow test is not likely to afford much satisfaction until he has mastered its principles.

Dalbeattie. Alex. Smith.

ELECTRIC STORAGE—A SUGGESTION.

[43171.]—As you have many inventive readers who are attempting the Quixotic (to put it mildly), might I suggest that they have scope in perfecting a system of electric storage. I thought there was a practical system till lately. I was arranging to put in Linotype machine, which requires very little power, ½H.P. or so—far too little to run our large gas-engine, which is off duty except on publication days. I thought I could use the engine to store electricity, and take it off by a small motor. This, I know, is possible; but in consulting an engineer who makes a speciality of such work, he advised me not to try it, as storage was unsatisfactory. This was against his interest, and therefore reliable. Evidently a storage system which would be certain and give high percentage of duty is still wanting. In my case, had I found the storage satisfactory, I would have gone further, and installed wind-power as the prime motor—a source of power which is waste because too variable for most modern requirements.

Journalist.

FIELD ARMOUR.

[43172.]—Modern quick-firing long-range weapons have effected a change in the art of war so profound that we are only just realising by experience that a total change of method is necessary.

Primeval war was armourless. Then armour held sway in historic times down to three centuries ago on the field. After that it was discarded as next to useless against gunpowder. Besides, troops could not manœuvre rapidly in armour. That period of projectiles and weapons lasted beyond 1870. It is now closed. The war of the present has necessarily become a war of entrenchments and sieges. Magazine rifle and machine-gun have practically abolished the bayonet charge, and that in this present war we should have ever got the bayonet to work at all is amazing testimony to the courage of our infantry, always matchless as such.

But, wherever armour can be carried, either by

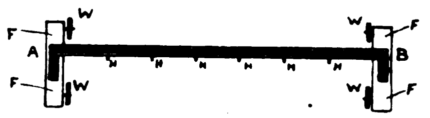


FIG. 1.—Horizontal section of iron infantry-shield. AB, iron plate, say, 4ft. high and 10ft. broad; WW, wheels; HH, iron handles; FF, framework at base.

flotation or steam traction, note that it is in full vogue. We have armoured warships and trains.

The Boer war-experiment actually up to the present has the conditions of success. The Boers are a bayonetless, entrenched, mounted infantry,

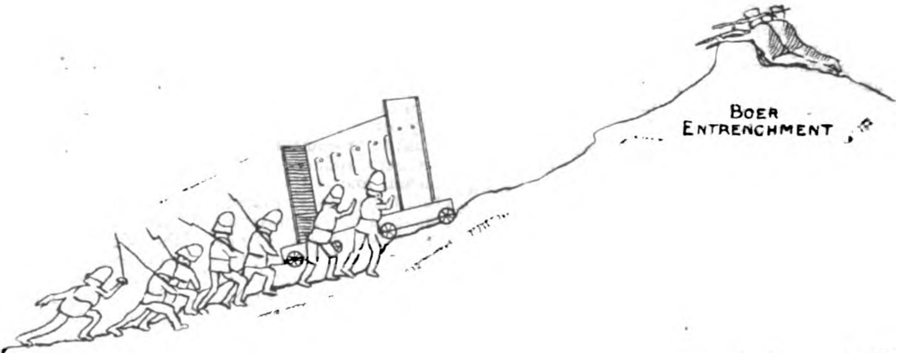


FIG. 2.—Shield being moved up by attacking force, and, if necessary, lifted bodily by them, using the handles, the wheels being locked by a pin when necessary.

only mounted in order to move rapidly to ever-fresh entrenchments.

Is the last word said, then? No.

The weak point of the Boer theory is the point we must attack. It is their system of sticking tight in entrenchments, and not manœuvring in the field at all, except for flight, and resumption of fighting elsewhere.

Armour thus can come in again. Armour, useless at Waterloo, perhaps also useless at Gravelotte—for those were battles of field tactics in the open with inferior rifles—is of the utmost use in Natal and Cape Colony to-day. It matters not if the Boers also use armour. The advantage will be thrown on the infantry who have the bayonet, and know how to use it. Intrepidity will win, not the Mauser.

Now, the following drawings show my system of

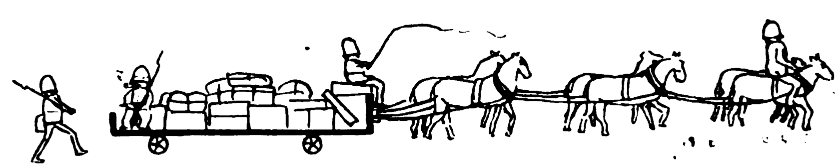


FIG. 3.—Shield adapted for transport purposes.

iron shields for infantry. The shields are useless against shells, but shells could not be used at close quarters, where the shield comes in. The whole object of the shield is merely to advance the attacking force near enough to admit of the delivery of a bayonet attack. The Boers have advantage of us at present by a mechanical device—the modern rifle—which they did not invent. Scope must once more be given for superior intrepidity to win.

My shield is a merciful device. The Boers will never stand a bayonet charge. In war it is a marvellous psychological fact that the bayonet is seldom faced. At twenty yards the moral effect is produced by the eyes of the man looking at his foe, and the inferior man, armed with bayonet or not, always gives way. The cavalry would complete the work. The shield would not, I think, be more than 4ft. high, or it would be too heavy to carry, and, of course, the ground would not permit of its being always wheeled. Hinged iron flaps might be attached at the base to protect the feet—several flaps. For river-fighting put the shields on boats. Now suppose each shield capable of covering twenty men, and of being lifted by ten of them, fifty shields would give shelter to a thousand men. This is ample to break any defence.

Dec. 23. O'Dermid W. Lawler.

WHERE IS THE IMAGE FORMED?

[43173.]—The paragraph with which Mr. Ewer commences letter 43114 (p. 406) is a rather surprising one, and I cannot at all agree with what he says there. The diagram which I gave in my letter, p. 343, is certainly a correct representation of the manner in which the image is formed, as I will now try to show. Let us trace the method by which the eye is able to see an object. In the first place, I think Mr. Ewer will admit that any object may be said to be made up of an infinite number of points, and anything that applies to one point will apply equally to all points of the object. Now, in order that the eye may see a point, it is necessary that some of the rays of light that diverge from this point in all directions be brought to a focus on the retina of the eye by means of its refractive media. It was the course of two of these rays that I traced in my diagram. We are not dealing with converging, but with diverging, rays. The fact that the rays in Mr. Ewer's diagram converge towards each other does not in any way disprove this. The principal difference between his diagram and mine is that while I only dealt with one point, he has taken a line as his object, and traces the course of one ray from each of two points, and it is impossible by means of one ray to tell how the eye will see an object. It is quite a mistake to treat the rays drawn by Mr. Ewer as if we were dealing with converging rays, because the fact is they are selected from two pencils of divergent rays, and are not brought to a focus in the eye at all. In fact, it is impossible for a normal eye to focus convergent rays: the eye would have to be more or less hypermetropic to do so.

I quite agree with Mr. Ewer that the image formed by a plane mirror is a ghost, an optical illusion, &c., and is not to be found when hunted for. But that is only what I have plainly shown before—in fact, the very word "virtual," which I used in referring to the image means that it is imaginary; but I cannot say that it is an encumbrance to the phenomenon of plane reflection—in fact, it is the phenomenon in itself. For the word means an appearance or a visible effect, and in the case of a mirror, the visible effect is the image, and hence to discard this is to dispense with the phenomenon altogether. Besides, when attempting to prove the cause or effect of anything whatever, it is the height of absurdity to disregard anything which has any connection with the question in hand.

With regard to the word "luminiferous," I think, as Mr. Ewer suggests, that the definition of light would be equally as good without this word, provided the phrase that I added be used instead. The phrase to which I refer is this: "of such frequency as to excite the sense of sight." I have not the back numbers to which he refers, and therefore cannot tell what his ideas regarding ether may be.

The well-known fact which he quotes of a beam of light passing through a box does not prove that there is no light there. It proves that while it is by means of light that we are enabled to see objects, light in itself is invisible, and the eye is only conscious of its presence when it excites the rods and cones of the retina. In order to show that light really consists of ether waves of certain frequencies, we will consider the different physical properties of ether as it vibrates at different rates. When the vibrations are comparatively slow, they manifest

themselves as heat, and the faster the vibrations the greater the heat. When they are vibrating at the rate of about 300 million million vibrations per second, we have the Hertz waves, as used in wireless telegraphy.

At 400 we have red light, and as the rate of the vibrations increases we get the different colours of the solar spectrum, violet rays vibrating the fastest, their rate being 760 million millions vibrations per second. Next we come to the X rays, with a still greater rate of vibration; but there are no nerves in the eye which are developed so as to be able to respond to these vibrations, and therefore these rays do not come under the definition of light which I gave, because they are not capable of exciting the sense of sight.

These facts lead us to one of two conclusions—either we may take it that the ether waves are themselves heat, Hertz waves, light, or X rays, according to the rate at which they are vibrating; or else we may suppose that the heat is originated by the sun, fire, &c., Hertz waves by the transmitter light by the sun, a lamp, &c., X rays by the Crookes tubes, and that each travels through the other, and sets up wave motions of certain definite frequency. In either case Mr. Ewer's statement that there is no light outside the eye is disposed of, for if his theory were correct with regard to light, similar conditions would hold good in other cases, and we should have it that there is no heat outside the body of a man or animal, no Hertz waves except at the coherer, and no X rays except on the fluorescent screen, these being the bodies which are able to receive and respond to the respective waves.

I must again state, in spite of what Mr. Ewer says, that the image formed on the retina, and which is seen in a bullock's eye, is a real inverted image formed by refraction of the rays of light from the object by the different media of the eye, and is not a reflection from the posterior surface of the lens. The reason why it is faint is because of the small number of rays which can enter, and owing to the media becoming more or less cloudy after death.

I do not think it is possible to see inside the eye by any means except the ophthalmoscope which I often use, with the possible exception of a highly hypermetropic eye, in which case it might be possible to view the retina in the manner Mr. Ewer suggests, although I do not think it would be successful on account of insufficient illumination. But what advantage would it be if he did succeed: he would merely see a red reflex of the blood-vessels of the retina, and would not see any image which might be formed there, because of the refraction of the media of the eye acting on the rays coming from such image on emerging from the eye.

C. A. Naylor, F.S.M.C.

NATURAL HISTORY STORIES.

[43174.]—THE statement in letter 43143 that the bees made their exodus, or, to put it plain, flew away, is, I should think, quite wrong. Being a bee fancier for a number of years, I think I should be able to give an opinion on the matter. The bees, on being disturbed with the axe, would soon be disturbing anything that was alive, although perhaps the majority present would attack the stores and gorge themselves with honey, but they would not fly away. Oh, no! they would stop there till their home was pulled piece by piece about them. Bees can be taken from a tree or anywhere if you can get them into a skep or straw hive, or, in fact, anything that will do for a home providing you make sure of the queen, and even then a large number forget their new home and go to where the old one was, or linger about and die.

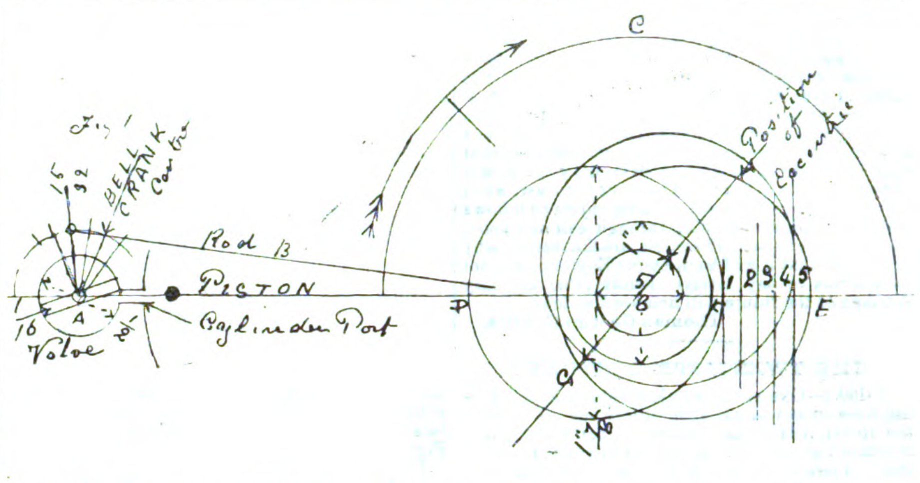
S. R., Bromsgrove.

HOW TO BUILD LIGHT ENGINE, &c.

[43175.]—THIS information looked so promising and read so nice; but are there not many more details wanting? I have tried my hardest to get at the idea complete, but give it up. Figs. 2 and 3 in illustrations are not mentioned. How does the brass triblet tube marked B come in as shown—for what purpose?

Bonchurch.

[43176.]—BEFORE going any further, I may as well give you the diagram by which to get your eccentric in right position. The flywheel and that is all cast in a piece, and if any of you should make a start you may find yourselves up in a corner when you little expect it, and you might blame "that Jack" for putting you all wrong. Fig. 1 is the valve, the port or steam way is $\frac{1}{16}$, you can make it $\frac{5}{8}$ or $\frac{3}{4}$ of an inch long, but it must be straight and linable, or it will not act properly. Diameter is $\frac{1}{2}$in. Sec. A B is the rod to bell-crank for driving same direct from the eccentric gate, below that is the piston home, and the port in valve is ready to open into the cylinder; D and E show you the range of the eccentric fore and aft, and from E to F is the stroke; G and H show you the eccentric in its proper position. Below H the stroke is marked off into five spaces. Now, when the engine is moving in the direction of the arrow it travels towards 5, opens

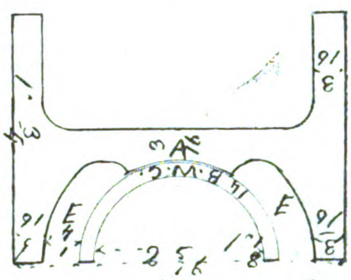


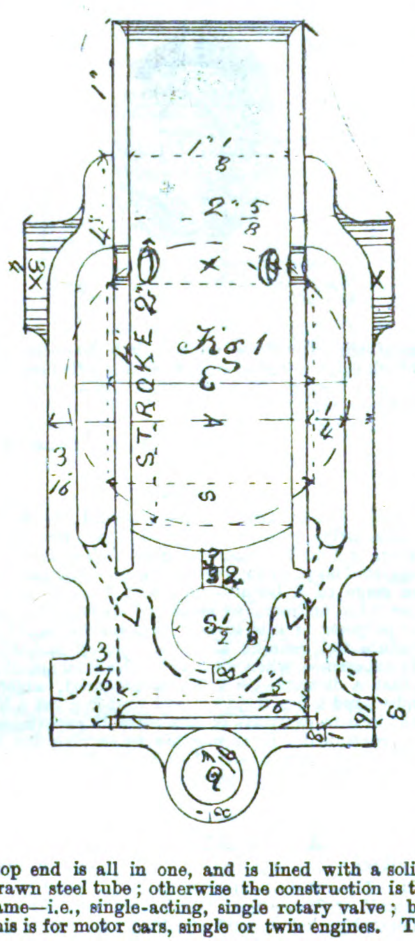
the port, until the crank comes over to the division under the arrow, when it is full open, as it travels towards C, it is closing at C, steam is cut off, all the lines and position are for the proper adjustment and putting things right, and I think plain enough to read, dimensions given so that there need not be any mistake. Of course, these are finished dimensions.

Jack of All Trades.

BUILT CYLINDER FOR LIGHT 2in. SPEED ENGINES.—II.

[43177.]—THIS cylinder differs somewhat from No. 1 (p. 428), as the jacket-valve chamber and





stop end is all in one, and is lined with a solid-drawn steel tube; otherwise the construction is the same—i.e., single-acting, single rotary valve; but this is for motor cars, single or twin engines. The jacket may be made out of any of the bronzes or ordinary cast iron or malleable cast. The dotted circle is the stroke of the engine, 2in., and it is squared off to show the action of steam—i.e., for the adjustment. S the commencement of steam, C is where it is cut off, and X is where it exhausts through the cylinder into the jacket. Now if your engine is fixed vertical, drill some holes through the bottom of the jacket (see dotted lines) into the chamber that surrounds the valve-box, and then you will need a bonnet, as shown at Q, where you can exhaust through. This bonnet can be turned round and fixed in the most convenient position for delivery to your condenser, and when your engine is in that position it will be well drained if laid upon its side, either side or inverted; then exhaust through X X either side, as the case may be. The various sketches are for a single engine; the bosses and distance pieces with the walls of the box only want repeating upon the other side opposite to carry the frame or entablature, and for studs for fixing in position, so that there will be no necessity for me to get out another drawing, as the twin engine will explain all that as laid down.

Jack of All Trades.

SPLICING.

[43178.]—THERE is no need for any carping over the proper length of a splice, because there is no proper length: it varies with the nature of the rope and also with its size. A rope is merely a collection of short fibres, so arranged and twisted as to give them coherence purely by friction. Exactly the same law applies to the splice. As a splice wastes rather more than its own length of rope, it is evident that it should be made as short as is possible, and, speaking as an old sailor, I should say that 4ft. to 5ft. is ample for any ordinary running rope of hemp. In wire ropes, it is clear that we cannot put the same twist in the rope, against which we have the greater length of each fibre. In the splice, on the other hand, we wholly lose the strength of the individual fibre, and we cannot get the surface friction, therefore the splice must be lengthened, or it will simply pull out.

Sigma.

AIRSHIP OR AEROPLANE—WHICH?

[43179.]—UNDER this heading you publish an article (p. 422) from the *Scientific American*, in which it is stated that the early flying machines in which suspension and forward motion were attempted by imitating the flapping wings of the bird were futile and wofully fatal. Now I wish to take exception to this, as, I think, very random statement, that the attempts to fly the air by the flapping-wing principle have been more fatal than those by the aëroplane, I, for one, most decidedly deny; and as to being futile, every man knows that every attempt to fly the air—either by the flapping-wing process or aëroplane, or, in fact, any other way—have one and all alike proved futile. I have no intention whatever of going into this problem any further than to suggest that the flying machine (I don't mean airship) will have to be built on the self-same principles that the bird's mechanism is designed upon; every other device that may be tried will fail, just as every device has failed up to the present time that has not for its foundation the true principles of aërial flight. I wish to point out here that an airship is a thing quite apart from a flying machine proper—these two will be as wide as the Poles asunder in their nature and work. The true flying machine will be to all intents and purposes an artificial bird, just as the locomotive is in every respect an artificial horse; whereas the airship will never be anything more than a mechanically propelled balloon. It strikes me as extremely curious that every new Yankee idea on this subject is thought a great deal of; while the man nearer home, the Englishman's ideas, are taken very little notice of. Why this should be I can-

not say; but I will suggest this much: that the chances are all in favour of bonny Britain being eventually the birthplace of the fairy carriage of the future—the flying machine. The reasons I give for this forecast is that in the first place the Briton is far more earnest in his work than your gay and brilliant-witted Yankee. He is, as a rule, more persevering in his object, whatever that may happen to be; he is less swayed by the power of the almighty dollar; and last, but not least, when his mind is once fairly set upon an object he follows it through thick and thin, through evil and good, unto the bitter end. These, Sir, are the reasons why I prophesy that it will be in bonny England, and not in America or any foreign country, that the fairy carriage of the future will first see the light.

Thomas George Challis.

THE TWENTIETH CENTURY?

[43180.]—ONE scarcely feels comfortable in differing from so logical an authority as our "Fellow of the Royal Astronomical Society," but I really find it difficult to accept his argument in your last issue, that "there never was a year 0." It strikes me that when Christ (or any other baby) was born, that this must have been in his first year, and if we wished to express his age in terms of the year, say, at three months old, we could only do this by putting it 0 year 3 months. After our Lord was one year old He entered his second year, and in the same manner, after a period of 100 years from 0, we entered the 2nd century, and so on till Monday, January 1, we entered the 20th century. We begin this century again as the 0 period, as the 00 at the end of 1900 represents the century period. Further, as regards B.C., there must have been a period of six months before our Lord was born, and this could only be expressed as 0 years 6 months B.C. The commencement of life must be a zero, and as we have B.C. and A.D., it is just the same as any other zero, as, for instance, that of a Centigrade thermometer, where 0 is the freezing-point, wherein before we register a degree we have parts of a degree, which is expressed, for instance, as + 0·6 or − 0·6, if the thermometer reads $\frac{6}{10}$ on either side of 0. **Wm. F. Stanley.**

[43181.]—UNDER this head on p. 517, Jan. 13, 1899, you did me the favour to publish a note referring to the absurdity of taking the tables in the Book of Common Prayer as an authority for the century question. They are for settling Easter, and the writer expressly explains what he means by the "next century," and inferentially why he leaves out 1900. The following note from the *Gentleman's Magazine* of April, 1800, may be of interest:—"In France, as in England, there have been disputes about the commencement of the 19th century. The astronomer Lalande thus determines the question, which, he says, was equally agitated at the end of the last century, he having in his library a pamphlet published on the subject. 'Many persons imagine that, because after having counted 17 they commence 18, the century must be changed; but this is a mistake, for when 100 years are to be counted we must pass from 99 and we arrive at 100; we have changed the 10 before we have finished the 100. Whatever calculation is to be made we commence by 1 and finish by 100; nobody has ever thought of commencing at 0 and finishing by 99.' Thus he concludes the year 1800 incontestably belongs to the 18th or old century." **Tenbyten.**

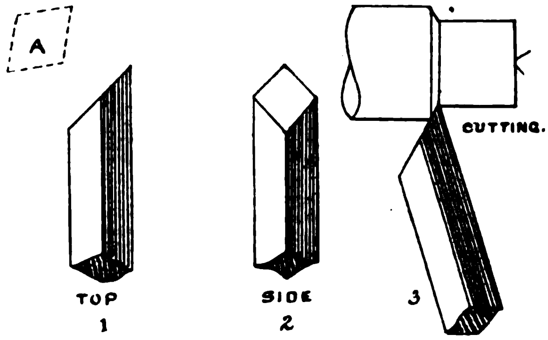
A SIMPLE HYGROMETER—THE MOON AND THE WEATHER.

[43182.]—A PIECE of ordinary twine twists and untwists with the moisture in the air. Suspend such a piece (a foot or more long) in any way—e.g., from one end of a piece of stout wire bent at a right angle and stuck in a bottle. To the lower end attach a rod, quill, or the like as a pointer (string attached to middle of pointer), and place below a piece of cardboard with graduated circle. Perhaps some of your readers may be disposed to make observations with this, and report, especially as to the indications of the instrument in regard to the barometer and rainfall.

With regard to "F.R.A.S.'s" playful criticism of the passage I translated from Augot, I cannot see that the passage is at all vague; indeed, it partakes of that lucidity which characterises the book throughout. It shows, however, that judicial quality, that philosophical suspense of judgment on a matter in course of elucidation, which is not always conspicuous in the utterances of "F.R.A.S.," and which may possibly be somewhat foreign to his temperament. The point of the passage seems to have been rather missed by your correspondent "S. R." **A. B. M.**

CUTTING EDGES FOR METAL.

[43183.]—THE late Mr. Adam Hilger, the optician, and one of the best mechanicians of our time, told me that he knew of no better edge than that obtained by grinding a four-sided prism at an angle of 45°, so as to produce a rhombic facet, as shown in the sketch at A. This tool, a graver in fact, to be held with one of its angles uppermost, and its ground facet in a nearly vertical position, as shown in Fig. 3.



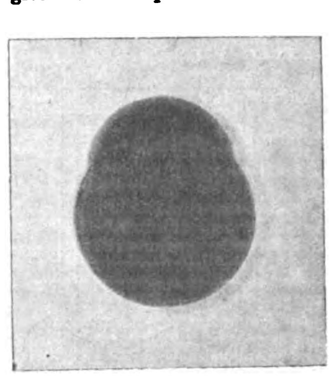
The cutting edge of this tool is about 60°, and this, Mr. Hilger told me, was equally suitable for steel and brass. He used the same style of tool for both metals, rejecting the commonly-taught opinion that an obtuser angle of cutting-edge was better for brass. I do not remember whether he approved of an almost rectangular edge for finishing brasswork, but I think not.

As a general principle, it seems that an edge for any purpose should be as acute as will stand against the material worked on without chipping, bending, or unduly heating, and it would be highly interesting if someone with the necessary appliances would experiment with edges ground at various angles, and used on different materials, so as to give us, once for all, the best information on the subject. I would suggest that the weight of metal removed, and the temperature acquired by the tool would form important criteria as to the suitability of the edge. The tool which kept itself coolest and removed the most material in a given time being awarded the palm. **Richard Inwards.**

20, Bartholomew-villas, N.W.

PENUMBRA OF X RAYS.

[43184.] — THE annexed radiograph shows a distinct penumbra produced by X rays. The radiograph represents two coins, one placed half-way over the other. In taking the radiograph the tube stood 1in. from the photographic plate. The exposure given was a quarter of an hour. On



examination it will be noticed that the outer edge of both coins is lighter than their respective centres, the coin farthest from the plate having a broader light margin. I should be glad to have an opinion from other readers as to the cause of this penumbra. **A. Stammwitz.**

OZONE.

[43185.]—SEA AIR is sometimes said to owe its health-giving power largely to the presence of ozone, and in the January *Strand Magazine* it is suggested on p. 84 to produce ozone electrically on the stage of a lecture-room and blow it gently among the audience by means of electric fans, and the proposer of this scheme believes he can "reproduce the genuine air of a country orchard." My experience, when working an electrical machine, is that a disagreeable smell is produced, which I understand is due to ozone, and that it gives a bad headache to everyone in the room if experiments are continued. Is it possible to ozonise the air without any unpleasant effect, and is it due to impurity of the ozone so produced, or to what? **Glatton.**

A LOW BAROMETER.

[43186.]—AT 8h. 23m. on the night of the 29th ult., I stood near the White Stone pond on the summit of Hampstead Heath, and read my compensated pocket aneroid 28·025in. As this reading was considerably lower than any previously taken in the same place, I thought it advisable to check the indications of the instrument by the reading of a reliable mercurial barometer.

The comparison showed the pocket instrument to be quite trustworthy. It follows from this that at the time indicated atmospheric pressure at sea level was equal to no more than 28·484in. of mercury. I think this is the lowest recorded reading about London since that of Nov. 11, 1891. Further, as the needle of the instrument had risen at least 0·05in. from the lowest point reached in the late afternoon of the 29th, owing to increase of atmospheric pressure, by the time I reached the top of the heath the barometer would seem to have indicated a lighter state of atmosphere about London that afternoon than any prevailing since Dec. 9, 1886. **William Godden.**

WENHAM'S AND "GOSSIP'S" SCIENCE.

[43187.]—APART from all reference to Biblical science, I must attack both Mr. Wenham's science, p. 429, and "Gossip's," p. 453, about the Dead Sea and its past history. These are purely mechanical and scientific subjects, and not to be ignored because Christ happened to mention them.

There are *no* "observed facts of science" to show the simultaneous fall of two large Leonids on two neighbouring cities "could never take place."

Moreover, the region of the Dead Sea has *not* had "the same geological aspect and condition" for "countless thousands of years." Mr. Wenham's science here is utterly false and worthless—"the suppositions and legends of men who knew nothing of such matters." The whole lake is now south of Jericho, but was lately (geologically speaking) wholly north of that place. The relative thicknesses of deposit, under the lake and under the Jordan, prove this recent change, and I challenge Mr. Wenham to prove it 4,000 years old. He talks again of "upheaval," but all other travellers see only a downthrow of strata, the whole valley being but a small portion of the length of a great rift, extending south across the Red Sea and Abyssinia, and even the Equator. This rift may be "countless thousands of years" old, but he has not a shadow of reason for saying the "Lake of Lot" is a year older than Lot.

That "no community could ever have resided there," is sheer imagination. Other travellers have found ruins of three or four cities near the lake. The barrenness is wholly due to the salt, which is not in the strata. The chief hill of salt, at the south-end, is called Jebel Esdoom (or Sodom Hill), and has every appearance of having fallen from the sky, like the similar hill near Biskra in Algeria. The vales of fresh-water streams that enter the lake, as at the Scriptural Engeddi, are very fertile, and abound in date palms. The high barometric pressure may make them sanatoria some day, and there may be factories of bromine for photography. When the lake was fifty miles north of its present site, its present bed must have been as described in Genesis xiii. 10, "well watered everywhere" and "like the garden of the Lord." It is perfectly ridiculous that matters of mechanical science are to be falsified with sham sciences like Wenham's and "Gossip's."

"Gossip," p. 453, quotes Josephus to prove Biblical science false, and might just as well quote Milton. Of course, the prophets taught no natural secrets (unless, perhaps, the dietary laws in Leviticus forbidding shellfish are very sanatory); but it is untrue that they touched nothing which was naturally to be discovered. No modern science was needed to show the days of creation were lengthy ages, for St. Augustine deduced this from Scripture alone. That this earth was formed before the sun is "Biblical science," and also recent science of yesterday, but not of one or ten centuries ago. That the stars are numerous enough to be ranked with grains of desert sand, is Biblical science of Abraham's time and of to-day; but not of three centuries ago, for the stars visible to the naked eye are barely 2000, and outnumbered by a thimbleful of sand. The contrast between the littleness of the earth and vastness of heavens (which the Bible always mentions before the earth) appears in no ancient book but the Bible. Elsewhere (even as

late as the Koran) we read of the earth and heavens as almost equal spaces, like the floor and ceiling of a room.

For all practical purposes the earth is fixed, and the sun goes round it. To state the contrary would merely make the teacher incredible. The millions that rejected Pythagoras would equally have rejected Moses or Isaiah for this, and all their moral teaching. Equally mischievous would be teaching the sun to be larger than the earth. In Job's time the fact of the sun and stars passing under the northern parts of earth was wondered at, as "hanging the earth upon nothing."

Instead of indulging "fancy with speculations," it would be more to the point to go and examine the alleged remains of Noah's Ark next summer. Why will not Mr. Wendham or "Gossip" attempt this? E. L. Garbett.

ORNAMENTAL TURNING.

[43188.]—In reply to "E." 43158, in our last issue, I have the pleasure to say that it is my intention to include the details of geometric chuck, as I wish to make the series complete in every way. I will prepare the same as early as possible, and hope to have the first ready to follow my next on the spiral apparatus. J. H. Evans.

USEFUL AND SCIENTIFIC NOTES.

A REMARKABLE instance of fluctuating values is to be found in the comparison of cost of steamers. It was stated recently that in 1894 a steamer cost £6 per ton deadweight, plates being about £5 5s. per ton, whereas to-day the cost is about £9 5s. per ton, £8 per ton being for plates.

THE Home Secretary has issued a notice under section 8 (1) of the Factory and Workshop Act, 1891, certifying that, in his opinion, the processes of sorting, willeying, washing, combing, and carding wool, goat-hair, and camel-hair, and processes incidental thereto are dangerous or injurious to health.

A SCHEME for extending Euston Station so as to make it front upon the square has been submitted by the London and North-Western Railway Company to the St. Pancras Vestry. The plans involve the closing of Seymour-row, Melton-mews, Euston-place, Euston-grove, and Euston-crescent, besides portions of half a dozen other thoroughfares. Provision is made for the construction of a new street and a new tunnel.

THE "ANNUAIRE ASTRONOMIQUE ET METEOROLOGIQUE" for 1900, by M. Camille Flammarion, has been issued (Paris: Librairie, Ernest Flammarion), and will be found very interesting. The frontispiece is a comparison of "La Grand Lunette de l'Exposition" with the height of the towers of Notre Dame. An illustrated description of this siderostat was given in our number for April 14, 1899. There are many notes which will be useful to amateur astronomers all over the world.

A MOTOR CARRIAGE has recently been introduced in France which is normally propelled solely by an oil-engine, but on hilly ground is helped by an electric motor. The oil-engine works at a constant speed, and when the vehicle does not absorb all the engine's power the excess drives the motor as a dynamo and charges accumulators. As the accumulators only have to supply power occasionally they are kept fully charged, and can therefore safely give rates of discharge which would seriously damage them if the cells were only partially charged. The engine is direct coupled to the dynamomotor, which is shunt-wound, and is used to start up the engine. The rate of charging can be adjusted by field regulation. Changes of speed are effected mechanically.

Coppering a Negative.—The following process, which is described by Graf Vittorio Turati, of Milan, in Liesegang's *Photographisches Almanach*, might be useful for the preparation of small ornaments by means of photography. The negative or positive should be prepared by means of the wet-collodion process, and fixed and washed as usual, only preferably on plate glass. The negative should be placed in a clean dish, and covered with the ordinary cupric bromide intensifying solution, and then blackened with silver nitrate, and this should be repeated two or three times, and after washing, the negative may be dried by heat, or spontaneously. It should now be placed in an accurately-levelled dish, and covered to the depth of about one millimètre with a saturated solution of cupric sulphate, and allowed to remain for about five minutes. Then should be added about half the quantity of fresh cupric sulphate solution which has been acidulated with sulphuric acid, and the dish well rocked. Fine iron filings should now be carefully and evenly sifted over the whole of the negative, when the negative image will be seen to gradually cover itself with a fine deposit of red copper, and it is then only necessary to rinse it under a tap and allow it to dry.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96613.]—**Motor Waggon** (U.Q.)—From data given in a paper by George A. Buris, read Nov. 2 before the Civil and Mechanical Engineers' Society, it appears that on a level the power should be—

$$\frac{\text{miles per hour} \times \text{gross weight in tons}}{C}$$

C is 6·25 for effective horse-power exerted by the wheels. C is 4·165 for indicated horse-power (allowing an efficiency of transmission from pistons to road wheels $= \frac{2}{3}$). Assuming "walking pace" to be four miles, your per hour indicated horse-power of a level should be—

$$\frac{4 \times 1}{4 \cdot 165} = 0 \cdot 961 \text{ horse-power.}$$

Say 1I.H.P. GLATTON.

[96784.]—**Grate Front** (U.Q.)—With reference to my grate front, I mean that the bars in grate mentioned in my sketch must be loose, as I want them to take out. Many thanks to "Glatton." R. QUICK.

[96964.]—**Typewriter Ink Ribbons** (U.Q.)—What looks like a good recipe appears on p. 507, Vol. LXVII. If you have not got it, send 2½d. for No. 1738, which contains this page. Other recipes are given in the following places:—Vol. LXVI. pp. 232 and 439. Vol. LXVIII. p. 242 (this is by "Regent's Park," and is ridiculed, as so many of that gentleman's replies are, the following week, on p. 263), also p. 285. GLATTON.

[96965.]—**Equatorial** (U.Q.)—An air-clock is described on p. 283, Vol. XXX., which might be adapted for your purpose. A number of letters appeared in Vol. XXXII. on the subject of sand driving clocks, from which I gather that while damp or badly washed sand is useless; clean, dry sand is so good that satisfactory photographs of the moon have been taken by means of a sand clock. GLATTON.

[97063.]—**Utilising Surplus Power** (U.Q.)—Your best plan would be to refer to the makers of the engine. If you prefer to design your own gear, let me know the revs. per minute the engine runs at, when loaded, to give the full power. I presume 350 revs. is the speed at half-power. Is there an explosion at each stroke? GLATTON.

[97069.]—**Formula.**—Your query is not clear as it stands. What is meant by "mass," for instance? Does it consist of a similar compound, but in different proportions? Perhaps if you state it more clearly some of our mathematical readers may reply. GLATTON.

[97075.]—**Small Motor** (U.Q.)—I do not know the "Bee" motor; but Mr. Seal, of Castelnau, Hammersmith, advertised small hot-air engines in these columns. The "Robinson" hot-air engine is well designed also. GLATTON.

[97091.]—**Defective Circuit** (U.Q.)—Although you say connections are clean, there may sometimes be a little dust on one. A sliding contact-piece in your clock would minimise the risk of this. You would be more likely to get a useful reply if you gave a diagrammatic sketch of the connections. GLATTON.

[97099.]—**Metal Spinning.**—If I am not mistaken, it has been pointed out in these pages that there is no book about metal spinning, and, moreover, that it is an art which cannot be acquired without plenty of practical experience. There is plenty of information about metal spinning in the pages of this paper; but, as the querist probably knows, it is one of the few arts the details of which have not been published. I wonder whether he ever gave any information. Aluminium lends itself readily to all the arts of the craftsman. PAGAN.

[97119.]—**Water-Gas.**—The querist has only to take the trouble to look through your back volumes to find out all that is worth knowing about "water-gas." I believe there is a company which supplies the "most improved method of manufacturing water-gas," but as to the "number of thermal units," that is merely a question which depends for its answer on the quality of the water-gas. It would be interesting to learn whether any of the water-gas schemes are really economical, for, I think, they have all been described in the back volumes. M. T.

[97125.]—**Colouring Metals.**—Generally speaking, they are coloured by means of coloured lacquers; but some are, so to speak, self-coloured—e.g., silver, with nitric acid, when exposed to light, turns black. Treated with bichromate of potash, turns something like red. As watches are mentioned, and they mostly have silver cases, see Gee's "Silversmiths' Handbook" (think that is title), published by Lockwood and Son. TIBBY.

[97196.]—**Science and Art Department Certificates.**—In reference to this question and the replies on p. 409, it would be as well to have a little matter cleared up. In my reply on that page I say the price of the "Directory" is 6d.—"Clara" (same page) gives 1s. 6d. Surely there cannot be much doubt about what should be a matter of fact. Perhaps Messrs. Eyre and Spottiswoode will kindly say what is really the price of the "Directory." M. T.

[97210.]—**Steel-Facing Copper Plates.**—(1) The best voltage is 4–6 volts. Your dynamo at present is useless for this work; must be rewound. (2) External resistance may be dispensed with if an adjustable resistance is inserted in shunt. (3) Best solution is the sulphate-of-iron and chloride-of-ammonium solution. A little practical help would be of more value than a whole page of written instruction. Are you near London? ELECTROPLATER.

[97219.]—**Rope-Driving.**—When replying to querist week or two back, I mistook figures he gave for 28ft. centres, or should certainly not have advised using a belt at all, but a shaft connection with skew or spiral gear direct. I may here add, to attempt to drive a car by belt 2½ft. centres means for the user an unmitigated source of trouble and annoyance. MONTY.

[97245.]—**H.P. for Car.**—

$$\text{H.P.} = \frac{W\,M}{335}\left(\frac{K}{2{,}000} \pm \sin.\,\theta\right)$$

Where—

W = weight of car and passenger in pounds.

M = speed in miles per hour.

K = resistance to traction in pounds per ton on a level, and is about 25lb. per ton.

S = angle of grade (Sprague).

Rickenzaun prefers equation in this form—

$$\text{H.P.} = \frac{W\,K\,S}{33{,}000} \pm w\,(\cdot 22408)\,\frac{\sin.\,\theta}{33{,}000}$$

Where w = weight in tons, and S speed in feet per minute, core on continuous current. Dynamo and motor: generally the theoretical value to actual H.P. is about 100 to 64. To find velocity of discharge in feet per second of water flowing through sluice or penstock. Multiply square root of height from centre of orifice to surface of water by 8·025. To find height of fall necessary to give a certain velocity: Divide square of velocity in feet per second by 64·4. Number of cubic feet of water discharged through sluice per second is obtained by multiplying area of sluice opening in square feet by number of seconds, and multiplying product by five times square root of height in feet from centre of orifice to the surface of water. To find quantity of water in gallons per second discharged through sluice: Multiply area of orifice in square feet by number of seconds, and this by 31·5 square root of height in feet from centre of orifice to the surface of water. Effective fall is half head of contact added to fall. Theoretical H.P. equals quantity of water in cubic feet per minute multiplied by head of water from tail race in feet, and this by 0·001892 (Björling.) Trolley wire, size No. of B. and S. Cable wire of closed conduits, say, No. 4 hard-drawn copper. (Atkinson.) REGENT'S PARK.

[97249.]—**Vertical Boiler.**—Coat with paraffin oil, solid paraffin, and blacklead. Mixture white lead and tallow; ditto, equal parts beeswax and Ozokerit; ditto, camphor ½lb., melted lard 1lb. After clearing off scum, add q.s. of blacklead, and leave on. REGENT'S PARK.

[97256.]—**Windmills.**—Many thanks to "Glatton" for kind reply. With regard to the instrument mentioned for velocity, what exact purpose does the wire gauze and thin metal plates serve, and what governs their size. ALTERNATOR.

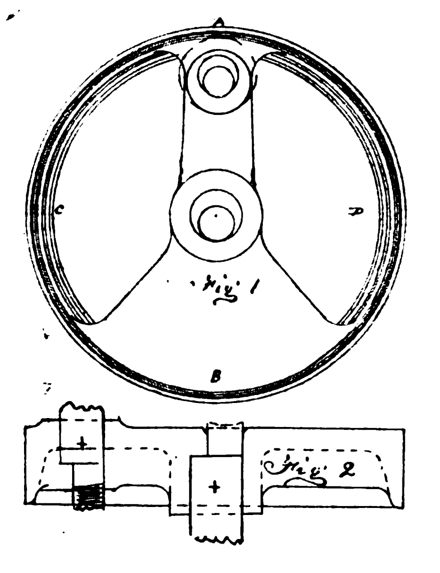
[97257.]—**Coherer.**—Many thanks to Mr. Bottone for his very kind reply, which I much appreciate. With regard to alternator, I proposed to make an armature with the stampings as supplied for Edison phono-motor, 40 teeth, 7in. diameter. The field-magnet would be a ring with a number of bolts fitted round inside to receive the wire, to be hoisted with about 10volt. 2amp., from accumulator or small dynamo; then to use a step up tranformer to raise the voltage; and so excite a Seale coil. Would this work? If so, could you say suitable size wire to use, and approximate quantity and voltage to expect. Also, must I have as many poles in field-magnets as in armature, viz., forty, or will any number do? ALTERNATOR.

[97267.]—**Indelible Washing Ink.**—1. Crystallised chloride copper 8·52 parts, chloride sodium 10·65, chloride ammonium 5·35, water 60 parts. 2. Aniline hydrochlorate 20 parts, water distilled 30 parts, mucilage acacia 20 parts, glycerine 10 parts, 4 parts of No. 2 to be mixed with 1 of No. 1; this practically a solution of nigrosin. REGENT'S PARK.

[97280.]—**Steam Pressure in Locomotives.**—The new six-coupled express engines of the N.E.R. have a working pressure of 200lb. per square inch. Other dimensions: cylinders, 20in. by 26in. (outside), leading four-wheeled bogie; diameter of wheels, 3ft. 7¼in.; six-coupled wheels, diameter, 6ft. 1¼in. Boiler: length between tube-plates, 15ft.; outside diameter, 4ft. 9in.; firebox, 8ft. long. Weight in working order: engine, 62¼ tons; tender, 38½ tons.

C. P.

[97283.]—**Motor Tricycle.**—Why should you key them on shaft at all, when the fitting of them on, as the sketch here given, will insure their fixity,



and will never sheer off or work loose, the eccentric pin being two-thirds of the diameter of the shaft? Fig. 1 gives the back view of back disc, with balance-weight all in one. The crank-pin can be put in one side and riveted, and the other a nut put on. Fig. 2, section through A B, the dotted lines show you the section the other way C D. These can be fitted much quicker than messing about with square keys and key way.

JACK OF ALL TRADES.

[97283.]—**Motor Tricycle.**—Unless you are a first-class turner, and used to working with a micrometer to ·0001″, do not attempt the parallel-shaft business. The taper hole is much easier if you go the right way about it, and stands a better chance of running truer; besides, you may, from some unforeseen cause, want them apart again. To bore wheels properly, first make a taper plug gauge, to size on which put a depth gauge line, then make a flat-ended nose chuck to fit your lathe, into which you must screw a taper plug at a distance that equals throw of crank; this plug to have end screwed to take a nut to secure flywheel when turning. Next take flywheel, chuck it in jaw chuck, and rough turn and face the one side, with crank-pin boss right depth from edge of wheel; throw out of centre, and bore crank-pin hole first, finishing with larger size outward to your plug-gauge, which it must fit accurately up to the line. Finish as many wheels as you require to this operation first, then put nose-chuck on, fix wheel on eccentric stud, and you will be able to bore centre-hole dead true and finish wheels complete, and make as many as you like with certainty that centres will be all alike. If making any number, then make sheet-metal gauges for outside diameter and inside depth from face. There is no better or simpler way of doing them.

MONTY.

[97284.] — **Geometrical Progression.** — The evident indignation of Mr. Burgess on p. 455 tempted me to turn up the original replies, which deal with a matter of some mathematical interest. The question of courtesy is nothing to do with a stranger who joins in like this, but Mr. Burgess's remarks on algebra are another matter. To begin with, it is not sound algebra to speak of a "biquadratic which happens to permit of further resolution into quadratic factors," inasmuch as any biquadratic with numerical coefficients can easily be broken up into quadratic factors with real coefficients by anyone who is able to solve a cubic. Frequently the easiest way of performing such factorisation is to guess at the required numbers, and try if the guesses will fit; but such a process does not involve any assumption, much less an "arbitrary assumption." "H. T. B." says there was no guessing in the solution he obtained, and since this was so, a querist is reasonable in asking how he did arrive at the statement $r = x$; also how such an assumption can be said to be justified by the result when part of the result is such as to negative the assumption. The solution offered by "A. O. S." is, of course, quite sound up to the point of the indeterminate equation—

$$x + 20r = 42;$$

but the only way to continue on his lines is to say: Let us see if any solutions can be found which make x and r both positive integers; of such solutions it is clear there is at most but one, namely—

$$x = 2$$
$$r = 2$$

and since this result satisfies the original conditions, we have for certain one solution of the problem. The solution by "C. P." is practically the form which would be adopted by any experienced mathematician. "Ontario's" subsequent problem is of just the same sort, and can be solved in a few lines. We have at once from the data—

$$x(1 + r + r^2 + r^3 + r^4 + r^5) = 315$$
$$x(1 + r^5) = 165$$

Elminating x, we get at once—

$$21(1 + r)(1 - r + r^2 - r^3 + r^4) = 11(1 + r^2 + r^4)(1 + r),$$

i.e., $(1 + r)(10 - 21r + 10r^2 - 21r^3 + 10r^4) = 0,$

i.e., $r^2(1 + r)\left[10\left(r + \frac{1}{r}\right)^2 - 21\left(r + \frac{1}{r}\right) - 10\right] = 0$

i.e., $r^2(1 + r)\left[5\left(r + \frac{1}{r}\right) + 2\right]\left[2\left(r + \frac{1}{r}\right) - 5\right] = 0$

i.e., $(1 + r)[5r^2 + 2r + 5][2r^2 - 5r + 2] = 0$

Of this there are two imaginary solutions corresponding to the second factor and three real ones, namely,

$$r = -1$$
$$r = 2$$
$$r = \tfrac{1}{2}$$

The finish of these has no arithmetical meaning, and the others lead to

$$r = 2 \qquad x = 5$$
$$r = \tfrac{1}{2} \qquad x = 160$$

Of course, the two series have the same terms in reverse orders. On this question, Mr. Burgess's argument is, if I may say so without discourtesy, quite worthless, for it states that r being integral, and equal to $\frac{315 - x}{150 + x}$, which is equal to $2 + \frac{15 - 3x}{150 + x}$—then r is necessarily 2. Please observe that the same argument shows that r being equal to $\frac{315 - x}{150 + x}$ which is equal to $-1 + \frac{465}{150 + x}$, must necessarily be -1! Or, better still, r being equal to the fraction $\frac{315 - x}{150 + x}$, must necessarily be zero. Furthermore, some quintics can be reduced to quadratics, *vide supra*. With all respect for the injured feelings of Mr. Burgess, I submit that the tone of his letter was not justified by the contents of the same.

QUIVIS.

[97284.] — **Geometrical Progression.** — Your method is quite correct where whole numbers are concerned; but, as you require another solution in quadratics, I will suppose a more difficult case with fractions, and I will use my method of dealing with biquadratics, described some months ago in these columns. Suppose, then, that $r = \frac{5}{3}$ and $x = \frac{4}{7}$, then it will be found that the sum of six terms of the series is $\frac{4,265}{243}$, and the sum of the first and last terms is $\frac{13,472}{1,701}$. The first is represented by $\frac{x(r^6 - 1)}{r - 1}$ and the second by $x(1 + r^5)$; eliminating x and reducing we get $931\left(\frac{r - 1}{r^6 - 1}\right) = \frac{421}{1 + r^5}$. This can be reduced to a biquadratic equation—

$$r^4 - \frac{931}{510}r^3 + r^2 - \frac{931}{510}r + 1 = 0.$$

Now bring all the terms except r^4 and r^2 to the right; then we have, solving as if for a quadratic in r^2—

$$r^4 + r^2 + \left(\frac{1}{2}\right)^2 = \frac{931}{510}r^3 + \frac{931}{510}r - \frac{3}{4}.$$

Then— $r^2 + \frac{1}{2} = \sqrt{\frac{931}{510}r^3 + \frac{931}{510}r - \frac{3}{4}}.$

This may be put in the form—

$$\frac{r}{510}\sqrt{931 \times 510\,r + \frac{931 \times 510}{r} - \frac{3 \times 510^2}{4r^2}}.$$

The last term amounts to $-\frac{195,075}{r^2}$. Now suppose we did not know the value of r, except that it is a fraction of the form $\frac{p}{q}$. It will be seen, on looking at the biquadratic above given, that, owing to the symmetry of the coefficients, if one of the roots is $\frac{p}{q}$, another must be its reciprocal $\frac{q}{p}$, as, dividing by r^4, you get the same equation, but with the r's in the denominators. Putting, therefore, $\frac{p^2}{q^2}$ or $\frac{q^2}{p^2}$ for r^2 in the last term under the radix, the square numbers which will divide the numerator exactly are 9 and 25, so that r is $\frac{5}{3}$ or $\frac{3}{5}$. Either of these values will make the terms under the radix a perfect square whole number, and the two sides of the equation will balance each other; then x can be found to be $\frac{4}{7}$, or $\frac{12,500}{1,710}$. This latter value is simply the last term of the series, so that the two values of r and x give the same series. In one case the series is to be read from left to right, and in the other from right to left. The other two roots are imaginary.

Bath. M.I.C.E.

[97284.] — **Geometrical Progression.** — It is strange that Mr. Burgess, in his reply on p. 455, has failed to notice that "Ontario's" latest problem is practically identical with the previous one (query 96725), at least as far as the method of solution is concerned. It is true that each individual equation is a quintic, but considered as simultaneous their solution involves only the treatment of a biquadratic identical with that reached in my solution to query 96725. Suppose S the sum of the six terms, and Σ the sum of the extremes. We have—

$$\frac{a(r^5 + r^4 + \ldots + 1)}{a(r^5 + 1)} = \frac{S}{\Sigma}$$

Throwing out the common factor $a(r + 1)$ this becomes—

$$\frac{r^4 + r^2 + 1}{r^4 - r^3 + r^2 - r + 1} = \frac{S}{\Sigma}$$

$$\therefore \frac{r^4 + r^2 + 1}{r^3 + r} = \frac{S}{S - \Sigma}$$

$$\therefore \frac{(r^2 + 1 + r)(r^2 + 1 - r)}{r(r + 1)} = \frac{S}{S - \Sigma}$$

which is identical with my equation on p. 189, and reduces to the quadratic $x - \frac{1}{x} = \frac{S}{S - \Sigma}$ where $x = \frac{r^2 + 1}{r}$. As in the other case, this is a general solution for all values of S and Σ. With the numbers given by Ontario $\frac{S}{S - \Sigma} = \frac{21}{10}$. This is the same numerical result as reached by the evacuation of $\frac{S^2 + \Sigma}{S^2 - \Sigma}$ on p. 189. It is, therefore, obvious that "Ontario" derives both problems from the same source. We have, as before $x = \frac{5}{2}$ or $-\frac{2}{5}$, whence $r = 2$, or $\frac{1}{2}$ or $\frac{-1 \pm 2\sqrt{-6}}{5}$. Since $a = \frac{\Sigma}{r^5 + 1}$ we have, from the real values of r, $a = 5$, or 160.

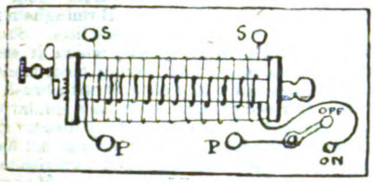
C. P.

[97284.]—**Geometrical Progression.**—The sum of the terms of this G.P. having been given together with the sum of the first and last terms, nothing more is necessary—not even the number of terms, for that is involved—in order to determine by a simple equation what the particular series is. "Ontario's" method is quite right so far as he has shown it; but he does not state his difficulty, nor has he been quite frank in explaining why the remainder is "$15 - 3x$ *or* $15 - 3x = 0$." Why *or*? There is nothing in the equation $\frac{315 - x}{150 + x}$ viewed as an ordinary equation, to suggest, necessarily, that this remainder = 0, though it is really the case. In any g.p. series $\frac{s - a}{s - l}$ = ratio (where a = first, and l = the last term) *without a remainder*, which is seen to be the case with $\frac{315 - x}{150 + x}$, for, if 5, the value of x, be substituted, we get $\frac{310}{155} = 2$. Now, as it is certain that the algebraical division cannot produce a different quotient than the arithmetical one, with the same divisor and dividend, we are invited to look for a reason why. In this case there appears to be a fraction more than 2, and it is found in the fact that a number *greater* by 5 is being divided by another *less* by 5 than the actual numbers. The result of the algebraical division being that the numerical excess is balanced by the deficiency of the x portion of the binominal $15 - 3x$. But this would not be true in any other case than this particular kind of problem, because in this case the assumed x represents two things — the actual numerical *value* of the first term, and also that it *is* the first term, since the formula $\frac{s - a}{s - l}$ indicates that the prime condition is the deduction of the *first* term, whatever be its numerical value. And this is the reason why "Ontario's" remainder $15 - 3x = 0$; it is $\frac{15 - 3x}{150 + x} = \frac{15 - 15}{150 + x} = \frac{0}{155}$. The

entire working of the question is: Let x = first term; then $165 - x$ = the last. And $\frac{s - a}{s - l} = \frac{315 - x}{315 - (165 - x)}$ = ratio. $= \frac{315 - x}{150 + x} = 2 + \frac{15 - 3x}{150 + x}$—an apparent fraction which, for the reason given, requires that the $15 - 3x$ should $= 0$, from which $x = 5$. One function of this x is to represent the actual value; its other function is to represent or symbolise the *first term*, and therefore gives both the ratio and first term in one operation. JAMES PARIS.

[97289.]—**Double Vision.**—Double vision, such as you describe, came upon me eight years ago, and got slowly worse for two years. I tried three doctors and two opticians, who could do nothing with it, though they tried many kinds of spectacles. Then I went to John Browning, optician, Strand. He said it was a very uncommon form of astigmatism, and he fitted me with spectacles that have quite cured it. I mean that I see clearly and singly with the spectacles, but without them vision is double, as it used to be, but not getting worse. W. M.

[97295.]—**Coil Connection.**—TO MR. BOTTONE.—The annexed sketch, in which the primary is indicated by heavy lines, and the secondary by finer



ones, illustrates the manner of connecting up. The battery wires are coupled to terminals, P P, and the shocking handles to S S. Presuming you are using a carbon zinc battery, you will find the following excitant give good results:—Chromic acid, 3oz.; water, 1 pint; oil of vitriol, 3 measured ounces. Mix in the order given, and do not use until quite cold. The solution can be kept in a glass bottle. Do not return the spent solution to the stock bottle; when it gets olive coloured, throw it away and replace it by fresh solution from the stock bottle. To keep the battery in good order, always plunge the zinc-carbon elements in boiling water, as far as the solution has reached, for a few seconds; then rear up to dry. S. BOTTONE.

[97296.]—**Gas Engine.**—Make the trunk piston as shown in reply 96864, page 429, Dec. 22, 1899. Make the hollow end ⅞in. deep, and allow ¼in. for clearance end of stroke, and that quarter full counter bored $\frac{1}{16}$ below the cylinder bore. Valves: air, ¾in. or ⅞in.; exhaust, ⅞in. or 1in.; gas, ⅜in. or ½in. See reply to 97283. I should never think of having a forged or bent crank for such engines; but should build them as shown, either a gas-bag or a rising gas-holder in water, as used formerly. JACK OF ALL TRADES.

[97298.]—**Cements.**—The following cement will answer both your purposes. See that the parts are quite clean. Put the very best and purest gum arabic in water, and leave overnight, when it should be of the consistency of treacle. Then add calomel (mercurous chloride or subchloride of mercury) enough to make a sticky mass. Mix well. The cement sets in a few hours, but it is wiser to leave it for a day or two. Mix only for use. ERFAHRUNG.

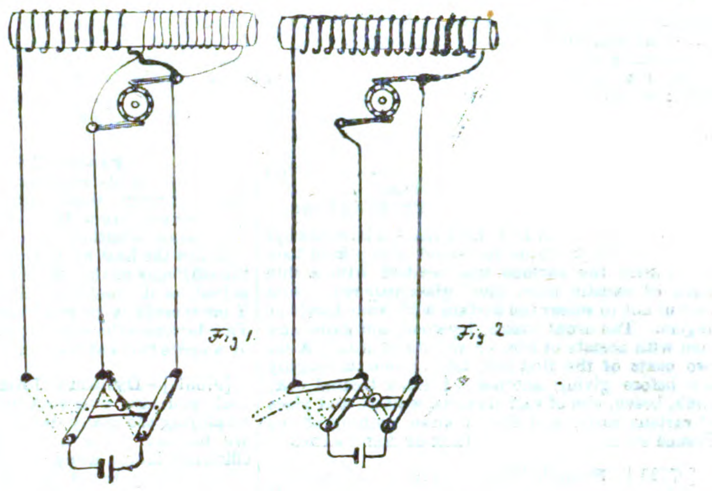
[97299.]—**Budding Roses.**—Querist asks what are Manetti stocks? Goodness knows! It depends where they are bought. The Manettia belongs to the Rubiaceæ, and in light soils seems to be a good stock for budding the Rosaceæ; but I agree with Mr. Bottone (p. 456) that it is very doubtful if they are superior to the dog-rose stock. Roses never do better than on the dog-rose of the hedgerows, and that requires a rather damp, stiff soil. The Manetti seems to be a better stock on sandy soils; but I think it soon fails. If the position is sandy, get some clay or stiff soil, and dig in about 3ft. deep. A rose-bush is always worth a little trouble. Get on own roots as soon as possible. DIJON.

[97303.]—**Soldering.**—Two of lead to one of tin, melted together in a ladle or pot. It can be bought as cheaply as you will be able to make it. Keep all other metals out, such as zinc, &c. Get some spirits of salts from your chemist, and place it in a stone jar by the fire, and throw in some scrap zinc until all action ceases—it is hastened by heat. Add as much water as there is killed spirits (chloride of zinc), and then it is ready for use. Never attempt to solder unless your copper-bit is tinned. To do so, get a lump of salammoniac, and heat your iron to a good heat (not red hot) and make a hole in the sal. with your iron. Drop a little solder in the hole, and again place in iron and it will be nicely tinned. Never get too hot; and, on the other hand, you cannot solder unless your work is the same heat as iron, or nearly so. Practice is necessary. Clean work, if dirty, by scraping. Apply solution where you want to solder. S. R. BROMSGROVE.

[97303.]—**How to Solder.**—This query is a mix, for although it is easy to solder tinplate, "brazing" copper or brass is a different thing. One thing is essential—the surfaces must be clean, and they must be made hot before the solder is applied, or that will be chilled and won't adhere. The best flux for tinplate work is chloride of zinc (spirits of salts "killed" with bits of zinc—that is, bits of zinc put in until the muriatic acid ceases to bubble). Rub the surfaces clean, apply a little of the flux, then warm up with the hot bit, and then apply the solder, melting that with the tinned copper bit, and the solder will flow where it is led. Brazing is different, and generally needs a blowpipe. The process has been described hundreds of times in back volumes, and in any of the manuals. M. T.

[97308.]—**Soda and Uric Acid.**—I asked if the soda contained in baking-powder, soda-water, and other preparations would be injurious to persons suffering from excess of uric acid in the system. "Regent's Park" replies (?) that "certain stewed fruits contain bicarbonate of soda"! He adds that "cane sugar creates acidity," and that "cream is a digestible form of fat"? Our feline pets will no doubt heartily concur with the last assertion, but its connection with my query is somewhat remote. I shall be grateful to any competent reader who can give me authentic information. "Glatton" wrote recently in praise of a lithia preparation for uric-acid troubles. Will he kindly say if he can confirm his first experience? With me it seemed to benefit the kidneys, but to increase the headaches. D. W. A.

[97309.]—**Fuller Porous Cells.**—This querist seems to have somewhat mixed up his quoted authorities. Both the first two quotations may be good advice, though opposed, because any such statements must be adapted to the particular case. Now, Mr. Perren Maycock gives the reason for his advice, and it is a sound one, as he directs the cell to be made non-porous at the part in which it is in contact with the saturated bichromate solution, which is most certainly not wanted in the neighbourhood of the zinc. The Fuller cell is used principally to give currents at high E.M.F., but only at intervals of short duration; therefore, the surface of the porous cell may be reduced, and every care taken to prevent useless diffusion of the liquids. But I cannot imagine why the quotation from my "Electricity" is brought in. The quoted section, p. 394 of third edition, does not relate to Fuller's cell, or porous cells, or even to zinc. It describes what goes on between two plates of copper in a copper solution. Its purpose is to show the effects of stratification in the liquid, and the consequent circulation, bringing a stream of acid against the upper parts of the anode. The same action occurs in the case of zincs, as described on p. 111 of my "Electricity." The querist may also find something useful about porous jars on p. 119. For the special case, soak both the top and the bottom of the cells with paraffin, for the reasons given. SIGMA.



[97310.]—**Armature.**—There are two modes by which this can be effected. Both require three lead lines from motor to switch. Fig. 1 shows the better plan; Fig. 2 the easier. In the first the motor must be compound-wound, with the series and shunt coils so arranged as to give precisely the same number of ampère turns, not coils. An ordinary Breguèt switch is arranged at the distant end, near the generator, between the three studs, so that when it is turned over to the right, as shown by the heavy lines at Fig. 1, the motor runs as a shunt motor; and when turned over to the left, as shown by the dotted lines, the motor runs as a series machine. In Fig. 2 an ordinary series-wound motor is shown. Here again a Breguèt switch is used, but in this case the left-hand arm must have a metallic extension, reaching to the extreme left-hand stud. When in the position shown in cut, the motor acts as a shunt motor; when the switch is put over to the left, as in dotted lines, as a series. And since a series and a shunt motor, *cæteris paribus*, rotate in opposite directions, your end is attained. S. BOTTONE.

[97319.]—**Belt.**—I do not see how you can expect to get a satisfactory drive with such short centre especially with ¼-twist belt. I should endeavour to put up a countershaft, and drive back again, and use certainly not less than 15ft. centres—more if possible. There is a special belt made by a Glasgow firm, with one edge overlapped on weatherboard principle for such work as you require, see advertisements in *Engineer*. I have seen leather link belting on a similar drive used when all others failed. You might try this, or a Dick's 4-ply by 9in. wide, this, I feel sure, would answer. Chain drive works well at slow speed, and is cheap. MONTY.

[97319.]—**Belt.**—Cotton manufacture: Lister, 1894 (C. Lockwood); Morris and Wilkinson, 1897 (Longmans). Wool manufacture: W. C. Bramwell's "Vade Mecum," 1881 (Thayer and Wadham, Boston), American; Jas. Burnley, "History Wool and W. Combing," 1889 (Sampson Low and Co.), &c. REGENT'S PARK.

[97319.]—**Belt.**—Has W. Moore tried the half-cross belting manufactured by C. O. Gehrckens, of Hamburg? English agents, Haughton and Co., 6, Lombard-court, London, E.C. ASHFORD HALL.

[97319.]—**Belt.**—I give approximate breaking strains of—

Leather	per square inch	3,660lb.
Best quality	,, ,, ..	6,800lb.
Stitched cotton do. solid woven....	,, ,, ..	10,420lb.
Waterproof linen.	,, ,, ..	12,000lb.

Horse-power (or 33,000ft.-lb. lifted 1ft. high): H = H.P. of pulley, P = circumferential force of power in pounds. Then H × 33,000, 1ft. high = power of pulley. Denote circumferential velocity of pulley in feet per minute by v_m; there is power in pounds—

$$P = \frac{33{,}000\ H}{v_m}\ (f\ 20).$$

Inversely, $$H = \frac{P\,v_m}{33{,}000}\ (f\ 21).$$

Rule: Query power of pulley in pounds. Divide 33,000 times the H.P. by circumferential velocity of pulley in feet per minute. To determine H.P.: Multiply power of pulley in pounds by circumferential velocity in feet per minute, and divide product by 33,000. If v = circumferential velocity of pulley in feet per second, there results $v_m = 60_v$, and (f 20) becomes, by substitution—

$$P = \frac{33{,}000\ H}{60\,v}$$

or— $$P = \frac{550\ H}{v}\ (f\ 22).$$

Inversely— $$H = \frac{P_v}{550}\ (f\ 23),\ \&c.$$

REGENT'S PARK.

[97320.]—**French Black Stain.**—Boil ½lb. chip logwood in two quarts of water. Add 1oz. pearlash, apply hot. Take ½lb. of logwood, boil as before in two quarts of water, add ½oz. verdigris, and ½oz. copperas. Strain off, put in ½lb. rusty iron filings, and apply as before. Take 1lb. of logwood, boil in four quarts of water; add double handful of

walnut peelings, boil up again, take out chip, add half-pint best vinegar, apply boiling hot. To improve it if when dry a solution of green copperas in water, 1oz. to quart, applied hot. Ebonised black stain: strong vinegar, 1gal.; extract logwood 2lb., green copperas ½lb., china blue ¼oz., nutgall 2oz. Boil over slow fire till dissolved. When cool is ready to use. Add half-pint of iron rust, obtained by steeping iron filings in strong vinegar. If you have not tried either, you have a choice.

REGENT'S PARK.

[97320.]—**French Black Stain.**—I have always found that black stains for wood of any kind took better after the surface was washed with a thin wash of caustic lime, then glass-papered, being careful not to smear the surface with your hands or fingers. The usual stains, logwood, nut galls, and then with acetate of iron or nitrate of iron. After two coats of the first hot, letting one thoroughly dry before giving another. I have treated oak, birch, beech, elm of various sorts, walnut, and pines of various sorts, and firs. I know nothing of the French stains. JACK OF ALL TRADES.

[97320.]—**French Black Stain.**—I am not sure that I can even guess what this query means. It may be some special stain, but it cannot well be French. Does the querist mean the ordinary black stain produced by solutions of logwood and sulphate of iron, or what does he mean? He must know, if, as he says, he has tried "numerous experiments from books." As a rule a solution of sulphate of iron will make oak as black as night, and, in the case of birch, a previous soaking with logwood decoction is necessary. Put the piece of wood into a boiling decoction of logwood for a quarter of an hour, and then into one of sulphate of iron.

M. T.

[97322.]—**Cement for Rubber.**—Some of these may work. Waterproof cement: Powdered resin 1, strong ammonia 10. Shellac 4, borax 1; boil in little water, and concentrate by heat to paste. Guttapercha 1lb., indiarubber 4oz.; dissolve in bisulphide of carbon. Pitch 2oz., shellac 2oz., boiled-oil 2oz.; melted together.

REGENT'S PARK.

[97322.]—**Cement for Rubber.**—A solution of caoutchouc in mineral naphtha or in bisulphide of carbon (the cheapest solvents) will cement (or unite) rubber; but I suppose this tricycle tire is vulcanised rubber, and is therefore different to caoutchouc. So far as I know there is no really successful cement. Rubber (caoutchouc) once vulcanised is practically done for: it cannot be mended, and is only of use for working up in fresh mixtures to make inferior articles. The querist, for his special purpose, might, however, try bandages of calico soaked in rubber solution. S. R.

[97323.]—**Dynamo.**—If the dynamo is constructed exactly as you state, and it is properly magnetised, so as to have a N. pole one side and a S. pole on the other, there can be but three causes for it not working: (1) The F.M. wires are coupled up to the wrong brushes, or, what amounts to the same thing, you are driving the wrong way. (2) Either the commutator sections or else the brushes short-circuit to one another. (3) The wire on the armature is not continuous, or may even have got detached from the commutator section. See any late edition of my work, "The Dynamo: How Made and How Used," for full instructions in the way of locating and remedying these parts under the heading of "Failures in Dynamos." S. BOTTONE.

[97325.]—**Wireless Telephone.**—To MR BOTTONE.—I have had no practical experience with the above, so I prefer to abide by Montaigne's dictum and write nothing. What little I know about the subject will be found in my last book "Hertzian Waves," now in the publisher's hands.

S. BOTTONE.

[97326.]—**Bell-Ringing Electrically.**—To MR. BOTTONE.—The three sets of bells must be arranged in parallel: otherwise they will not work satisfactorily. S. BOTTONE.

[97330.]—**Steel-Facing Copper Plates.**—In further reply to "Trinacria," the subjoined may be of service. (1) The best voltage for iron depositing is six volts. Since no addition to the resistance in circuit can lessen the E.M.F. of your 50-volt dynamo, you must procure one of suitable voltage. (2) Having decided upon the largest surface you are likely to require in your vat at one time, secure a dynamo of sufficient output to allow a current of 10 ampères for each square foot of surface to be coated. The anode surface should always be larger than the surface to be coated, and by varying the distance between the former and the latter in the vat, the current can be regulated to a nicety. An ammeter should always be placed in circuit so as to be able to measure exactly the current passing. (3) The best solution is made as follows: Dissolve clean iron wire in hydrochloric acid, adding iron wire until the acid will take up no more. Let this be done as rapidly as possible to avoid oxidation, and giving a boil up towards the end of the operation. For every 58 parts of iron wire dissolved, add 54 parts of salammoniac, 1 part of glycerine, and 500 parts of water. The solution must be kept as much as possible away from the air when not in use, as it oxidises so rapidly. It can, however, be renovated by the addition of more acid, more iron wire, boiling up again, and adding salammoniac.

S. BOTTONE.

[97331.]—**Dynamo Coils.**—There is too little wire on the field-magnets, hence too much current passes through these coils. This heats the wire, and detracts from the efficiency of the machine. The mere addition of outside resistance would diminish the heat by cutting down the current; but the efficiency of the dynamo would be greatly impaired, as it would not magnetise up sufficiently. Your remedy is to wind more wire on the F.M.'s. This decreases the current, but increases the number of ampère turns at the same rate. S. BOTTONE.

[97331.]—**Dynamo Coils.**—The heating shows that you are overworking your dynamo, and employing too many lamps. Four 60-watt lamps are too many for a 200-watt machine. High-efficiency lamps using less power should be substituted; they do not, however, last so long.

H. L.

[97332.]—**Electric Ignition Coil for Motor-Car.**—To MR. ALLSOP OR MR. BOTTONE.—Premising that I do not greatly prize dry cells for this purpose, I give the following specification for a coil to be used specially in conjunction with dry cells in series:—Core, a bundle of No. 22 soft iron wire, carefully annealed, 7in. long 1in. dia. Primary ½lb. No. 24 silk-covered wire, to be wound in four layers, over about 6in. of the core, the other inch being taken up by the coil heads, &c. There will be about 180 turns in each layer. The secondary should consist of ¼lb. No. 36 silk-covered copper wire. This must, of course, be separated from the primary by a stout ebonite tube, screwed into the heads of the coil. It is not necessary to build so small a coil in sections; but the greatest care must be taken to insulate perfectly. The condenser should be built up of 50 sheets of tinfoil 5in. by 4in. interleaved with paraffined paper. S. BOTTONE.

[97333.]—**Spring Pressure.**—You will get nothing in the shape of a spring—spiral, flat, or elliptic—or any other form with a working constant of 40lb. As the work advances or recedes, the power will be augmented or reduced. A spiral spring made of No. 14B.W.G. steel wire wound upon a ⅜in. mandrel, hardened and tempered, will, I think, give you 40lb.; or No. 15 would be better. Ah! I see I have made a mistake, 40lb. per square inch, then a spring of 18 or 20 gauge will give you what you want, which will be about 10lb., which is rather more than will be required for an area of ⅜in. = ·1104. JACK OF ALL TRADES.

[97333.]—**Spring Pressure.**—Find load by multiplying area of safety-valve in square inches by pressure of steam in pounds per square inch; then multiply load by diameter of coil from centre to centre of steel; divide quotient by constant 3 for round, or 4·29 for square steel, and cube root of quotient gives size of steel in sixteenths of inch when diameter is round, and side of square when square. Internal diameter should equal four times thickness of steel. Lift for all sizes taken at one-tenth of an inch. The compression or extension of spring to produce initial load should be forty times lift of valve, or 4in. for all sizes of valves with above limit. To find compression or extension of one coil in inches: cube diameter in inches of coil (centre to centre of steel), multiply by load in pounds; divide product by product of fourth power of diameter (or side of square) of steel in sixteenths of an inch, multiplied by constant of 22 for round, and 30 for square steel. REGENT'S PARK.

[97333.]—**Spring Pressure.**—The area of a ⅜in. circle being ·1104, the downward thrust must be $40 \times \cdot1104 = 4\cdot416$, or, say 4½lb. GLATTON.

[97334.]—**Spiral Barrel.**—The same principles are adopted in loam, as in the loam pattern illustrated, but the rig-up is necessarily different. The templet screw is laid in the bottom of the mould, and the striking boards are guided by it. To explain the work in detail would require many illustrations; but I will keep the request in mind. J. H.

[97335.]—**Dandruff.**—Borax 2 drachms, dissolved in camphor water 1 pint. Head washed with this lotion once or twice a week. Or wash head with tepid water, agitated with a piece of quillai bark until strong lather is produced; or with water with salt of tartar, 2 drachms of salt to 1 pint of tepid water. Discountenance, as a rule, soap. Called Pityriasis. REGENT'S PARK.

[97336.]—**Roller Bearings.**—These would be expensive luxuries on carts, cabs, &c. The loads and shocks on locomotive axles is so great that the roller bearing would probably get out of order quickly. J. H.

[97338.]—**Motor Tricycle.**—You can obtain a two-speed gear that will fit any 1¼ Dion motor tricycle, and will fulfil your requirements, the reduction being about one-half. It is similar to one I designed in August last that I mentioned before in this paper, though carried out in rather a cruder manner. It is of French vintage, and as it is already offered for sale here, I will now describe it. It is of the Crypto form, or the old sun-and-planet, and is not a new idea by any means, and cannot be claimed as a patent. It consists of a box, about 8in. diam. by 1½in. thick, formed in two halves, one of which carries an external cone, the other internal leather-faced friction cone that fits it. The spindle takes the place of the ordinary one that carries driving pinion; being made Dion taper to fit flywheels over this spindle, a sleeve is fitted, which the new pinion is placed on. This sleeve is fastened to one half the gear-box, and carries inside the box teeth round it, that engage with two small pinions, which latter gear into a large internal toothed ring, fitted inside one half the box, allowing sleeve pinion to revolve at a reduced speed at a ratio proportional to differences in the diameters. On extreme end of spindle is a bearing with a bracket that will fit axle of tricycle to hold the lot steady. Ordinarily all the box runs round; but when gear is thrown in, a light spring steel band clips one half the drum, or box, bringing low gear into play without the least shock or noise. The motor can be started with a small handle independently of pedals, and so be warmed up, without grinding up and down street for a shot in the orthodox manner. It costs, I believe, £13 complete, fixed to any machine. You can get particulars from the Automobile Supply Company, Birmingham; I have not seen it in any other firm's lists. Should clutch get covered with grease, which it seems likely to do, no arrangement having been made to throw it off, you can easily clean it with brush full of petrol. A friend of mine, who has a similar one, says he would not ride at all in a hilly district if his tricycle was not so fitted, though he has not had it long enough to give an extended experience on faults that may develop. MONTY.

[97339.]—**Accumulator.**—To MR. BOTTONE.—Place a 50-volt 16c.p. lamp in series with one wire leading from dynamo to accumulator. This will give you just the right resistance to enable you to charge the accumulator from the said dynamo, without injury. S. BOTTONE.

[97340.]—**Oil-Engines.**—In running oil-engines, a good deal depends if the compression is perfect; as to the consumption of oil used, a good oil-engine, if the compression is good, will consume between one pint and one pint and a half of paraffin per horse-power hour, costing about 6d. or 7d. per gallon. Oil-engines have been run satisfactorily using "Russolene" oil, having a density of 0·823, costing 3¾d. per gallon; a "Crossley" engine having developed 7·01B.H.P. when consuming 0·82lb. of "Russolene" per hour, a small engine would use about ½d. or ¾d. worth of oil per horse-power per hour. Oil-engines are started by getting the tube and vaporiser heated, when the engine should start by turning the flywheel a few times. A 1in. leather belt is plenty strong enough to transmit all the power developed by your engine. If the tube is heated too high, the mixture explodes too soon, causing a bump or knock in cylinder. The mixture of oil and air is, roughly speaking, one to seven. IGNITION TUBE.

[97341.]—**Small Dynamo.**—To MR. BOTTONE.—I am very doubtful whether you would possibly get as much as 4 ampères at 20 volts pressure out of a drum armature as small as 3in. long by 1½in. dia., unless, indeed, the field magnets and pole-pieces were exceptionally massive. However, if you like to try, the following are the proportions to be observed:—Armature to be wound with ½lb. No. 24 silk-covered copper wire, field magnets with 2lb. of wire of same gauge, which may, however, be cotton-covered. Fields to be connected up in shunt with brushes. For details as to the exact manner of tackling the winding and connecting up of a drum armature, I must refer you to my book "The Dynamo: How Made," wherein, at p. 86, you will find full instructions, with working drawings.

S. BOTTONE.

A TYPE of compound express locomotive in use on the Chemins de Fer du Nord, of France, has high-pressure cylinders 1ft. 1⅜in., and low-pressure cylinders 1ft. 8¾in. diameter, by 2ft. 1⅛in. stroke. The initial steam pressure is 213·3lb. per square inch; the diameter of driving-wheels, 7ft.; the grate area, 24¾sq.ft.; and the heating surface, 1,890sq.ft.

THE Russian Ministry of Ways of Communication has approved of the following projects for developing the railway system of the empire:—The construction of the projected railway from St. Petersburg to Vitebsk, on the Western Dwina, and 380 miles south of the capital; between St. Petersburg, Vologda, and Viatka in north-east Russia; and finally, the projects for bringing the port of Archangel into connection with the railway system of Russia, and for affording communication between the towns of Cheliabinsk, Orenburg, and Zarizin and the Ural Region, Siberia, and Black Sea.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will lo k over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Glatton" has replied to 96613, 96964, 96965, 97063, 97075, 97091.

96919. Floating Body in the Air, p. 258.
96926. Velocity of Centre of Gravity, 258.
96929. Electric Ignition, 258.
96931. Dry Batteries, 258.
96934. Motor Tricycles, 258.
96936. Locus, 258.
96939. Ebbing Well and Burning Cliff, 258.
96949. Mutoscope Pictures, p. 259.
96950. Slade Micrometer, 259.
96951. Inflammation of the Parotid Glands, 259.
96958. Negatives on Celluloid, 259.

97098. Adjustment of Newtonian Reflector, p. 345.
97112. Tin and Sheet Mills, 345.
97116. Tortoise, p. 346.

QUERIES.

[97342.]—**Incubator Tank.**—Can any reader inform me whether, if I paint the under-side of the hot-water tank in a Hearson incubator with lampblack, it will permit more heat to pass into the egg-chamber?—A. DICKESON.

[97343.]—**Influence Machine.**—I have a frictional machine with two 18in. plates, which I should like to convert into an influence machine. Will some reader please give most efficient arrangement for same, and say probable spark obtainable?—MILLS.

[97344.]—**"A Perfect Marking-Ink."**—Is the ink described under this heading on p. 38, Vol. XXX., still procurable, and what is its trade name? I believe Mr. Albert Smith, its inventor, is no longer among us.—GLATTON.

[97345.]—**Wax Phonograph Records.**—Will any reader familiar with the subject please describe fully the manufacture of wax phonograph records? I have seen one or two inquiries on the subject in the "E. M.," but no satisfactory replies were ever given. What is the composition? What is the kind of wax used in the composition of the records? Are any other ingredients used? What is the melting-point? How are the cylinders moulded—under pressure or at rest? What kind of mould is used—separable or otherwise? hot or cold? What chemical will quickly dissolve the material in a record? Is there not some process similar to hard-soap making that would answer in the manufacture of records? Would not paraffin-wax do if hardened with another higher-melting-point wax? Will acetone dissolve the material of phonograph records, and would it be possible to mould them from saturated chemical solutions? Please describe fully.—JUNIUS.

[97346.]—**Emery Wheels.**—Will any kind reader inform me how to make reliable emery wheels from emery powder? Also, where do the blocks come from, and how are they pounded into powder?—EMERY WHEELS.

[97347.]—**Air Cylinders.**—Will any kind reader tell me what thickness of steel plate I should require to make six cylinders, 4ft. long 12in. diam., to contain compressed air sufficient to supply a man inclosed in an air-tight space of 125c.ft. for five hours? At what pressure would the air be required in the cylinders when charged?—W. MURDOCH.

[97348.]—**Orientation.**—What notable examples are there of buildings possessing some specially designed orientation with respect to cardinal positions of the sun or other heavenly body? Say, with an opening allowing the sun to illuminate a particular spot on a particular day in the year, or the like.—JOHN BACON.

[97349.]—**Sore Throat and Tongue.**—Can any of our homœopathic or allopathic readers tell me the proper remedy for the following condition? I have been, and am still, painfully tormented by very tender and painful pimples at the back part and sides of tongue, and extending down and (it seems to me) all round the top of the throat, causing a painful sensation when swallowing. There is also inflammation of all the surrounding surfaces on looking into mouth. I have been taking doses of Gels., Phyto., and Bry., but with little or no results. Would any of our readers tell me the cause of this condition of mouth and throat, with the proper remedies for same? I am a non-smoker, temperate in all things, but my last attack (the seventh) of influenza (with one of those blood-red throats) left it very tender. I am sixty-four years of age, and otherwise perfectly healthy. If I go to sleep for only five minutes my tongue and mouth go quite dry, and it is some few minutes before I can get the sensation of moisture back again into mouth. Please to advise.—COMUS.

[97350.]—**Thermo Dynamics.**—What is the difference between entropy and thermal capacity (that is, sp. heat) in thermo-dynamics?—CARNOT.

[97351.]—**Coating Cardboard Cylinders.**—I wish to construct an apparatus for covering cardboard cylinders with a thin coating of wax. Will some reader kindly give me some hints how to do it?—C. C.

[97352.]—**Longitude.**—Will some reader kindly explain the simplest and nearest way to get longitude far from civilisation, and with a 6in. transit theodolite, without having Greenwich time? I hear there is a new and easy way, which was shown in some back number. Writer is in lat. South.—ARGENTINE.

[97353.]—**Altitude.**—Will some reader kindly explain the following? In taking verticals, face right and left, I use the same vernier, and carefully level the horizontal plates with telescope bubble, taking mean of readings. If the horizontal plates are not exactly level, I suppose the mean of readings to be incorrect also. Am I right in this? Can an accurate altitude be taken by adjusting telescope as a level for bubble and collimation, and then, after setting vernier of vertical arc to zero, levelling-up telescope with the levelling screws under horizontal plates, and then taking a single altitude?—ARGENTINE.

[97354.]—**Naval Coppersmiths.**—Kindly inform me what the test work is for a coppersmith in the engine-room staff of H.M. Navy, and oblige.—A. R. GEORGE.

[97355.]—**Mercury Interrupter.**—How is the platinum which fills up the hole in the bottom of the glass containing the mercury attached to the glass?—A. T.

[97356.]—**Sun's Altitude and Azimuth.**—Will some mathematical correspondent kindly explain the method of calculating the above quantities, latitude, declination, and time being known? I asked this question not long ago, and though "F.R.A.S." kindly gave me a reference to back numbers, it was useless to me, not having access to them.—FLEUR-DE-LYS.

[97357.]—**Linoleum Paste or Cement.**—Can any reader supply me with a recipe for a paste or cement for sticking linoleum, &c., to floors, wood or stone (wood mostly)? It should not be expensive to make, and should also keep well.—LINO-LAYER.

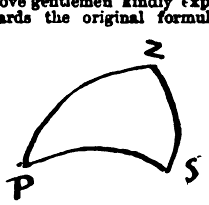
[97358.]—**Spherical Triangle.** To "ARCTURUS" or "F.R.A.S."—In working out longitude observations, I use the formula—

$$\cos. \tfrac{1}{2} P = \sqrt{\frac{\sin. \tfrac{1}{2}\Sigma \times \sin. (\tfrac{1}{2}\Sigma - SZ)}{\sin. PZ \times \sin. PS}}$$

where P = hour-angle, and $\tfrac{1}{2}\Sigma = \tfrac{1}{2}$ sum of three sides of the triangle. As used, the above formula becomes—

$$2 \log. \cos. \tfrac{1}{2} P = \log. \sin. \tfrac{1}{2}\Sigma + \log. \sin. (\tfrac{1}{2}\Sigma - SZ) + \log. \mathrm{cosec.}\ PZ + \log. \mathrm{cosec.}\ PS - 20.$$

I quite understand the development of the working form from the original, except the reason of rejecting index 20 from the sum of logs. on the right of the equation. Will either of the above gentlemen kindly explain why this is done? As regards the original formula, if it is not



asking too much from the patience of the good-natured mathematicians who so kindly help beginners, might I ask for demonstration of the formula, particularly the function of the quantity $\tfrac{1}{2}\Sigma$, which comes into so many solutions of spherical triangles? I feel that the above is of general interest to many readers of the "E.M.," and as I have not access to back numbers, please do not merely refer to them.—FLEUR-DE-LYS.

[97359.]—**Flash Powder.**—I take formula below from a recently-published annual. Is it reasonably safe to use? Picric acid, 37.5 parts; chlorate of potash, 50 parts; magnesium powder, 12.5 parts.—OPTICAL L.

[97360.]—**Wehnelt Brake.**—I have made one of these interrupters as follows. Cathode a lead plate 3in. by 4in. Anode No. 16 B.W.G. platinum fused into the end of small glass tube, and bent at right angles to face or point towards the cathode. When connected to coil, which will spark 10in. by mercury break, I could not get more than a 3in. discharge; but it was a continuous blaze, and appeared about ¼in. thick. (I should say the platinum point is about 1½ from cathode, and the dilute acid, say, 1 acid to 25 water.) I expected to get a much longer spark. Can anyone say where the fault may be? I tried at 50, 60, 70, and 100 volts. When I connected to X-ray tube the platinum plate became white hot. Does this harm the tube? Of course it was only connected for about two seconds. If left longer, am afraid it would melt the reflector. Where am I wrong?—WEHNELT.

[97361.]—**Clock-weight.**—Can some correspondent kindly tell me what is the law governing the weight of a clock-weight? I recently purchased a movement with seconds pendulum and dead-beat escapement. Since then I have seen a clock by Cooke and Sons in the possession of a neighbour, and noticed at once, not only that the weight was distinctly smaller than in mine, but that in the course of the week it falls only to about 3in. below the bottom of the pendulum, the cord passing over two pullies, whereas in my clock the weight is larger, the cord passing only round one pulley, and the weight descending 6in. every 24 hours. Why is there this difference in two similar clocks?—C. D.

[97362.]—**Perpetual Calendar.**—I see that a perpetual-motion calendar has been invented which "indicates automatically" the day of the week, the date, and the month, and shows "the 29th of February every four years." Can any reader tell me where this calendar can be seen?—A. F.

[97363.]—**Artificial Oysters.**—It is said that artificial oysters are served at the restaurants in Paris. Can any of your readers tell me how they are made? It is stated that "connoisseurs" cannot tell the difference—hence this query.—S. S.

[97364.]—**Hand-Camera Shutter.**—Will Mr. Bennett, or any other reader, kindly give full instructions how to make a shutter for ½-plate hand-camera capable of giving instantaneous exposures ranging from, say, $^1/_{50}$sec. to $^1/_5$sec., and also time exposures?—CAMERA.

[97365.]—**Deafness.**—Will "M. B., Galway," or other reader, kindly give me the best treatment for catarrhal deafness of middle ear, with nerve weakness? Patient male, age 35 years. Deafness is chronic; no discharge. Is the Drouet treatment of deafness worthy of trial? They have a branch in London. Is the above form of deafness curable?—CAMERA.

[97366.]—**Mouldy Growth on Prints.**—Last August I mounted some silver prints in optical contact with glass. They were floated on with a weak solution of gelatine, to which a few drops of thymol solution had been added. The superfluous gelatine was squeegeed off. After a month or so bright pink spots began to appear on the prints, which gradually spread into more or less circular smudges. The paper under the spots was found to be rotted, or, at any rate, to leave the glass easily when rubbed. A few weeks later similar spots were found to be forming on some platinum prints which had been mounted with the same solution on a sheet of glass, close by the first. The spots spread from a centre, gradually increasing in size, were of a bright pink colour, and appeared to be on the surface, and to be covered with small dark specks; but the paper under them seemed quite rotten, and, indeed, the spots could hardly be distinguished from those on the silver prints. Can anyone explain them? They give the impression of fungoid growths. There is no question about the complete fixation, &c., of the prints.—No. 7.

[97367.]—**Maximum Rainfall.**—I have some information as to this in London and neighbourhood; but the shortest space of time for which the maximum is recorded is one hour, but it is quite certain at the very heaviest falls never last so long. Will some observers kindly tell me the maximum for a shorter space of time, say a quarter or one-third of an hour, in London and neighbourhood, with dates?—PLUVIUS.

[97368.]—**Reconstructing Organ.**—I shall be greatly obliged if organ experts will kindly give their views on the following? We have an old organ, two manuals and full compass of pedals, eight stops on Great, eleven on Swell, two on pedals; case in good condition, and pipes for the most part decidedly good. The action, however, is antiquated and bad, and the Swell has the grave fault of ending at 4ft. C. What I want to know is whether the following plan of renovating the organ would be advisable? To replace the entire action with one of modern design, with three manuals; fit new wind-chests, &c.; leave room on each manual for a few additional stops to be added; fill up most of Swell stops down to 8ft., and form a small Choir by taking Twelfth from Great to form Open Diap., and filling it up in the Bass; two soft stops from Swell, and a new Clarionet. The new action would have all the usual couplers, including Swell Superoctave. There is not likely to be very much money available, and this plan is suggested as the cheapest, the present action being entirely past repair. Will someone give a rough estimate of cost of new action as above, new pipes to complete Swell, and new Clarionet for Choir? Would £120 cover it?—No. 7.

[97369.]—**Matches without Phosphorus.**—Can any reader tell me what results have followed the offer of a prize for matches without phosphorus that would strike anywhere, and what of those patented devices which were supposed to solve the difficulty? The prize was offered by the Belgian Government, I believe. There were many notes on the subject last year, and notes can be found on pp. 137, 168, 319, 351, 581, Vol. LXVIII. The paragraph on p. 581 seems to give some definite information; but I want to know whether anything more has been heard of those "safety matches."—PHOS. J.

[97370.]—**Balloon Fabric.**—Is there any particular method of seaming when joining? How must the silk be treated so as to become impervious to water—as a gas-bag when immersed in water, say, to a depth of 5ft.?—JOSEPH H. ROWNEY.

[97371.]—**Prevention of Silver Oxidising.**—I have a pair of candelabra which tarnish in a very short time; they are Sheffield plated silver. Presume it is due to sulphur from gas. How can I treat them so as to retain their bright silvery appearance?—CASENHEM.

[97372.]—**Aluminium.**—Be kind enough to tell me the best and easiest way to buff aluminium? Also the best and easiest way to frost the same a deep frost?—W. H. FRY.

[97373.]—**Theatre.**—Please give small sketch showing R. and L. of stage, prompt side, O.P., proscenium, wings, &c.—S. O.

[97374.]—**Windmills.**—Several inquiries, including one of my own of months ago, have done very little in getting what is evidently wanted by several—sufficient information as to size of parts and drawing of details of revolving head, carrying the wind vanes and "rudder," to enable us to construct one, say equal to ½ or 1H.P. It is useless to say "the mill is thrown out of action when wind is too strong by an arrangement of weights." That is just one of the wrinkles wanted to be described in detail. Will not some competent reader, of whom there are plenty, kindly take the trouble? The mill I am thinking of is of the circular kind, with fixed wind vanes. The vanes, I imagine, could be made of thin wood, all attached at the proper angle to circular supports; but the size of all the parts is a puzzle, and how automatically thrown out of action.—BONCHURCH.

[97375.]—**Induction Coil.**—What sized condenser should be used with an induction coil having a core 6in. long by ⅝in. diameter, wound with three layers of No. 24 silk-covered wire? Would a condenser composed of 20 sheets 4in. by 2in. give different results from one of 40 sheets 2in. by 2in.? In winding on the secondary of a ⅝in. coil, is it absolutely necessary to recover the wire with silk in places where it may have been removed for the purpose of soldering a joint? Would it not be sufficient to fold a piece of thin paper around it? What battery power (in ampères) would such a core as the above require to produce a ⅝ spark in a secondary of 6oz. of No. 40 wire? Is there any form of Leclanché cell that would suit for short experiments? I cannot find any information on these points in any book, or would not trouble your correspondents, as they must no doubt be tired of answering so many queries on the subject of coils.—D. E.

[97376.]—**Wheatstone Bridge.**—Will Mr. Bottone or Mr. Allsop give me the length and gauge of silk-covered wire (copper or German) to be used to give accurately 1 ohm resistance? I should like as short lengths as possible, to prevent the taking up of great space.—ALBERT A. HARLEY.

[97377.]—**Oil-Engine.**—Will some reader enlighten me on the following? I want to turn a gas-engine into an oil-engine. How could I do this? Please explain how to make an oil-burner to heat ignition-tube, the oil to be taken from the supply-pipe of engine? A sketch will greatly oblige.—A. C.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such iinformation, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 3, and unacknowledged elsewhere:—

THOMAS JOHSON.—W. E. Gibson.—Bonney.—Apex.—A Fellow of the Royal Astronomical Society.—H. L.—N. M. Munro.—S. R. Bottone.—John W. Faulkner.—Ignoramus.—New Moon.—Motor Car.—Jack of All Trades.

SPOKE.—You cannot place the matter in the "hands of the police," because it is not a case of fraud. part of the goods having been delivered. You are entitled to sue him for the price of the wheels not delivered, and for any loss you have sustained by their non-delivery. You should write, giving him notice that you will do this if the wheels are not delivered within a week. We do not remember that he has advertised in these pages, so that we have no ground of interference.

WM. SCOTT.—The ·60 is a very obvious misprint for ·80, and is corrected elsewhere. If Merthyr Tydfil is 3° 22′ 41″ West of Greenwich, this, in time, = 13min. 30·733sec., and we say 60m. : 13m. 30·733s. : 9·8565s. : 2·22s. The sidereal time at Greenwich mean noon on Jan. 1 is 18h. 42m. 43·51s., and this + 2·22s. = 18h. 42m. 45·73s. The Right Ascension of α Orionis on Jan. 1 is 5h. 49m. 47·91s. If from this we take 18h. 42m. 45·73s., we get 11h. 7m. 4·40s. as the sidereal interval after mean noon of that star's southing at Greenwich, and this = 11h. 5m. 15·12s. p.m. G.M.T. If, again, from 5h. 49m. 47·91s. we take 18h. 42m. 45·73s., we get 11h. 7m. 2·18s. as the sidereal interval after Merthyr Tydfil mean noon at which α Orionis will south, and this = 11h. 5m. 12·90s. p.m. local M.T. At this instant it is obviously 11h. 18m. 43·63s. at Greenwich itself.

A. B. H.—Do not know of any French journals which are at all "corresponding." Nothing of the kind in France or Germany. That is probably why we have so many correspondents from the Continent. You could put the question to Mr. D. Nutt, Strand, W.C. (sufficient address); he would know about all the likely publications.

MARINE ENGINEER.—To obtain a certificate as a marine engineer you must have had at least twelve months' experience in the engine-room "on the watch" at sea. See "Wannam's Marine Engineers' Guide," published by Crosby Lockwood and Son, Stationers' Hall-court, E.C., price 8s. 6d. That will supply all the information needed, and give some useful hints about the examination papers. Candidates must have had experience in engine-shops on shore, and, above all, have had at least a year at sea in the engine-room "on the watch." That is indispensable.

THOS. W. WHITELEY.—If you have tried all the remedies for creaky boots which have been given in back vols. without success, perhaps you had better take the boots to the shoemaker, and ask him to lift the sole and put some French chalk underneath. As a rule, a number of short rivets driven into the sole at parts effect a cure.

G. HUDSON.—If you refer to p. 18, Feb. 18, 1898, No. 1717, or to p. 158, No. 1723, you will find full accounts of the composition of acetylene. It is a hydrocarbon with the formula H_2C_2. It is mentioned in any good textbook of chemistry—not exactly a novelty. Calcium carbide is the cheap source of supply. That probably explains the cause of your surprise.

W. BRADLEY.—That is the correct address, we believe. We know no other.

SIGNAL.—Get the "Railway Directory," published by McCorquodale and Co., Cardington-street, N.W.

L. C. W.—The advertisers referred to say they have never refused you the piston or the return of your money, but have repeatedly told you they were out of stock. They say they have now returned you the 1s. 6d. sent.

E. CATCHPOOL.—The best source of information of that kind would probably be the secretary of the Royal Meteorological Society, Victoria-street, Westminster. As to rainfall, the records are no doubt in the library of the Society. For the British Isles, Mr. G. J. Symons, F.R.S., Camden-square, N.W., has published for many years records of rainfall. The Governments of the United States, of India, and of Australia, also publish official reports. Possibly all such reports for "twenty years" can be found at the British Museum.

PIERCIE PICKERILL.—Not so far as is known, but you will find something on the subject in the back volumes under the head "Argentaurum."

JOSEPH H. ROWNEY.—Probably of any of the makers of balloons, and possibly also already prepared to resist water and gas. The technical query is inserted.

CHARLES MCARTHUR.—Luminous paint was described many years ago; but as to where to obtain it in the commercial way, we do not know. It was advertised as Balmain's Luminous Paint. It requires exposure to light, and then "glows" for hours. It is mainly a phosphide of calcium, and is mentioned in all the textbooks, some of which you can see in the free libraries of Glasgow and probably also the back volumes of this paper, in which its history has been fully described.

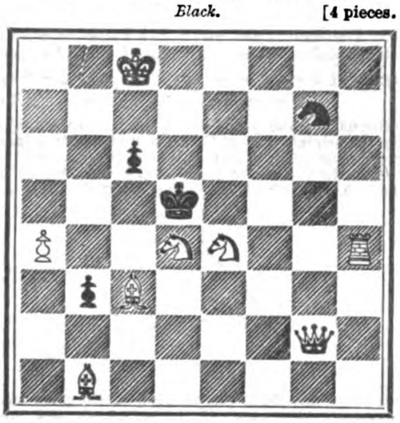
W. A. JENNER.—Such questions should be put to the tax-collectors of the district, in the first instance, and then to the representatives of the local authority or of the county council. The "license" applies only when the vehicle is used as a conveyance plying for public hire. As to the storing and selling of inflammables like petrol, you must consult the local authorities, because they have by-laws.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1708.—By G. B. VALLE.

Black. [4 pieces.



White. [8 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Jan.* 15, 1900.)

Solution of PROBLEM No. 1706.—By V. KRAUSE.

Key-move, Q-Q R 2.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1706.—Correct solution has been received from W. E. Collins, Rev. Dr. Quilter, Richard Inwards, Whin-Hurst, Oracle, A. Tupman, J. E. Gore, Quizco, N. M. Munro, F. B. (Oldham), Frank Gowing.

N. M. MUNRO.—Correct solution of No. 1705 received.

F. GOWING.—In yours of 30th you ask us to point out where your key-move B-K B 6 fails in No. 1704. We are glad to say that it does *not* fail. It is the correct solution, and in "E. M." of 22nd ult. we acknowledged you as one of the correct solvers. What more would you have?

The Chess Editor heartily reciprocates the many kind wishes from his correspondents, and hopes that a Happy New Year may be the lot of all his little band of ardent solvers.

SPECIAL OFFER.—CHEAP VOLUMES.

In the course of the next few months we are compelled, owing to the making of the new street from Holborn to the Strand by the London County Council, to remove our Offices and Printing Works. Due notice of our removal will be given shortly. In the mean time, to reduce stock and save trouble of removal, we offer readers desirous of making up sets of back volumes *any volume* in the list below at HALF PRICE, or post free for 4s. 1d.

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Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 12, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—II.

FIGS. 2 and 3 show two views of the motor complete. It will be seen that this is of very simple construction. As far as practicable, forgings have been replaced by malleable iron castings. The only forging of any difficulty is the crank-shaft. The numbers refer to both views, the references being:—1, the cylinder; 2, the cylinder-cover; 3, the crank-chamber fitted with covers 4 and 5. The cover 5 has a boss (6) on it, which takes the stud 7 carrying a sleeve 8, on which is formed the exhaust-valve cam. This sleeve has keyed to it the gear-wheel 9 driven by the pinion 10, which is keyed to the crank-shaft 11. The wheel having twice as many teeth as the pinion revolves at half the speed of the crankshaft, thus operating the exhaust valve at every alternate in-stroke of the piston. The piston 12 is provided with three packing rings (13) which make it a gas-tight fit in the cylinder. The connecting-rod 14 is a malleable-iron casting fitted with brasses at each end. On a facing cast on the side of the cylinder is bolted the valve-box 15, which communicates with the combustion-chamber of the cylinder by the port 16. The valve-box has a water-jacket which opens into the cylinder water-jacket, thus keeping the valves and seatings at an even temperature. The inlet-valve, 17, is automatic in its action, opening by the suction of the piston, and returned and held to its seat by the light spring 18. The exhaust-valve, 19, is furnished with a stronger spring, 20, which resists the suction-stroke, and is lifted from its seat every second revolution of the engine by a cam on the sleeve 8. This cam raises the roller 21 on the bell-crank lever 22, pivoted at 23, the other arm of bell-crank lever having the push-rod 24 jointed on to it. This rod pushes up the exhaust valve. On the face of the gear-wheel 9 is a disc, 25, both gear-wheel and disc being formed of vulcanised fibre in one piece. On the edge of the disc is the brass segment 26 in metallic connection with the sleeve 8. On the projecting end of the stud 7 is mounted a fibre plate on which is a brush or spring bearing on the fibre disc. As the primary circuit of the induction coil will have one wire earthed on to the motor and the other connected to this brush, at every revolution of the fibre disc the brass segment will be brought into contact with the brush, thus completing the circuit and causing the ignition of the charge. To

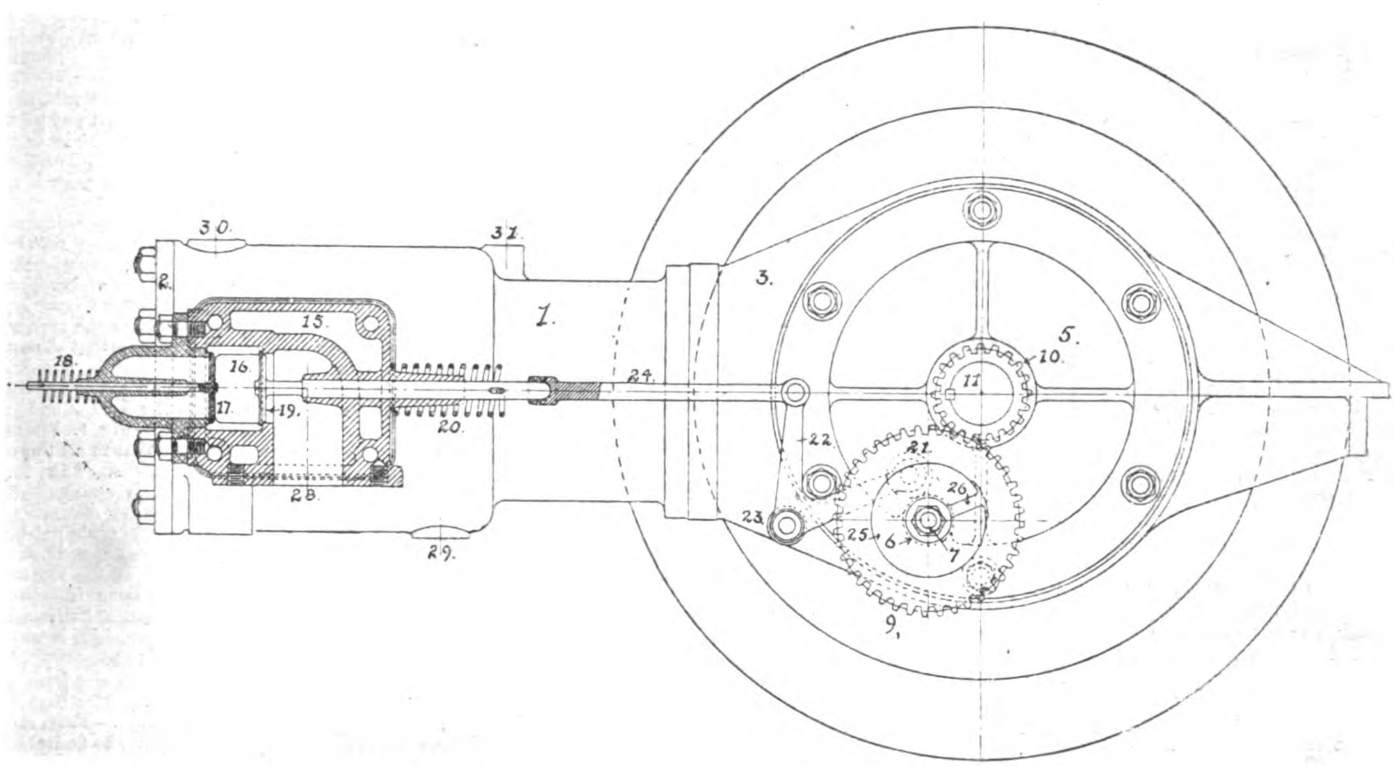


FIG. 2.

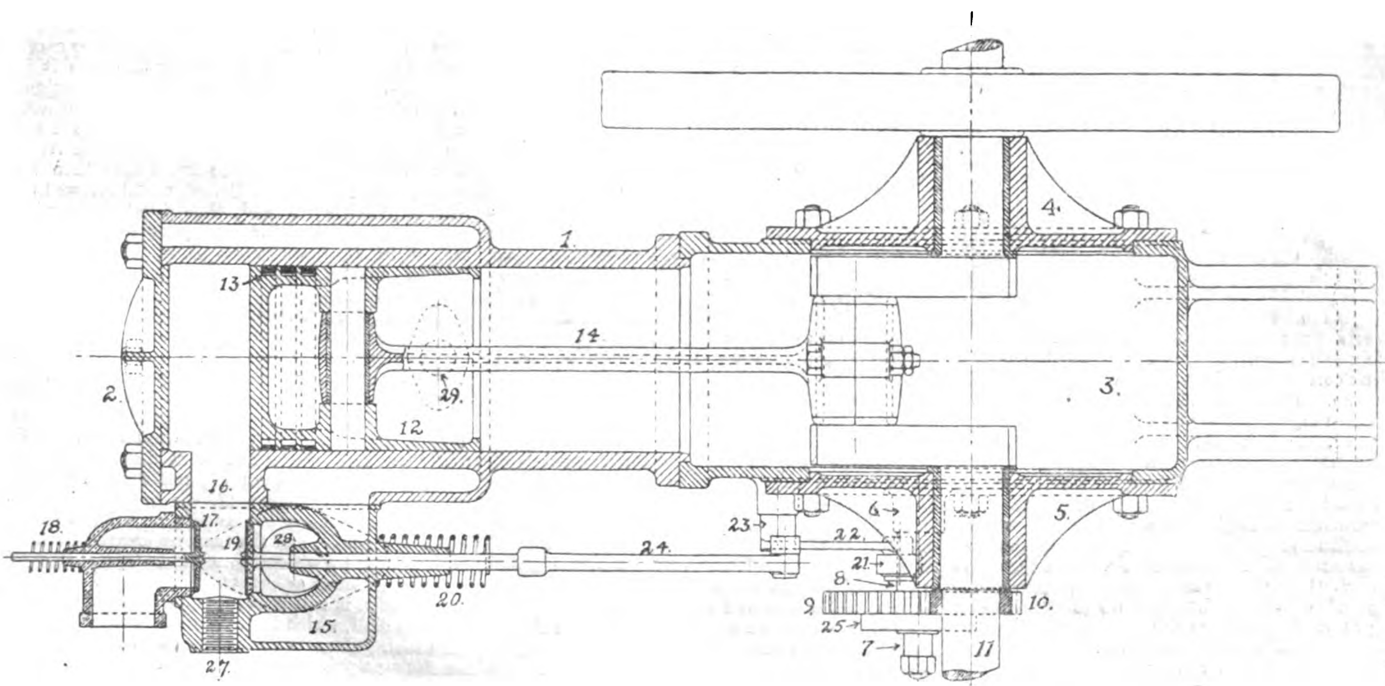


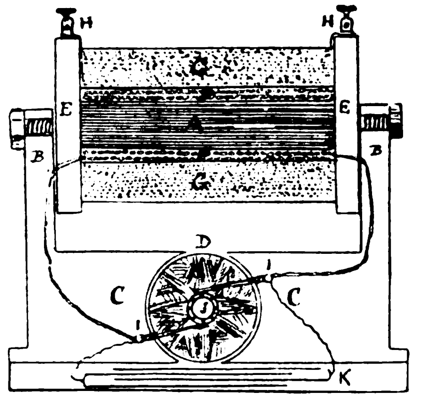
FIG. 3.

avoid confusion, I have omitted the fibre plate and brush in Figs. 2 and 3. The sparking plug will be screwed into the valve-box at 27. The exhaust gases pass away to the silencer through the hole 28. The water for cooling the cylinder enters the jacket at 29, and leaves it at 30, an oval facing being cast at these points to which the flanges on the water-pipes are secured by studs and nuts. A sight-feed lubricator for the cylinder is screwed into the boss 31. To insure the lubrication of the sleeve S and the fulcrum of the bell-crank lever at 23, the studs carrying these are drilled up from the inner ends, a sufficient quantity of oil being splashed into these holes by the crank, whence it is led by smaller holes on to the bearing surfaces. There is also provision made, as will be seen later, for continuous lubrication of the crank-shaft bearings. All the bearings of the engine and valve gear are thus lubricated automatically—a matter of considerable advantage in a motor carriage where the neglect of oiling one bearing may cause it to seize, and land one miles from home with a car that will not work. In order to enable one to adjust the big end of the connecting rod without having to take off the covers of the crank chamber, a hand-hole covered by a plate is made in the crank chamber in its upper side. As the motor is to be as simple as possible, I have not shown a governor on it; therefore, to prevent the engine from racing when the car is stopped, use must be made of the throttle-valve, which will be bolted to the dome-shaped cover of the inlet-valve. As a governor is a great convenience, reducing as it does by its action the number of levers to attend to when making a stop, I propose showing later on how one may be fitted by which the speed of the engine may be prevented from exceeding a given limit. The inlet and exhaust valves are of ample area to insure free working without throttling the incoming charges or causing back-pressure on the exhaust stroke.

A NOVEL DYNAMO-COIL.

MESSRS. BOTTONE AND SON, of Wallington, have secured provisional protection for a new form of dynamo-coil, which promises to be of great service in many branches of electrical work, such as igniters for gas and oil-engines, the production of current at very high E.M.F. for X-ray work, and, in point of fact, in all cases where a quick and easy mode of setting up high-tension electricity, without the use of batteries, accumulators, or a separate dynamo is required. On the battle field, for radiographic work, this apparatus will prove itself invaluable, as it is portable, easily driven, and not nearly so heavy as coil and accumulators. Our illustration gives a good idea of the general construction. A is a soft iron wire bundle, which serves at once as the core of the coil and the field-magnet of the dynamo. This is wound with wire suitable to render the machine an efficient series-wound dynamo, and at the same time to impart magnetism to the core as a primary coil. This wire is shown at F F. Thence the wire is led to the brushes I I, whence the current generated by the armature D is picked up. The commutator J is constructed specially to give sharp interruptions in the current. No contact breaker is therefore needed. G G are the secondary coils, the terminations of which are brought up to the binding screws H H. B B are the yokes, and C C the pole-pieces of the dynamo proper. A condenser, K, is in circuit with the brushes.

In our illustration neither bearing nor pulley is represented. On rotating the armature at its proper speed the machine enters into action as a dynamo, and, in so doing, at each interruption of the current, which occurs as the slits of the commutator pass under the brushes, powerful currents are induced in the secondary coil, which currents can be taken off the secondary terminals. So efficient is the apparatus that one of these dynamo-coils, standing 7in. high by 7in. wide, and 5in. deep, and weighing only about 12lb., will give a continuous and fat ½in. spark from the secondary terminals, the entire machine occupying actually less space, and being of less weight than that of the accumulators usually employed to work an ordinary coil of the same output. The winding of both portions of the machine can be varied at will to produce different effects; hence it is possible to adapt the machine



to the production of soft, steady currents for medical purposes, or to the generation of hot "quantity" sparks for gas or oil-engine ignition, or, finally, to the evolution of high frequency discharges of enormous tension, but small ampèrage, for X-ray and wireless telegraphy effects.

ORNAMENTAL TURNING.—XXXIV.

By J. H. EVANS.

AS intimated in my last, I now have the pleasure to illustrate and give the details of the specimen of work executed by the aid of the slide-rest, which has occupied our attention through four or five articles, and to those who have finished, nay commenced, the task of making this instrument, I offer my hearty congratulations. These may not be, in fact are not, worth much; but with them goes the corresponding desire to give all the further help I can; so I say no more than, to all questions I am ready to give the fullest information, hiding nothing; knowing no more than I have told, and hoping for nothing but that the very best results may reward the amateur who is bold enough to have undertaken the task.

The vase shown in the illustration not only gives an idea to copy and improve upon, but at the same time further illustrates many different applications of the spherical slide-rest, which, I may say, have not yet even come under our notice. I may as well here candidly confess that, much space as I have occupied, it would entail the filling of even many entire numbers of the "E.M." were I to attempt to show all and everything that could be done with this particular tool; but the following explanation of the specimen before us will enable those interested in it to follow, and discover what I am unable under the circumstance to further dilate upon.

The vase, as here depicted, may, of course, be either enlarged or reduced; also it may be made of different materials. That from which the autotype was taken is made of boxwood only, which arose from the fact that when I commenced it I intended only to carry out some experiments in connection with the spherical slide-rest; one part after another turned out a success, and so I determined to complete the whole thing in the same material. I must say that after the amount of time and labour I expended upon it, I rather regretted I had not made it in ivory; however, in all respects, it was all I could desire.

I should strongly recommend turners to always make their first attempt in this particular wood; but when about to produce a finished specimen, it should be made either of ivory or blackwood, or a combination of the two is most effective. I have seen three different copies of the vase now illustrated: one composed entirely of ivory, a second in African blackwood, the third being a combination—that is, the base being of blackwood, while the tazza and stem is in ivory, and, as a matter of fact, it was a difficult task to decide which I really preferred, all being equally beautiful; however, I think the ivory had the preference. There are reasons why it is not always available, and the choice of material must be left entirely to the turner who is about to execute the work.

The first attempt to reproduce a piece of work of this nature may not result in an exact copy. This is scarcely to be expected, as the instrument is in itself complicated, and it will require some practice to overcome the difficulties of such an intricate piece of machinery. This, however, is more or less modified by the explanation of its manufacture and manipulation in the previous articles upon the subject.

When about to commence such a piece of work the proportions must first claim the attention of the operator, and the material, whichever it is, must be selected with equal care as to size, colour, and grain.

Should it be desired to produce a fair copy, the dimensions of the original are as follows: 12½in. high, the tazza or bowl 5½in. in diameter. Should any of the material selected fail to turn up to the required size, it must be at once discarded and replaced by fresh. It is the idea that one piece being a little small will not matter: that leads to disaster in the finish, and if the sizes of the various parts be not maintained, the result cannot be satisfactory.

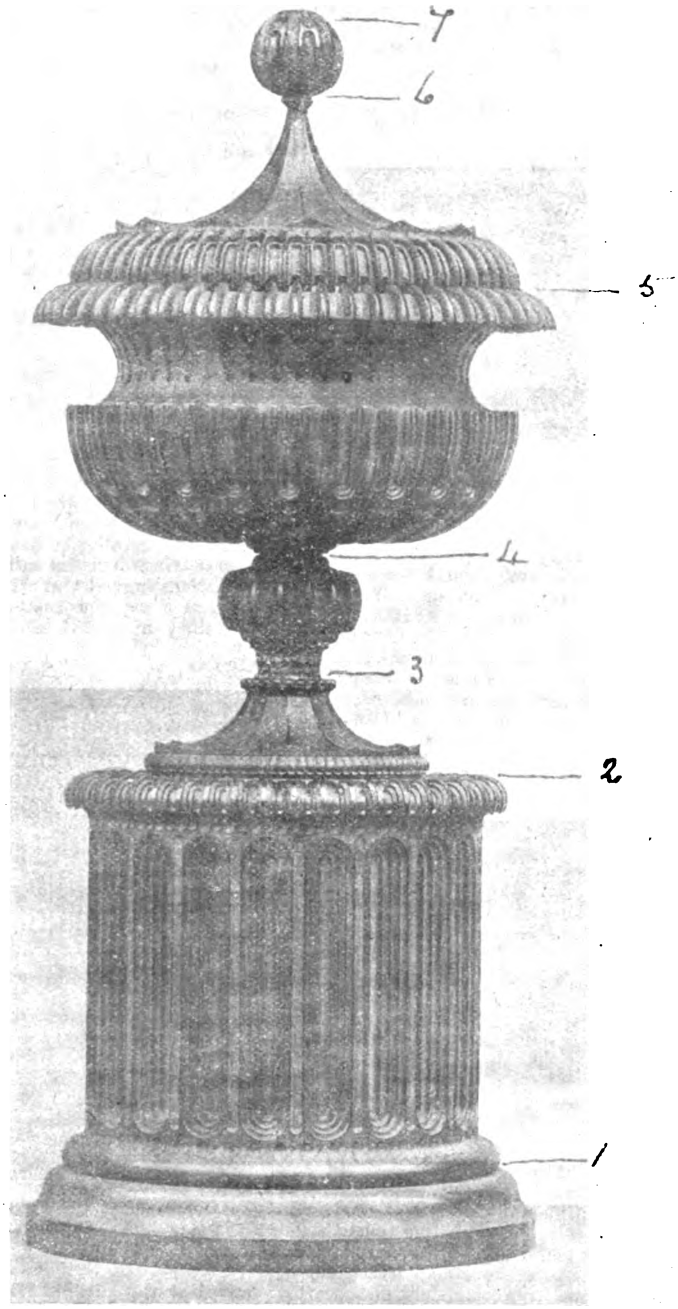
In making these remarks, I do not presume to imply that the base I illustrate may not be improved upon by many of our experienced amateurs who may read this; the observation simply refers to the production of a true copy. The choice of material being left to the turner, I will, as a basis, assume that ivory is that chosen for the work, and we will commence at the foundation—viz., the base. This is composed of a plain ogee. This should be cut from the hollow end of a tusk, and the thickness as shown, Fig. 1. I have numbered the autotype, showing that in all there are seven distinct and separate pieces. This, for the reason that much material is economised, labour saved, and the facilities for decoration much enhanced, in fact, some parts could not be done if the whole of the upper part were in one piece—I mean, of course, as far as the top or cover. The measurement may be taken from the illustration, as it is as nearly as possible half-size, so if it should be considered large enough, it may be made to the dimensions existing in the copy.

The body, 1 and 2, must be cut also from a hollow, but of lesser dimensions. The base 1 may be best held in the following way:—From the unevenness of the interior, it may not be desirable to turn it out true; anyway, it is not necessary. In this case, a boxwood chuck should be turned down to allow the ivory to pass freely over it, to admit of the external diameter being as nearly true as possible. The ivory must then be carefully faced on one side, and by this face it is securely held to the boxwood with strong glue. When dry, the ogee moulding is carefully turned, and being perfectly plain, may be shaped by hand. This, it will be noted, is the only portion that is entirely plain; the front may then be turned out to a suitable diameter, and screwed to receive the body 2, and, thus fitted, it may be considered chucked for further operation, being turned in its permanent place, therefore no further chucking will be required.

The body is now turned to a short cylinder. To do this, the ornamental slide-rest may be used, and as a matter of preference I should recommend that it be so, as it will be as well to save the more delicate rest all the work possible. However, as I have already stated, this was done entirely with the spherical slide-rest. I will explain it as so:—The top slide must be turned round to front the work, then fixed with the binding screw of the socket, and the third slide set parallel with the second, the top slide is (for rigidity sake) kept as much over the worm-wheel as possible, and the traverse created by the second slide, by which the work is turned to the before-mentioned cylinders.

The body, it will be seen, is fluted with a large size step drill, which is substituted in place of the fixed tool. Here is an instance of the necessity for fitting a pair of fluting-stops to each slide, as previously recommended. This must be set one on each side, to meet the requirements as to the termination, the flutes at the ends. The flutes being deeply cut and of increased sizes, each one will require a series of cuts to complete it. Also, when working round a large diameter of this material, it may reasonably be expected that the drill will lose a deal of its clean-cutting powers; therefore, when one round has been completed, the drill may be removed and very carefully sharpened.

The best way to effect this is either by means of



piece of Arkansas stone, with a sharp square edge or a series of brass slips, also made sharp, for the fillets, and curved for the various profiles. The same will require to be made with concave and convex: they should be fitted into convenient handles, and when used, charged with crocus and oil, the tool held in the left hand, while the slip is applied with the right, care being exercised to keep the brass flat on the vertical angle. The face of the drill must, of course, not be touched, beyond what is required to remove a slight burr should any have been created.

With the drill thus sharpened, a final cut may be taken over each flute; it is, of course, not impossible, but somewhat probable, that, in the process of sharpening the exact profile of the drill may have been slightly altered; this, however, will not interfere with the result, as a slightly increased penetration will again render it perfect. Between each flute sufficient space is left for a round-nose drill to be inserted. The original being 4in. in diameter at this particular part, contains twenty-four. The deeply-cut step flutes are cut by the smaller round-nose drill, being placed to cut between each; at the two extremities a round-nose drill is again used to pierce or serrate the corresponding hollows at each end; the lower curve having two drills employed alternately as seen in the illustrations.

We now arrive at that part of the work which affords the first instance of the application of the spherical slide-rest, and this is contained in the curved lip at the top of the body we have just fluted. The curve may be carefully shaped by hand approximately; the spherical rest is then placed on the bed of the lathe and fixed, the main slide is now adjusted to coincide with the lathe axis, and the slide which carries the worm-wheel so fixed as to place the latter exactly under the curve to be turned. This will at first be found rather a tedious and troublesome job, but a few trials and short experience will soon obviate any difficulty in this respect. When thus set, the work is first turned in plain form, which will be found to take much less time than the the settings and adjustment occupied. The drilling instrument again replaces the fixed tool, and with a smaller size step-drill this curved lip is fluted to correspond with the other parts.

It will be observed that the curved form is carried completely over the top. If it is found that the drill will not traverse over the curve far enough to cover the distance, it may be adjusted to do so by moving the tool receptacle on the socket; but on no account must the position of the worm-wheel be disturbed.

The difference between the positions of the fixed tool and the drill will arise from the fact of the plain form being turned with a curved tool while the drill is central to the stem of the instrument. The distance to be traversed once decided, the segment stops are employed to certify the same for each consecutive cut. So far we may consider the base and body complete. Before removing it, however, a recess must be turned out, and screwed to receive the foot of tazza.

The foot No. 3 should be first roughed into shape by hand, and screwed to fit the recess in the body to which it is to be attached. It must then be fitted to a well-seasoned boxwood chuck, and, as a matter of security, it is a good plan to place a little thin glue between the faces. This is not absolutely necessary, and, if the fitting is well made, it may be omitted; but in the case of any excessive excavation being required, it is always a safeguard against the work moving in the chuck.

The concave curve thus approximately shaped, the spherical slide-rest is again adjusted, and the tool in this case extended beyond the centre to suit the curve, which is then turned; we now cemo to the application of the vertical cutter in place of the drill. This is placed in the tool-box, and by shifting the same in the socket, the cutting-edge of the tool is brought to the necessary position, by which it will follow the curve already turned by the fixed tcol. The vertical cutter with the spindle passing through to one side is the most suitable for application in this rest, as there is no framework to prevent the tool passing round the curve or come in contact with any shoulder on the work or face of the chuck. With the tool adjusted twelve consecutive cuts only are made. At the base of this foot, it will be seen is a small serrated moulding cut with a drill, and at the top, a series of small beads. These are better cut with an astragal or square-end bead-tool, in order that, when finished, the beads stand well apart. The intermediate piece 4 is carried out in a similar way, being first shaped by hand, and afterwards decorated as shown.

We have now arrived at that portion which may be considered the most difficult, and forms, so to speak, the most important feature of the design. This is all in one piece, which to a great extent creates a difficulty in its execution. The rough block of material is held in a Universal chuck. The inside is then first excavated. In the first instance, a short, slightly taper fitting should be left. It is then removed from the jaw-chuck, and rechucked carefully upon a boxwood plug by the inside fitting referred to. Here again the application of glue will be found an assistant, especially if the work is likely to remain for any length of time upon the chuck unfinished.

The lower convex curve forming the bowl is next shaped approximately, followed by the concave curve at the upper part receiving the same treatment. The spherical rest must again be very carefully adjusted to the precise axis of the lathe. This setting is not a difficult matter in any case, seeing we have the index-line already marked upon the lower slide. This done, the second slide must be brought into use, to place the axis of the worm-wheel exactly under the hemisphere or curve to be turned. In this case a straight tool will be found to travel far enough round the curve to meet our requirements.

Again is the drill substituted for the fixed tool, and in this case a step-drill of smaller dimensions than that used for the body. As the drill passes out at the upper part it will only be necessary to adjust one segment step to arrest the cut towards the centre. Around this bowl there are forty-eight consecutive cuts, half of which are first cut—viz., those that go throughout the curve to the centre. The intermediate incisions, it will be seen, are arrested at half the distance, in order that the true form of the curve be not destroyed by their too close proximity at the centre. This admits of a series of round-nose drills of different sizes being used to stud seriatim over that part left uncut. It is scarcely necessary to point out that, when about to cut the intermediate step flutes, the segment stop of worm-wheel must be readjusted, to prevent undue traverse in that direction. It is found in practice that a great deal of the superfluous material may be removed by the partial rotation of the circular movements by hand; but for finishing cuts, the tangent screw should be placed in gear, and the motion governed by it.

The second slide must next be adjusted to suit the concave curve beyond the one we have just turned; this will require a careful and precise setting. Once more is the drill spindle resorted to, and a series of different sized round-nose tools employed to decorate this form. The work is now removed, and chucked by the edge of the curve bowl. Here, again, much care will be required. It will be noticed that it is held in the chuck by the uncut spaces on the body. It

will, however, hold perfectly tight if correctly fitted to the chuck. Thus held, the convex curve is turned, and the spherical rest adjusted to suit the curve. This curve is decorated with a series of reeds, which are cut with a quarter-hollow drill having an astragal end, thus creating the space between each, as seen in the illustration. As in this case the distance at which the drill was arrested between each reed did not allow the true form of the hemisphere to result, the reeds take an elliptic form, which adds to, rather than detracts from, its appearance.

So far, the specimen is complete, with the exception of the cover. I have heard it expressed that the latter is not an improvement. This may, at the same time, be considered a matter of opinion, and any turner deeming it worthy of reproduction can omit this part or not, according to taste. The proceeding for the shaping and decorating of this part is almost identical with those already explained. I may mention that the cover is not intended to fit closely, the spaces rendering the vase appropriate in a *pot pourri*.

I have, I hope, now given all the details necessary to enable a turner of some experience to either reproduce this as shown, or to improve upon it, as the notes with respect to the movements of the spherical slide-rest are more or less the same throughout its application to works of all kinds.

I have received more than than one request to treat next the spiral apparatus, which I propose to do, also with illustrations of rudimentary examples of work, ending with complete and finished specimens.

THROUGH A SMALL TELESCOPE.—IV.

By NORMAN LATTEY.

RESUMING our examination of the circumpolar constellations and those which are approaching the horizon in their annual drift westward to disappear for the season, we begin our work this evening with Aquarius (the Water-Carrier), lying immediately beneath the celestial Equator, and about to set in the south-west. There is a beautiful planetary nebula (No. 4628 in Klein's Atlas, position R.A. 20h. 58m., S. Dec. 11° 50') in this constellation, close to the star ν. It was discovered by Sir William Herschel in 1782, and is sometimes called the "Saturn Nebula." 41 Aquarii is another pretty double, composed of a yellowish star of 5½ mag. and a tiny companion nearly 9 mag. Almost immediately over this little object is ζ Aquarii (Fig. 1), a tolerably close double; but the components are fairly large and of almost equal magnitudes—viz., 4 and 4·1. Both are pale green. Yet one more easy double, fairly wide apart, is ψ Aquarii, with its deep yellow primary and blue companion.

Above Aquarius towards the zenith stretches the extensive constellation of Pegasus (the Winged Horse). ϵ Pegasi, a wide double, is a fine 2-mag. star, with a companion 8-mag., the latter another of Sir W. Herschel's many discoveries. η Pegasi, of 4 magnitude, with a minute companion 11 magnitude, affords a severe test for both a 3in., and the eye looking through it, in the detection of the *comes*. β Pegasi is a fine variable of 2 mag. with a faint companion. Its variability is, however, almost imperceptible as well as irregular; but it is accompanied by a slight change in the reddish tint of the star. An instance of a multiple star is furnished by γ Pegasi; but the two companions are hardly visible in the aperture at our disposal.

Between Pegasus and the cross of Cygnus is the small diamond-shaped group constituting Delphinus (the Dolphin). β, the most southern of the four, is a fast-moving binary, the components of which revolve round each other in about twenty-eight years. The spectrum yielded by the light of this star is remarkably similar to that of our sun; but computations go to show the former must be at least seven times brighter.

Higher up, towards Polaris, is located the minor constellation Cepheus in which are a number of fairly easy doubles, among them β (Fig. 2), pale green and of 3 mag., its small violet companion a little way off. Almost due south of this and almost in the middle of the diamond formed by α β ι, and ζ Cephei will be found a dense star cluster, a pretty spectacle even in a small telescope. δ Cephei is a yellowish-red variable, and the primary of a wide double-star system in which the companion is blue. Besides being a variable, with a period of 5d. 8h. 48m. δ Cephei is also, in itself, a "spectroscopic double"; but its minute *comes* is probably a dark body, as it is quite invisible to direct vision. ζ Cephei is another double, though somewhat close and difficult to divide; while μ Cephei, the ruddiest star in the Northern heavens, has also a minute companion.

Adjacent to Cepheus towards the east, the

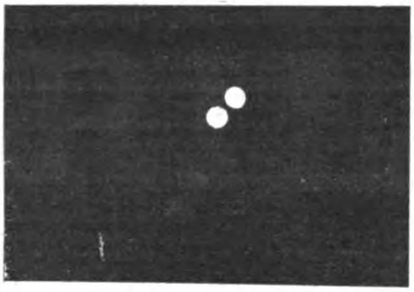


FIG. 1.—ζ Aquarii.

prominent W formed by the principal stars in Cassiopeia (the Lady's Chair) form a striking figure. Among the first objects we encounter about half-way between this constellation and Cepheus is a star cluster (No. 4957 in Klein's *Atlas*, but erroneously stated in the text to be in Cepheus). Close to β Cassiopeiæ (a star of 2½ mag. with a faint companion) is another star cluster; but it needs a large aperture to show it well. Several more occur between β and γ Cassiopeiæ. In fact, in this as with all the groups lying in the neighbourhood of the Milky Way, the entire

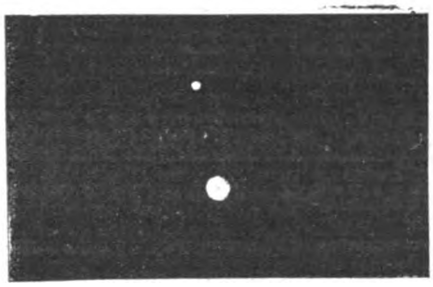


FIG. 2.—β Cephei.

region is crowded with clusters scattered and dense. γ Cassiopeiæ, lying in a field strewn with stars, has a companion 9½ mag., some considerable distance from it. It was in this constellation that the famous temporary star observed by the Danish astronomer Tycho Brahe blazed out in 1572 A.D. It long ago completely disappeared, yet it may be of interest to examine the place it once occupied. The approximate position is R.A. 0h. 19m. N. Dec. 63° 24'. η Cassiopeiæ (Fig. 3) of 4 mag. is yellowish with a 7½ mag. purple companion. It is an interesting binary with a period of 200 years. Special attention may be drawn to a star cluster immediately south of the star ϵ. Not only is it large and rich in stars; but a

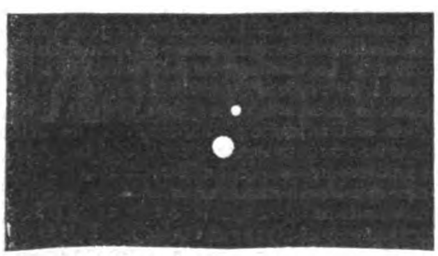


FIG. 3.—η Cassiopeiæ.

double and red-coloured star (both about 8 mag.) are to be seen in its midst.

To the immediate south of Cassiopeia stretches the attenuated form of Andromeda, containing one of the most famous objects in the Northern heavens, the Great Nebula (Fig. 4), a weird elliptical patch of hazy light shining with a strange translucence. Its ellipticity is, however, doubtless due to an effect of perspective, for it is in all probability nearly circular—a colossal maelstrom of glowing gas viewed almost edgwise. Its position is easily discerned even with the naked eye, being quite close to ν Andromeda, the most northerly of the two small stars lying at right angles to β Andromedæ (shown in Phillips' "Planisphere"). A reference to the atlas will at once make its exact situation clear (R.A. 0h. 36m., N.Dec. 40° 35"). An opera glass will show it distinctly, and a small telescope easily reveals its nebulous nature. In a 3in., on a dark, clear night, it is a splendid sight, the observer's wonder deepening with steady gazing into its mysterious depths. A few facts regarding this celestial wraith may be interesting. The existence of the nebula has evidently been known since the 10th-century. Messier noticed an increase of brilliancy towards the middle; but even the highest optical power of to day cannot resolve it into stellar points. About the end of August, 1885, a star of 6½ mag. suddenly appeared near the centre; but in a fortnight dwindled down to 8½ mag., and by the following summer had disappeared altogether. There are several small stars scattered throughout the length and breadth of the nebula; but they do not seem to have any physical connection with it. The well defined dark rifts on each side of the brighter portion are in all likelihood vacant spaces between the rings of matter surrounding the nucleus. Calculations suggest that the entire structure is a vast mass of vaporous matter partially condensed into a fluid or viscous condition, though not yet

FIG. 4.—The Great Nebula in Andromeda.

arrived at the present stage of our sun. The distance of the object is difficult to determine. Estimates have been made amounting to five times the distance of α Centauri, the nearest star to the Solar System, a distance that can only be measured by 650 light-years! Our luminary removed to such a remoteness would pale to the insignificance of an 11th-mag. star. Close by is another nebulous looking object commonly called the "Companion of the Great Nebula." It is, however, a star cluster which requires considerable power to resolve. μ Andromedæ (the lower of the two smaller stars marked on the planisphere) is worth a few minutes' scrutiny, as its tiny companion of 11 mag. affords another severe test of excellence both of eyesight and instrument. It really needs a powerful telescope to see it well. Not so, however, that exceedingly pretty and comparatively wide double γ Andromedæ (Fig. 5), a specimen almost as fine as ζ Ursa Majoris, with its beautiful gold and greenish-blue components. The colours of both stars are very intense. They really form a triple system, the primary itself being a close double, far beyond the separating power of our modest aperture.

Beneath Andromeda lies another straggling constellation, Pisces (The Fish), in which are several interesting doubles, all well within the range of an instrument of 2in. or 3in. Among them may be mentioned Nos. 35, 51, 55, and 65, all of which are marked on Klein's atlas. Special allusion may be made to ζ, a lovely double, easy to see with its components of 5 and 6 mag. Its position (R.A. 1h. 8m. N. Dec. 6° 56') is slightly to the east of ϵ Piscium.

Almost wedged in between Andromeda and Pisces is the lesser constellation Aries (The Ram), which gives its name to the first sign of the Zodiac, although, owing to the precession of the Equinoxes, this group no longer exactly corresponds with that sign, as it did in the time of Hipparchus when the sign was named. Not far below the smaller of the two principal stars

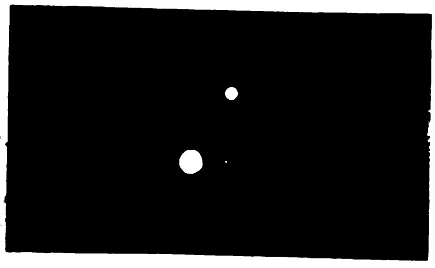


FIG. 5.—γ Andromedæ.

(shown in the planisphere, and by the aid of which they can be easily identified in the sky) lies γ Arietis (Fig. 6), an historical double, inasmuch as it was one of the first to be telescopically observed by Hooke in 1614, who remarked that "it consisted of two small stars very near together, a like instance of which I have not else met with in all the heaven." The smallest telescope, almost, will divide its two nearly equal components of 4·2 and 4·4 mag. Just above α and β Arietis may be found λ Arietis, another easily-divided double; but its companion, being only 8 mag., is not very prominent.

About the same distance still further north of α Arietis lies 14 Arietis, a triple star with a primary 5½ mag., and two tiny companions. It is well worthy of inspection, and will afford us a convenient example with which to close our investigations until next week. Probably, too, by the time the student has examined these three last constellations he will have had enough of astronomy for one night, if indeed he has not succeeded in completely dislocating his neck in his endeavours to look upwards through the, by now, almost vertical tube. He may, however, derive some small consolation from the knowledge that if uncomfortable to observe he has been seeing these objects in their best possible positions as far as clearness and good definition are concerned; for celestial bodies need to be placed on or near the meridian, high above the dense horizonal mists and sluggish atmospheric strata which lie close to the earth's surface, in order that the more delicate minutiæ of both planetary and stellar detail may be fully revealed. Obviously, if we are gazing directly overhead, we are looking through a lesser thickness of fog and smoke than if our vision were directed more obliquely to objects of a lower altitude.

One or two of the illustrations in the last article did not reproduce quite as expected—viz., the star cluster in Hercules, which came out too bright, and the "double-double" ϵ Lyræ, which should have been much reduced. The views this week have, however, been drawn exact size to

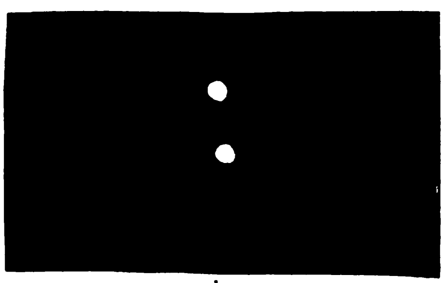


FIG. 6.—γ Arietis.

fixed scales, both of magnitude and distance, which will be adhered to as far as possible throughout these papers, although it will necessitate making the star discs of the higher magnitudes seem rather larger than they appear in the telescope, in order that pairs with very small companions may be portrayed in their correct relations.

The instrument in use is one of Messrs. Thos. Cooke and Son's superb photo-visual refractors of 4in. aperture, stopped down to 3in. Possessors of telescopes of ordinary quality must therefore not feel despondent should they not be able to readily see faint objects quite so clearly as they are drawn. Often, too, the indistinctness may be entirely due to unfavourable atmospheric conditions which frequently render the most perfect lenses almost useless.

SOME METEOROLOGICAL INSTRUMENTS AND THEIR USES.—XI.

AS seen in the measuring-glass of a rain-gauge, the amount of water derived from a moderately heavy shower seems very insignificant, and even one inch of rainfall does not bulk very largely. A fall of one inch does, however, in reality represent a very large amount of water, and the statement that such a fall over any given area means that roughly 100 tons weight of water has fallen on every acre, gives a slight notion of what this amount of precipitation really is. Over an area of the size of the Thames valley, a fall of one inch of rain means that 53,375,000,000gal. of water has been condensed out of the atmosphere, an amount which has to be drained into the main river by the rivulets and streams, and when such a quantity of water as this falls, say, within an hour, it is not surprising that destructive floods sometimes occur. In northern India 10in. of rain once fell in less than two days over an area of 10,000 square miles, the weight of water in this downpour being no less than 7,248,000,000 tons. On another occasion elsewhere 2·34in. of rain fell in thirty-seven minutes, and ·62in. in seven minutes, and where successive falls of rain such as these occur over large tracts of country, it will be gathered from the figures quoted above that the amount, although small in the measuring-glass, may readily be translated into millions of gallons and tons. Given, therefore, the area of the country over which any heavy rain has fallen, it is not difficult to work out how much water has passed into the watercourses and rivers, and to make an estimate as to the quantity of the rainfall available for the feeding and nourishment of the local springs and wells. In this connection, the easily-remembered jingle which says that a pint of water weighs a pound and a quarter will be of service; while, in making other calculations, the recollection of the fact that a cubic foot of water weighs 1,000oz. will have its uses. It has been proposed at various times that in order to prevent floods in the Thames Valley, reservoirs should be constructed to hold the rainwater, and since it is not unknown for 3in. of rain to fall in one day, it will be seen that such reservoirs would need to have a total capacity of 160,000,000,000 gallons. The cost of constructing such reservoirs as these has been estimated at £15,000,000. Now, of course, in these times of great national expenditure, such enormous works as these are not likely to be undertaken; but the figures at least serve to indicate how very great a quantity of water is represented by a tenth of an inch in the measuring glass of a rain-gauge.

Now, the contemplation of the enormous volumes of water represented by the foregoing figures raises the question as to where all the rain comes from, and the attention is soon led to the consideration of the causes which carry the moisture into the air and throw it down again. The prime agents in the production of rain are, of course, the sun, which provides the heat, the ocean, from which the moisture is evaporated, and the atmosphere, which acts as the condenser. From the atmosphere the moisture is condensed in a multitude of ways, and from the violent condensations which occur during some large cyclonic disturbance to the quieter depositions of moisture which happen during a heavy display of hoar-frost, there are plenty of different methods for consideration. It used to be said that rain was mainly produced as the result of two currents of air of different temperatures and of a different humidity coming into contact and mixing with one another, but although this action is in many circumstances responsible for much rain, it has given place to other theories. Dynamic cooling as the result of the expansion of vapour-laden air in an ascending current now finds most favour as a rain producer, and a consideration of the facts leads to the conclusion that meteorologists are right in adopting the newer standpoint. When a moist current of air flows against a range of mountains rain commonly follows, and, according to the old statement, this rain was owing to the fact that the air had been cooled by contact with the cold sides of the mountain; but the newer statement ascribes the rain to the fact of the current of air being thrown upward and reduced in temperature by expansion. The mountain range, therefore, gives the wind a vertical component, and the reduced pressure results in a dynamic cooling, as it is termed, and rain follows.

Cumulus clouds, which so much resemble huge bales of wool, are commonly said to be the tops or capitals of columns of hot, moist air, and when these clouds become surcharged with moisture or are overgrown, then rain falls from them. These clouds may, moreover, almost be said to spring into existence like a bursting rocket, for it is only when the rising stream of air reaches a certain level that the moisture in response to dynamic cooling bursts into cloud. The height at which the condensation takes place is indicated by the long base of the cloud, this level base with the rocky or turreted peaks of clouds above it being, as is well known, the distinctive feature of these cumulus clouds. Such ascending currents as these are called convection currents, and of all the forces which put volumes of vapour in a position to be cooled by expansion, they are perhaps the most important. There is not much difficulty in imagining how the moisture which is thus condensed grows to the size of a rain-drop, and increases in size until it is heavy enough to fall to the earth. In recent years there has been in meterology quite a boom, so to speak, in dust, and whenever condensation of moisture is thought of it is commonly considered that there must first be a tiny atom of dust for it to settle on. Were it not for these dusty nuclei, the atmosphere would be continually raining down moisture, and it is owing to their presence that the condensed vapour is able to float about in the air, and be transported from one place to another. When once moisture has condensed on one of these dusty nuclei a surface is formed on which further supplies of vapour may settle, and the drop gets, as it were, a start in life. But as moisture condenses on any surface, latent heat is of course set free, and some authorities say that this action has the effect of evaporating the very tiny particle of moisture which may be condensed, and the raindrop makes but small progress, or may even die as soon as it is born. All dust nuclei, however, are not alike, and many keep the moisture which settles on them, and sooner or later such favoured drops collide with their neighbours, and in this way increase in bulk and commence to fall. The drops also overtake one another like the bubbles in a bottle of soda-water or like the drops of moisture on a window-pane, and amalgamation goes on apace. Since, moreover, the drops of moisture are very cold, they readily collect more material from the ascending moist current of air through which they are falling, and they eventually reach the earth as a full-sized raindrop. In this connection it may be remarked that if an ordinary school-slate be ruled into a number of squares, some interesting observations may be made concerning the distribution and size of the raindrops which fall during a shower. Some idea of the distance the drops have fallen may be gathered from their size and the force with which they splash on the slate. The rain, then, which falls as the result of these ascending currents is sometimes called convective, and the term is used to indicate that there was but little horizontal movement in the air-currents by which the rain was produced. These convection currents rise from all parts of the earth, but they perhaps occur on the largest scale in the belt of calms at the Equator, and here it may often happen that the moisture which evaporates from any surface returns to the same spot as rain, since there is no horizontal movement of the air to carry the evaporated moisture away to other neighbourhoods.

The great carriers of evaporated moisture are, of course, the cyclones. Not only have these low-pressure systems strong convection currents, but they also have a great horizontal movement, and are indeed much wider than they are high. Rain which falls from these swirling vortices is termed cyclonic, and this forms a large class, and includes thunder showers, which are produced in a variety of ways, and such torrential rains also as occur during what is sometimes termed a "cloud burst." The rain which falls during the cyclones has commonly been evaporated in some distant locality, the rain which is discharged over the British Isles, for instance, from cyclones which come in from the Atlantic being an illustration

of this process. The dynamic cooling necessary for the production of rain is, in this case, the resultant of the two forces termed as above convective and cyclonic; and it is not at all times possible to say how the rain associated with such systems should be described. A similar condition of things occurs with some of the smaller cyclones; but whenever there is a marked horizontal component in the circulation of the wind, the rain which falls is properly termed cyclonic. Now, the enormous quantities of moisture condensed by some of these cyclones amounts, as already indicated, to many millions of gallons, and it follows that equally great quantities of latent heat are set free. This latent heat it is which keeps the cyclone going. Supposing, for instance, a cubic mile of air is at a temperature of 72°, and its dew-point is 61°, it will be necessary before rain can fall that heat be abstracted to an amount that would raise 88,000 tons of water from freezing point to boiling point.

To increase the condensation of rain, further abstractions of heat would be required, and supposing the temperature to be reduced another 10°, the result would be an insignificant shower of rain of only ·25in. in depth, or, roughly, 20,000 tons of water. Such a shower as this is of no importance compared with a fall of 3in., but it liberates sufficient heat to raise 100,000 tons of water from freezing-point to boiling-point, and serves to give the convection-currents in the storm new vigour, and sends the rising columns of air to higher and colder regions, where further moisture is squeezed from them by dynamic cooling.

As already mentioned, the currents of air gain an upward movement by impact with mountains and other inequalities on the surface of the earth, and they are thus thrown upwards and cooled by expansion. It has been suggested that rain which is thus produced should be termed orographic, and so common is this action that it will not be necessary to say very much about it. Such range of mountains as the Andes are very active in producing orographic rain, and it is well-known that winds which strike on one side of this range are thrown upwards, and all the moisture condensed out of them, so that they descend into the valleys on the opposite side of the range as cold, dry, devastating winds. In cases where the sides of the mountains are covered with foliage, there is doubtless considerable rain to be set down to the account of the reduction in temperature, which occurs when the moist warm current of air strikes them, and another factor is accordingly introduced into the problem. Broadly speaking, however, the three chief causes which give an upward component to the winds and so produce rain may be termed convective, cyclonic, and orographic.

A consideration of the many instances in which these three causes may be observed at work throws a little light on the question as to whether cultivation of the land and deforesting has had any effect in diminishing rainfall. Now when once rain has fallen on the ground it either percolates underground or is evaporated to the atmosphere, and it is upon the supplies of moisture gained by this latter process that the future rainfall depends. Cultivation of the ground may increase percolation and decrease evaporation, as is often the case when stiff clay soil is broken up, and if the rainfall of such a locality is produced by the convective methods referred to above, it is possible the local rainfall may be diminished. Further the sides of mountains are warmer when bare than when covered with trees, because absorption of sun heat is greater, and the removal of trees may have an effect on the rain condensed from the currents of air which flow against them. In any case the modification of the amount of rainfall is small, and, as a rule, too much weight is attached to the supposed effects of deforesting. It has been suggested that where the orographic conditions have been thus modified it sometimes happens that the result is to keep rain in a certain river basin that would otherwise have been carried to a distant locality. Moreover, cyclones move in the direction where moisture is most plentiful, and here again it is possible that cultivation of the soil may, by affecting evaporation, diminish or increase the amount of moisture in the air, and the usual course of local cyclonic disturbances may be altered, and in this way some change in cyclonic rain may occur. So many different things, however, cause the amount of rain to vary from year to year, that caution is required in ascribing any suspected change to any one cause.

MILLWRIGHT'S WORK.—XXIII.

At various times millwrights have to take dimensions of worn or broken wheels, and make new ones to gear with existing ones in position. There are a good many points of importance to be attended to in such work, as the following illustrations will indicate. The millwright has to take dimensions, draw out the new wheel, make, or superintend the necessary pattern work, and often to follow it through the foundry. Sometimes broken or worn wheels are brought into the shop; sometimes he has to go and take dimensions of wheels partly or entirely fractured, or of worn wheels still at work, or to take dimensions for entirely new wheels required to effect changes in direction of motion, or in rates of revolution. It is seldom safe to attempt to work from dimensions supplied by people who are not engineers. Often the diameter is given, and number of cogs, but without anything to indicate whether the diameter is at pitch circle, or outside the points of the teeth. Particulars are seldom given of dimensions and shapes of teeth, or of depth of boss, or minor details. So that it is generally safer to send a trustworthy man to take particulars of wheels that cannot be brought to the works.

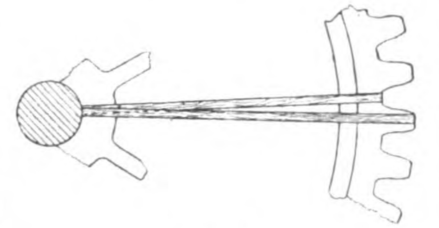


FIG. 145.

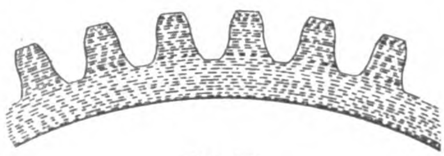


FIG. 146.

Since one doesn't always know exactly what has to be measured, it is generally best to take a plumb-bob or a plumb-rule, a lath or two, a bradawl, screwdriver, and half a dozen screws, a rule, and calipers. With these, any particulars can be taken of spurs or bevels.

If dimensions have to be taken of a spur-wheel in place, and a replace wheel made without any further reference to the worn one, no forethought should be lacking. A man looks very foolish when he comes back to shop, and finds that he has forgotton some particulars without which the wheel cannot be made. There are the major dimensions to be attended to first. Count the teeth, and count twice, chalking the one you start from. Take the diameters to the points of the teeth, and also to their roots. If the shaft is small these may be measured right across on a strip. If the shaft is of moderate or large diameter this cannot be done. Then measure, still with the strip from the shaft to the teeth points, and roots, Fig. 145. One end of the strip will be set against the shaft, and the radius of the latter added on to get the correct radius of the wheel. Or, hang two plumb-lines suspended by nuts, or anything heavy to hand, from the diameter of the wheel at the tooth-points, and measure and mark off the distance between them on the strip.

The shapes of the teeth from which to make the new wheel, or from which to get those of the new wheel in which the old one will have to gear, will be taken by means of a rubbing. That is, a sheet of white paper is taken, Fig. 146, long enough to cover about half-a-dozen teeth, and being laid against one face of the wheel, the fingers are rubbed hard against the paper, over the ends, and round the edges of the teeth. This leaves a good impression of the teeth forms on the paper, of which Fig. 146 gives an imitation. If a sharp outline cannot be obtained thus, in consequence of the tooth faces being very bad, then a wooden templet is fitted between a few teeth, Fig. 147. In either case, having the tooth forms, they are drawn out upon a board on returning to the shop, and the pitch circle and the tooth curves located therefrom.

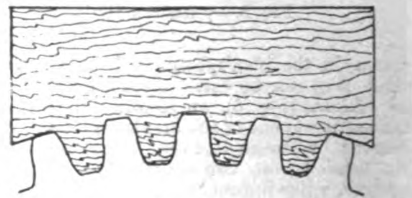


FIG. 147.

Measurements must now be taken of the boss and bore, the arms, and any other particulars needed. The shaft may be measured with calipers for the core prints, but for the boring of the wheel a gauge must be made, Fig. 148. A gauge should be also made for the keyway. Sketches of the arms must be made, and fully dimensioned. Fig. 148 shows a *facsimile* shop-hand sketch of a wheel, in which all necessary dimensions are inserted, and from which, with the rubbing in Fig. 146, a new wheel is made quite as well as from a highly-finished drawing.

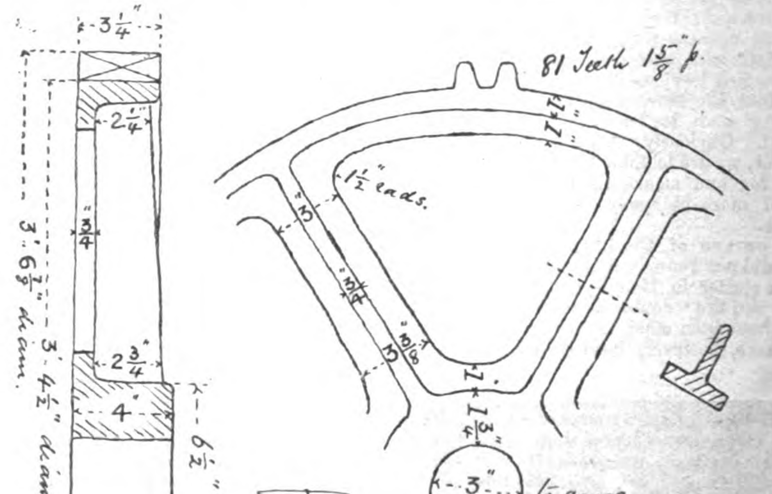


FIG. 148.

An awkward job sometimes is the taking dimensions from a broken wheel, when, as is sometimes the case, it has been utterly smashed

to pieces, and probably some of the pieces are not available. The only course open, then, is to see that all broken parts are brought closely together before attempting to take dimensions, assuming nothing, and checking everything. If, instead of making a new wheel to replace an old one, a new one has to be made to gear with one already existing, then the centres must be taken from the shaft on which the new wheel has to go to the teeth of the wheel with which it has to gear. These are best taken by measurement from the

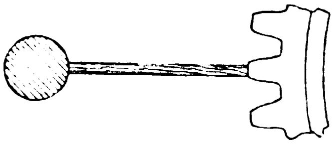


FIG. 149.

outside of the shaft to both root and point of the existing wheel, Fig. 149. Then, having the diameter of the shaft and a rubbing of the teeth of the wheel, the rest can be worked out in the shop.

If the teeth of a wheel are worn very badly, the proper shape for the new one can generally be obtained from the less worn side—one side, as a rule, being merely smoothed by wear, while the other is deeply indented. The thickness at the root is generally intact, while the thickness measured on pitch-line can be obtained from the pitch. If, however, the wheel is to gear with a mortise-wheel, it is well to measure the thickness of the teeth of the latter, for which, if worn, it will be desirable to make the iron teeth a little thicker than the rules give, to avoid backlash.

To get fairly good shapes of the teeth, centres

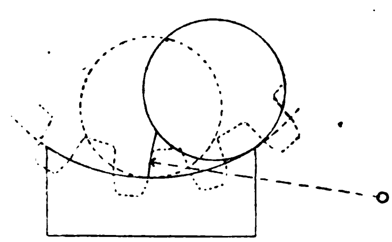


FIG. 150.

will have to be located from which to strike the curves. The teeth will certainly not be all alike, and so an average will have to be struck. It is always safer to give the fullest rounding off to the points which they seem to warrant, in order to avoid possible interference of these when engaging with the roots of the other wheel.

When a wheel has to be made with teeth to gear with an existing wheel, the rubbing, or the wooden templet (Figs. 146, 147), is used to obtain the correct curves from, before those for the new wheel can be determined. If a wooden templet is used, then the tooth-shapes can be scribed off to a drawing-board. If a paper rubbing is used, the tooth-shapes can be pricked through the board, or the paper itself can be glued or pinned on the board; then the centre of the wheel is

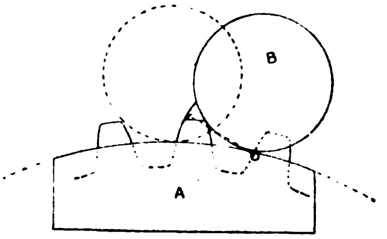


FIG. 151.

obtained, and the position of the pitch-line determined and struck, together with curves for the points and roots. Afterwards the sizes of the generating circles which have been used for points and roots must be discovered. This is done by cutting templets, one of which is shown in Fig. 150 at A to the curve of the pitch circle, and rolling generating circles of different diameters upon them until the one B, Fig. 150, is obtained, which traces the curve. This will often be found to be one having a diameter equal to that of the radius of a small pinion of the same pitch; but in many old wheels, the teeth of which were originally struck without much regard to system, curious results may be expected. When the circle is found, which, when rolled on the pitch diameter, will trace the curve of the tooth—say, above pitch-line, Fig. 150—that will then be used to strike the curves below pitch-line of the wheel to gear with it, Fig. 151.

It will not do to assume that the same circle will strike the curves also of the pinion teeth above pitch-line. It would, provided the original wheel had been struck out on a proper system; but this must be tested by making a sweep for Fig. 150, against which generating circles will have to be rolled to find the curves of the teeth below pitch-line, and then this circle will strike those of the teeth above pitch-line in the new wheel. The rest of the work is merely locating circles, as in Figs. 150-151, from which to strike the curves so determined in a manner which is well understood. J. H.

THE DRIVING OF ELECTRIC GENERATORS.

EVER since the introduction of the dynamo-electric generator into commercial service the question of the best method of driving it has been a subject of discussion, and at the present time the subject of the power portion of an electric plant really constitutes the most important section of the work.

The question of the choice of motive power, and the best methods of application, form the subject of a paper by Herr Robert Friese, published in the *Zeitschrift des Vereines deutscher Ingenieure*, and presented before the recent convention of that society at Nürnberg.

After referring briefly to the electrical magnitudes of voltage and ampèrage, as related to the mechanical elements of force and distance, and showing how the equations giving the relations of electricity generated to power required may be derived, Herr Friese proceeds to consider the various methods of connecting the generator to the source of motive power by which it is driven. The development of the direct-connected generating set is discussed, and the important influence which this development has exerted upon steam-engine design is shown to have been for the improvement of both generator and engine. With the earlier dynamos the high rotative speed required demanded quick-running engines, and although some very excellent machines of this type have been made, such as the Westinghouse engine in America, and the Willans in England, yet it is generally conceded that the best economy is attained by larger engines operating at moderate rotative speeds. The improvements made in large alternating and polyphase generators render it possible to use such engines in direct connection with the generators, and this type, with vertical engines and large armatures built directly upon the engine-shafts, is the prevailing form now used in large electrical stations where steam is the motive power.

The question of speed regulation has naturally been given much consideration in connection with the subject of driving electric generators, and Herr Friese has some interesting remarks to offer in that connection. While the centrifugal governor maintains its supremacy, in spite of its inherent defects, the demands of electric service have resulted in various improvements in the matter of speed regulation. The natural auxiliary of a governor is a flywheel, and in one form or another the inertia of a revolving mass is generally relied on to assist in the maintenance of uniform speed. The usual method of expressing irregularity in speed is that of a percentage variation from the normal, it being stated that the speed shall not vary, for example, more than 2 per cent. above or below the standard; but this method does not give a clear idea of the conditions, because it fails to take into account either the duration of the regulating operation or the number of variations from the normal which may occur during that time. The fluctuations of electric lamps, however, make both the extent and duration of speed variations visible. Herr Friese calls attention to the difference in sensitiveness of people in different walks of life to variations in brilliancy of electric lamps, and shows that fluctuations almost unbearable to persons of culture were hardly perceptible to the peasant labourer, so that the personal equation must be considered in this connection, as well as the service to which the light is to be put. As a matter of fact, the degree of variation in speed is not a constant factor, as some treatments consider it, but is a resultant of varying influences in every portion of the combined machines. All that can be expected is the restriction of the variations within certain predetermined limits, and this should be effected not only by regulating the impelling power after the variations have occurred, but by so combining the parts that the variations may neutralise each other as nearly as possible, and at as early a point as possible after their inception.

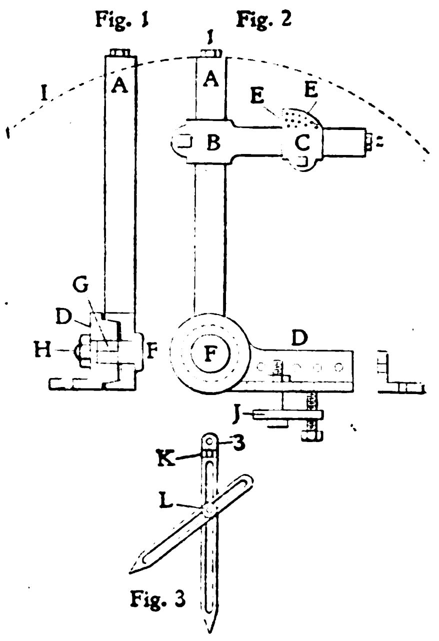
As an example of what can be done in this direction, the subject of the connection of electric generators in parallel is discussed, and the equalising effects of two generators is illustrated by comparison with that of two engines geared in parallel with a certain degree of elasticity in the connections. The use of accumulator batteries for the purpose of equalising variations in the load is also considered, and the analogy of such batteries to flywheels is clearly shown.

The probable use of gas-engines for the driving of electric generators is considered, and although the single-cylinder four-cycle engine is considered unfit for this service, Herr Friese maintains that with two or more cylinders, and with proper arrangements for the equalisation of the load, there is no reason why the internal combustion motor, with its superior economy, may not come into general use as a motor for dynamo-electric machines.—*Engineering Magazine.*

A NEW "OLD MAN."

THE following description of the workshop appliance known as an "old man" may be useful, or at least suggestive, to many readers. It is by Mr. W. de Sanno, of Kern City, California, and is published in *Locomotive Engineering*, N.Y.

As far back, he says, as he can remember (and it

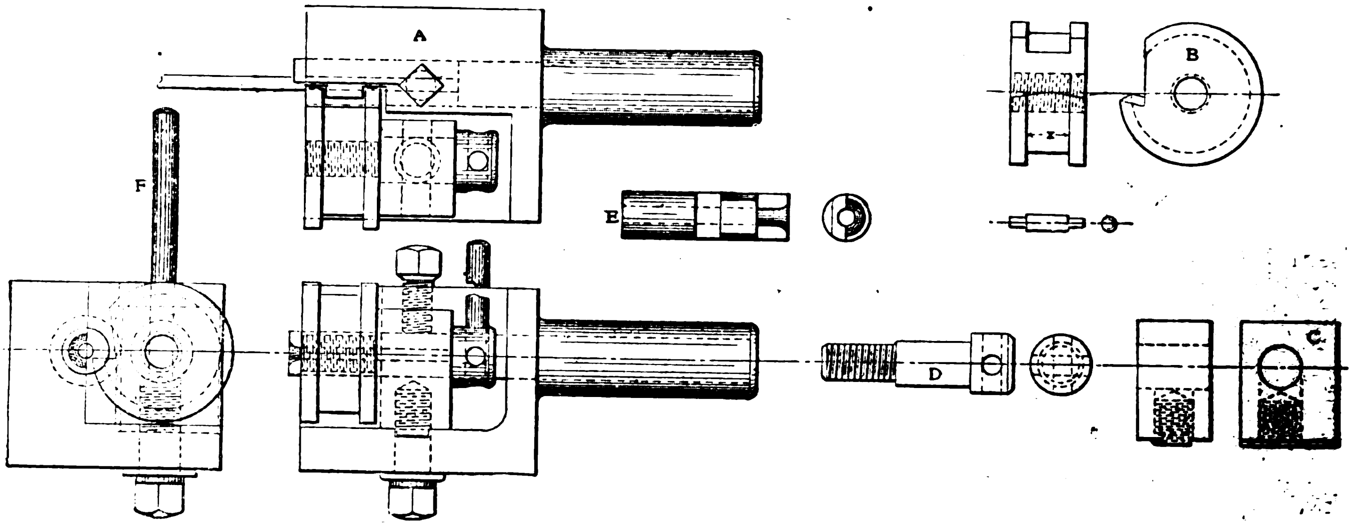


is a long way back) the tool known as "old man," used in ratchet drilling, was of the same shape as it is to-day. Having been put to my wits' end many a time for something to support my ratchet, the appliances in general use not being suitable for the job, an "old man" of the design shown suggested itself to me. A A, Figs. 1 and 2, is the post, B the arm, and C a hardened piece that will pinch on post or arm, as the case requires. The spots shown on the side of C are permanent centres for the feed-screw of the ratchet. The curved and straight faces E E also have the permanent centres. The idea of the piece C is that there is no position for the ratchet that one of these centres cannot be used for, thereby obviating the necessity of putting centres in the post or arm.

You will notice the lower end of the post A has a boss, bored out taper. The angle foot D also has a boss, fitting into boss on post A, making a male and female fit. The taper is of such a degree as will make a tight fit when drawn together by the bolt F; and the fit is not supposed to move when any reasonable pressure is exerted by the ratchet. The hole through the boss on the angle-foot D is square, and the end of the bolt F made square to fit. This prevents the post moving and slackening the nut H. So far as the angle-foot D is concerned, the post A has a full sweep of a complete circle.

J is a clamp to be used when required. Fig. 3 shows an adjustable brace to be used when required. The brace is secured to the post or arm by the bolts 1 and 2 passing through the hole 3. At K is a hinge joint to allow the brace to adjust itself. At L is a pinching bolt to hold cross-brace in position.

I don't know why good malleable iron would not do for this tool by coring the post and arm and doing just as little machine work as possible to save the outside skin. Perhaps steel castings would be better. It is not patented.



BOX TOOL FOR PIVOTS.*

THE accompanying drawings illustrate a box tool for making clock pivots, corner posts, or anything of that class in which accuracy between shoulders is required.

A is the body of the tool, with shank to fit turret; B is a circular tool recessed at x to a width corresponding to distance required between shoulders. B is pivoted in block C by bolt D, which has left-hand thread and holes at right angles in head to receive pin F. Block C has cross adjustment to regulate diameter of pinion ends. E is a bushing to support stock while being cut, and is cut away as shown, to clear B.

To operate, the tool is brought forward to the stop with the right hand, as is usual in screw machine work, and cutting-edge of tool B is forced against the stock by pressure of left hand on pin F, which is continued until the cutter swings by. It is then turned back to clear the stock, and withdrawn from the work, which is then ready for cutting-off tool.

The diameter of the pinion ends will vary if the stock is not of a uniform diameter, but this may be avoided by selecting the stock with a micrometer. The distance between shoulders cannot vary, and removing the tool and grinding it does not necessitate readjusting. The stock, running in the bushing, while being cut, prevents burrs forming on the corner of the shoulders, and the body and ends must be concentric, which is important on some work.

With this method, if the stock is not round the pinion ends will be out of round also, but as cold-drawn stocks run within one-half a thousandth, the error will be within reasonable limits.

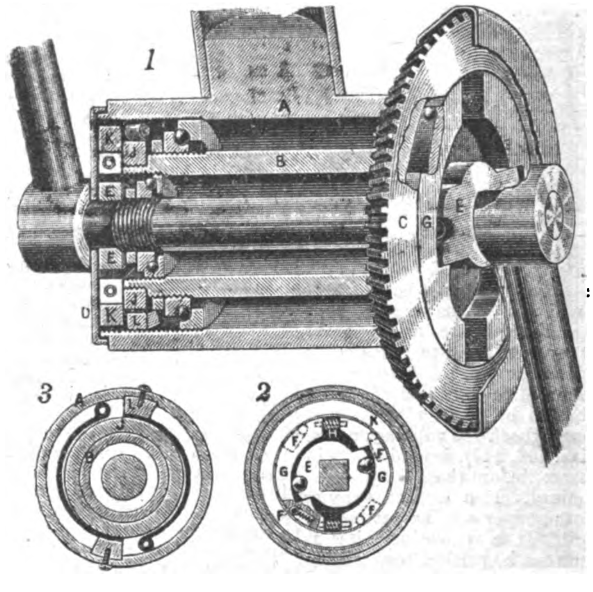
* By A. J. STRONG, in *American Machinist*.

BACK-PEDALLING BRAKE FOR CYCLES.

THE following description of a back-pedalling brake, which, according to the *Scientific American*, presents many novel features in its construction, has been invented by Edgar S. Stem and Arthur O. Dunlap, of Alderson, Penn. Fig. 1 is a general view of the device; Figs. 2 and 3 are cross-sections.

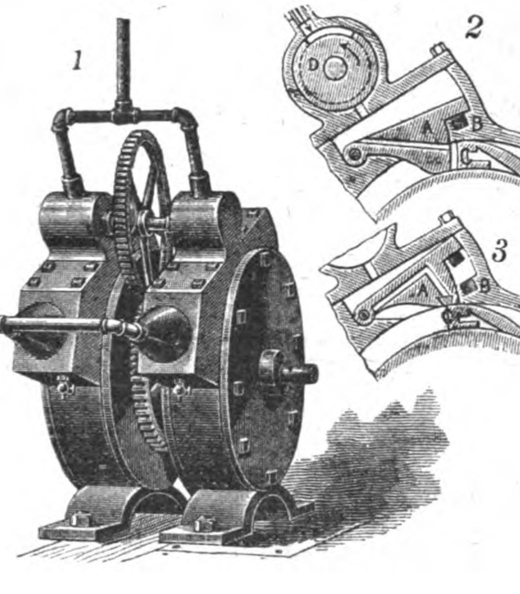
The braking mechanism is applicable both to chain and chainless wheels, and is contained in the crank-hanger. On suitable bearings, a sleeve, B, is carried, forming the trunnion for the driving-gear wheel C. The pedal-shaft turns on bearings within the shaft B. At one end the crank-hanger is provided with a case for the gear wheel; at the other end with a cap, D. Near the cap end of the pedal shaft a cross-arm, E, Fig. 2, is fastened, forming a clutch member, having eccentric edges terminating in shoulders, adapted to engage corresponding shoulders on shoes, G, likewise provided with eccentric edges. Recesses in the cross-arms E contain balls for rollers designed to engage the edges of the shoes G. A ring, K, is loosely fitted within the crank-hanger, and a cam encircles the clutch member E, and is held in place by the cap D. When the shaft forces the shoulders of the cross-arm E into engagement with the shoulders of the shoes G, the shoes are turned loosely within the ring K and around with the shaft and clutch member E. But when the shaft turns in the opposite direction, the rollers or balls are forced against the eccentric inner edges of the shoes, thus locking the shoes and ring together. Rigidly secured to the left end of the sleeve B is a collar, J, Fig. 3, against which act two brake-straps, each fastened at one end of the crank-hanger by a dovetailed connection, L. The other ends of the straps are connected with the ring K by pins. When the ring is idle, the brake-straps are loose; but when the ring is locked with the shoes G, and therefore turned with the shaft, the straps will be drawn tightly against the collar J.

At the gear end of the crank-hanger a somewhat similar clutch mechanism is provided. Here we also have a shouldered cross-arm, E, the balls of which are caused to impinge against brake shoes, G, held movably together as in the first case. There is, however, no loose ring. When the shoulders of the clutch E and of the shoes G are in engagement with each other, the clutch member, E, the shoes, and the shaft turn together. When the clutch member E is turned in the opposite direction, the rollers on the clutch member bind against the eccentric edges of the shoes, and lock the gear and shoes together, so that the gear is caused to turn with the shaft. When the shaft is driven forwardly by the pedals, the clutch member E on the gear end will be caused to turn with the shaft, in the manner just described. When it is desired to coast, the pedals are held stationary, and the parts are free to run. In order to stop the machine, back pressure is applied to the pedals, so that the clutch E on the left end will throw the shoes G out against the ring K, thereby causing the ring to turn, contracting the brake-straps against the collar J, and stopping the motion of the sleeve B, and therefore of the gear C.



MUSICAL PITCH.

AT a meeting of the Musicians' Conference last week, the chairman, Mr. W. H. Cummings, principal of the Guildhall School of Music, delivered an address on "Musical Pitch," and in the course of that observed that the past history of musical pitch was somewhat remarkab'e. There was a prevalent idea that centuries since the standard pitch was very low, and that it had been steadily rising until it had strained voices and strings almost to breaking point. This was a fallacy that could be shown by reference to a few well-established facts. Pitch had been lowered to suit modern necessity. In Handel's time there were two pitches—Church and Concert—and the former was a whole tone higher than the latter. Those who were familiar with Purcell's music would readily recognise the evidence it gave of two distinct pitches. Comparisons of Church and chamber music of the 16th and 17th centuries afforded similar conclusions. On the Continent there were formerly also two pitches. But now there was practically one pitch there, which approximated very closely to that known as the "diapason normal." As a result of the action taken by himself and others, the pitch known as the Philharmonic Concert Pitch was adopted and generally warmly approved. By the universal adoption of this pitch many works which were distressful from the strain put on voices would become comparatively easy. Moreover, singers who travelled to foreign countries would not be confused by differences of pitch, and the same might be said of violin players. It would also facilitate the time when children would be able to sing without the Sol-fa figures or any other crutch for musical cripples. Speaking, as he did, to practical musicians, he need not say more of the great advantage which would accrue from one universal pitch, and he was sure they would be glad to witness its adoption in the future. One of the difficulties which presented itself was the attitude of some of the British pianoforte manufacturers, who appeared to think they were the arbitrators in a matter which, he took it, scarcely came within their prerogative. Surely, if they, as performers and practical musicians, were of opinion that a lower standard of pitch was desirable, that ought to suffice and settle the question. If British makers would not supply the needs, then musicians would be driven to obtain the instruments they required from foreign sources.—Prof. Prout said he was a most hearty supporter of the proposed lower pitch.—Mr. T. Westlake Morgan (Bangor) had found, during the past three years, since the change in the pitch of the organ at the cathedral, that the choir singing had lost the element of brilliancy which it before possessed. He did not say the lowering of the pitch had been a mistake. Time would show, but it was the opinion of people attending the church that the singing was now not so good.



Sir Frederick Bridge observed that the alteration of pitch would, in some instances, involve much cost. That was one of the difficulties. To alter the pitch of the great organ at the Albert Hall would cost something tremendous. The pitch of that organ was the highest he had ever met with. The change to low pitch had been attended with some curious experiences. In the case of Birmingham it had, at first, most curious results. An oratorio performance could not be given in the low pitch, for the pitch of the instruments was not suitable, so poor unfortunate Mr. Perkins, the organist, had to transpose the whole by half a note to suit the instruments. The result was that the performance was given in a key half a note higher than before. It was the same all over the country, and instruments had to be obtained to suit the lower pitch. It seemed to him, however, that there was such a body of expert opinion in favour of lowering the pitch that by doing so they could not go far wrong. Mr. Frederick H. Cowen said that at first he was rather against the lowering of the pitch. He had a sort of idea that it would interfere with the brilliancy of a performance, but he had been fast coming round during the last two or three years to the idea that it would be better all round if they had the low pitch adopted in this country. He hoped some resolution would be taken, and some movement made by which the pitch could be lowered universally throughout the whole of the country, and the sooner they did that the better.

Upon the motion of Sir F. Bridge, seconded by Mr. Gardner (London), it was unanimously resolved "That it be a recommendation to the general council that they consider the question and take such action as they deem desirable."

THE BIGGEST FAST STEAMER IN THE WORLD.

WHAT the German claims to be the largest fast steamer in the world, the *Deutschland*, will shortly be launched by the Emperor from the Vulcan Yard at Stettin. The *Deutschland* has been constructed to the order of the Hamburg-American line, and will run between Hamburg and New York. She has a length of 208·5 mètres, a breadth of 20·42, and a depth of 13·41. Her displacement fully laden is 23,200 tons and her register tonnage is 16,200. The ship exceeds the *Kaiser Wilhelm der Grosse*, built by the same firm in 1897, by 11 mètres in length, and by 0·3 mètres in breadth and depth. Her displacement is about 2,500 tons and her register tonnage about 2,000 tons greater. Schooner rigged, the *Deutschland* is built in numerous water-tight compartments, and her pumps will enable 4,000 tons of water an hour to be taken out of her, should the necessity arise. She is of steel, will accommodate 467 first-class passengers, 300 second-class, and 290 third-class, while her crew will number 525. She will be lighted electrically by 2,000 lamps, and will carry 20 boats. Her indicated horse-power is 33,000. The *Deutschland*, which would have been launched on the 3rd intant but for the ice, will certainly be one of the monarchs of the ocean.

THE average daily advance of the Simplon Tunnel is about 30ft.; but the contractors will have to average 42ft. to 46ft. per day, in order to meet their engagements. About 2,600 men are at work, and twelve drills. The calculated length between the two heads of the tunnel is 12¼ miles.

JAMES'S ROTARY ENGINE.

AN ingenious rotary engine, in which the steam is used expansively, has been patented by William F. James, of Phœnix, Arizona Territory, says the *Scientific American*. Fig. 1 of the accompanying illustrations is a perspective view of a compound engine; Fig. 2 is a cross-section, showing the cut-off valve and abutment; Fig. 3 is a detail section, showing the valve in a different position. The cylinder casing is provided with two recesses, one of which serves as an exhaust-chest and the other of which receives the abutment. The piston, upon which the abutment bears, consists of a block, C, secured to the outer surface of the piston disc, so as partly to close the steam space. Secured to the block C is an inclined plate resting on the piston disc. By placing packing-plates between the inclined plate and the block C, the depth of the piston in a radial direction may be regulated. The abutment A is hinged to the outer casing so as to swing up or down, in obedience to the action of the rotating piston. The abutment is provided with an extension engaging the wall of the recess; the swinging movement of the abutment is therefore limited. By this means the disc is relieved of the pressure of the abutment without destroying the steam-tight contact. A steam-port extends through the abutment, and opens at the swinging end, so as barely to clear the wall of the steam-chamber. When the abutment is in the position shown in Fig. 2, steam is admitted through ports in the abutment recess. To avoid the jar due to the seating of the abutment upon the disc, a dash-pot is employed, entering a hole, B, in the casing. In order to work the steam expansively, a rotary cut-off valve is employed, which is geared with the piston-shaft. The gears are of such diameter that the valve and shaft rotate synchronously. By providing the engine with two or more cylinders, the pistons are placed opposite each other, so that there are no dead centres.

PICRO-CARMINE AND ALUM-CARMINE AS COUNTER STAINS.*

THE excellence of picro-carmine was first noticed in staining developing bone which had been decalcified. Picro-fuchsin was being regularly used as a counter stain with hematoxylin. Merely for the experiment picro-carmine was used on one section and left nearly two hours. Much to our surprise and, pleasure we found that, instead of our section being ruined, we had secured an excellent differentiation. This was not the first attempt with picro-carmine, but always before the time had been short, from two to fifteen minutes. The advantage of the stain over picro-fuchsin is noticeable in the superiority of differentiation secured.

The embryonal cartilage cells are better marked by the hematoxylin and picro-carmine, for the alkaline picro-carmine does not fade the hematoxylin as does the acid picro-fuchsin. It is particularly in the zone of calcifying cartilage that this superior differentiation is noticed. The vertically-arranged rows of cartilage cells have lost their horizontal septa, but the vertical septa are pronounced and project into the primary narrow cavity as irregular trabeculæ of calcified cartilage. The osteoblasts have enveloped these trabeculæ with a covering of true bone, and at the same time the cartilaginous trabeculæ within are being absorbed, and true bone substituted.

This true bone, with the picro-carmine, has taken a red which is brilliant in comparison with picro-fuchsin; and the gradually diminishing and disappearing cartilage which, with picro-fuchsin, has taken a stain not distinguishable from that of the cells of the true bone is, with picro-carmine, beautifully differentiated by a clear pronounced blue, showing the alkalinity of the picro-carmine. This tendency on the part of picro-carmine to bring out the hematoxylin as a blue, while the acid picro-fuchsin fades it, is very noticeable in the tonsil of dog which was next submitted. In the mucous cells near this gland the nuclei, removed as far as possible from the lumen, are brought out with unequalled clearness. The structure of the blood-vessels is also brought out with great distinctness, and the differentiation throughout is very marked.

Quite as striking a contrast between picro-carmine and picro-fuchsin is noticed in a section of the pyloric stomach of a kitten. The stain with picro-carmine is not only more differential, but the unstriped muscle of the stomach and blood-vessels is brought out much better by the picro-carmine. During the summer picro-carmine was tried with good results on sections of the Fallopian tube of a mare. It has been used with greatest success on tissues which present a mucous surface, and while these successes have been noted, an equal number of failures were encountered, so no claim is made for picro-carmine as a "pan" stain. It seems particularly unsuited for tissues that stain with difficulty. Ranvier's picro-carmine was used in most of these experiments, but Bizzozero's was used with equal success. Mayer's recent formula was used in the histological laboratory at Cornell last year, with results quite as good as those from Ranvier's.

In the summary, then, we find picro-carmine, in the cases noted, gives, with hematoxylin, a more differential stain than picro-fuchsin, and shows the characteristic alkaline reaction with hematoxylin, bringing out the hematoxylin as a beautiful sharp blue, while the acid picro-fuchsin tends to fade it. Two hours is, in general, the best time for picro-carmine. There is no danger of overstaining. Stohr, in his textbook of "Histology," directs that developing bone be stained with hematoxylin and then with picro-carmine.

Alum-Carmine.

During the summer it was my privilege to prepare some slides of liver of guinea-pig to show Anthrax bacilli. I attempted to get a contrast stain, and finally succeeded with alum-carmine. I had tried picro-carmine without success, and had never been able to secure a good stain with picro-carmine on liver. One hour and fifty minutes with alum-carmine gave the best results. The crystal-violet with which the bacilli were stained, and which is washed out much or entirely by the alcohols and clearer, must be sufficiently intense to permit of thorough dehydration and clearing and yet leave a distinct stain. One minute and a half will suffice if care is taken not to leave longer than is necessary in alcohol. By this stain the nuclei and the cell-body are clearly differentiated, and the alum-carmine forms a very good contrast stain with the crystal-violet. The simplicity of the method commends it. With methylene blue a still greater constrast may be secured.

* By B. D. MYERS, in the *American Monthly Microscopical Journal*.

CARBON LANTERN SLIDES.

IT is generally conceded that the acme of perfection in slide-making is reached either by the Woodburytype or carbon processes; the former is, as a rule, quite beyond the amateur, and the latter is not very much used, as the preparation of a slide by means of the gelatine lantern plate is so simple. The beauty of the carbon slide lies, as a rule, in the exquisite transparency of the shadows and the perfect rendering of all the tones in the negative, and the general absence of anything like grain, as the pigment in special transparency tissue looks more like a stain than a solid.

For absence of grain there is no doubt that the gelatino-chloride printing-out plate ranks next to them, and then the gelatino-chloride developing plate. It is possible, however, to obtain slides in almost any colour by what is certainly a carbon process, and a modification which has the advantage of requiring no tissue, but in which the ordinary gelatino-chloride printing-out paper can be used.

It is immaterial whether the paper has become yellow through age or whether it is a spoilt print, though in the latter case the printing is a little more difficult.

Allow the paper to darken to a deep rich colour by exposure to daylight, but in no case must it be allowed to bronze; it should then be immersed for two minutes in a 5 per cent. solution of common salt, then a 4 per cent. solution of bichromate of potash and dry it, preferably by squeegeeing it to a piece of waxed plate glass and allow it to dry in the dark. When thoroughly dry, it can be exposed under the negative, allowed to soak in water till limp, and then squeegeed to a lantern plate from which the silver image has been removed by means

of potassium cyanide well washed, and then treated with a 10 per cent. solution of formalin and rinsed. The exposed paper may be squeegeed to a plain piece of glass without any gelatine, but it requires extremely careful handling.

When squeegeed down, it should be left for at least half an hour and then developed in warm water exactly as an ordinary carbon print, only that the paper should not be pulled off, but merely allowed to float off.

When the image is quite developed, it may be dipped into alum solution or weak formalin, washed, and then toned with any gold bath or platinum, or intensified by any of the ordinary methods as used for negatives. Exquisite results are obtained by merely immersing in a 10 per cent. solution of silver nitrate, blotting off superfluous moisture, exposing thoroughly to daylight, and then toning in a combined bath.—A. D. PRETZL, in *British Journal of Photography*.

USEFUL AND SCIENTIFIC NOTES.

THE native countries of the tallest and shortest people of Europe, the Norwegians and the Lapa, adjoin each other.

FOR several years attempts have been made at Omaha and Los Angeles to hatch the egg of the ostrich artificially, but so far these attempts have been unsuccessful, the difficulty being the application of moisture. Now, however, an ostrich farm in Florida can boast of the first incubator-hatched ostrich in the United States. The incubator required 41 days of careful watching; the thermometer was kept at 110°, and the moisture was applied at intervals.

On the Wing at 8,000ft. Altitude.—The Rev. J. M. Bacon, in *Knowledge* for January, describes his balloon ascent in November last in quest of the Leonids, and mentions, incidentally, some facts of peculiar interest. He says:—"The trivial incident of our having suddenly found a big blue fly buzzing noisily about us, when hanging at a height of 8,000ft., would have passed without serious notice but for certain correspondence which has since arisen. Mr. F. T. Wethered, of the Alpine Club, writes to say that he has seen a butterfly scudding across the summit of the Grandes Jorasses at a height of 13,799ft., and sees no reason why the fly should not have been on the wing, and not taken up in the car, as we had supposed. M. C. Flammarion tells of white butterflies fluttering round his balloon at 3,280ft., though in the same voyage he remarks on the silence of bird and insect life at sunrise. My own experience has always been that winged creatures of every kind have been left behind long before the first thousand feet were reached. The height at which the swift is flying is surmounted with the first leap into space, and even when sailing at the lowest levels compatible with safety the skylark is neither seen nor heard. Very possibly, however, all creatures of the air take alarm at a balloon, and naturally give it a wide berth."

The Danger of Flash-Lights.—Notwithstanding the number of serious accidents that have been chronicled, and the cautions given as to the dangerous character of most of the flashlight compositions, mishaps are continually occurring. We read of one that recently happened in a studio at St. Louis, which may serve as a warning to those who compound their own flashlight powders here. Briefly, the facts are these:—An operator was using the blade of a knife to mix a quantity of Blitz powder and magnesium together, when the compound ignited, with the result that the man was terribly burnt about the face, hands, and arms, and had to be removed on an ambulance to the City Infirmary, where his condition was found to be serious. It was also stated that some of the white-hot flame had been inhaled by him, which, of course, added greatly to the gravity of the case. We have on several previous occasions warned those who make flashlight powder, containing chlorate of potash and the like, as to the way that the compounds should be mixed. They should be dried and pulverised separately, then mixed in small quantities at a time, as required for use, on a sheet of paper, using a strip of stout paper or thin cardboard for the purpose. Had this method been adopted in the St. Louis studio, the accident would not have happened. There the operator used the blade of a knife for the purpose, probably because it was more convenient. Here is one more caution we would give:—When mixing the ingredients in ever such small quantities, do it at arm's length, because then, if the mixture does ignite, the operator's face will not be injured by the flame, as in the case just cited, for most of these compounds are liable at times to "play tricks," and go off when least expected. Our object in specially calling attention to this accident is to once more impress the necessity of extreme caution upon those of our readers who may not know the dangerous nature of the material they are dealing with when they compound their own flashlight powders.—*British Journal of Photography*.

SCIENTIFIC NEWS.

IT is announced that the Paris Observatory will adopt the plan of time-reckoning from midnight to midnight, which has been adopted by the *Nautical Almanac* for many years.

The editors of the *Observatory* magazine ask us to state that, owing to the change in the system of time-reckoning in the *Annuaire* of the Bureau des Longitudes, the variable star Ephemerides in the *Companion* for 1900 are given in Greenwich civil time, the day being considered as beginning at midnight.

An ephemeris of the minor planet Eros is given by Signor Millosevich, of Rome, in *Astronomische Nachrichten* 3609. The period of the planet is 643·14d.

The prizes offered by the Paris Academy of Sciences for 1900 are—the Lalande (540 francs) for the most interesting observations or for work most useful to the progress of astronomy; the Damoiseau prize (1,500fr.) for a memoir on the theory of one of the periodic comets of which several returns have been observed; the Valz prize, for the most interesting astronomical observation made during the year; the Janssen prize (gold medal) for the most important discovery in physical astronomy; and an "anonymous" prize of 1,500fr. for the encouragement of calculators of minor planets, especially those planets discovered from the Nice observatory.

Holmes's comet is calculated to have a position on Jan. 20, G.M.T., of R.A. 2h. 23m. 17s., N. Dec. 40° 17' 38·4", but it is probably so faint that it can be observed only with the most powerful instruments. Even with the Lick telescope it appears to have been only glimpsed in August and September last.

In *Knowledge* for this month Mr. E. Walter Maunder, F.R.A.S., commences a series of articles on "Astronomy without a Telescope," and Mr. A. Fowler, F.R.A.S., has an article on "The Constituents of the Sun," with illustrations of spectrum analysis.

Prof. A. S. Herschel, writing from Slough on Jan. 3, says there was an unusually fine shower of the Quadrantid shooting-stars through nearly all last night, which the clear sky here gave me a very favourable opportunity to observe continuously, from 11h. p.m. until 4½h. a.m. this morning. The meteors fell all the while at a rate of about twenty-five per hour, and consisted mainly of first and second magnitude shooting-stars. But at 2h. 58m. one must have been of three or four times the brightness of the planet Venus, for it cast a glare on my notebook which made me look up overhead, and enabled me to see the long and broad bright tapered light-streak there, which remained, on the path which it had traversed, persistently visible for about ten seconds. Another meteor of the shower at 4h. 17m. was also quite as bright as Venus, and left a sensibly curved long wide yellow streak of light for six seconds along its track. About three minutes after its disappearance, two second magnitude Quadrantids ran a race side by side across the head stars of the Great Bear, about 5° apart, keeping nearly abreast of each other for some 20°: while at 2h. 22m. a meteor as bright as Vega Lyræ disappeared, after a course of about 20°, for about 5° or 6°, and then reappeared almost immediately, and described a further course of about 12°; unless the latter part of the visible bright course was perhaps also a second independent meteor. Eighty meteor-paths were mapped and fifty more were counted, making 130 Quadrantid and other meteors seen in a five-and-a-half hours' watch. Of this number about four-fifths appear to have been Quadrantids, with a rather scattered region of radiation round the usual centre of the shower in Quadrans Muralis. But the mapped paths have not yet all been projected to determine their radiant focus, if it was a well-defined one, with exactness. Only one of the brightest, besides the two already-mentioned large ones, left a faint enduring light streak, and the heads were also seldom tailed with sparks, and presented only long-flighted, bright yellow, starlike points of light. The exact date and hour of this shower's annual return has not been well observed for many years, owing generally to cloudiness of the nights and mornings of Jan. 1 and 2; but also owing to scantiness of its displays, which in any clear hours of those nights have not for a long time been very brightly recorded. The exceptional richness of the shower last night in brightness and numbers of its meteors at least marks its time of greatest intensity this year with unusual certainty, if it does not perhaps also indicate that the shower's return this year was one of the earth's encounters with a quite exceptionally dense portion of this somewhat overlooked and but little watched for and investigated meteor-cluster.

The death is announced of Mr. Henry Tracey Coxwell, who was born at Wouldham, near Rochester, in 1819, and was well known (by name at least) to balloonists all over the world. In early life he took much interest in the subject of balloons, and in 1848 commenced his work as a professional, making several ascents from the Continent, and in 1859 from the Crystal Palace. In later years, when the British Association took up the observation of meteorological conditions at high altitudes, Mr. Coxwell, with Mr. Glaisher, F.R.S., as the scientific expert, made several ascents, and the memorable one of Sept. 5, 1862, when a height of seven miles above the earth was reached. Mr. Coxwell urged upon the authorities the value of balloons in war long before they were adopted.

Mr. Richard Boyse Osborne, who was born in Wexford in 1815, migrating to the United States in early years, died recently near Philadelphia. He became one of the most sucessful civil engineers in America, and was at one time the chief engineer of the Philadelphia and Reading Railroad. He returned to Ireland, and took charge of the construction of the Waterford and Limerick line, and then, going back to America, he did much valuable engineering work, and planned and laid out Atlantic City. Mr. Osborne was the originator of the well-known "Lyons' Tables," which are extensively used by civil engineers.

Prof. Elliott Coues, the eminent American naturalist, died at Baltimore, Maryland, on Christmas Day. He was born in 1842, and entered the medical department of the United States Army. He saw many years' service in various parts of the country until his retirement by resignation in 1881. Wherever he went the scientific tendency inherited from his father was stronger than the purely professional one. His "Key to North American Birds" (1872) and his "Field Ornithology" (1874) had already given him recognition, so that he was made secretary and naturalist to the United States Geological and Geographical Survey, under the direction of the late Dr. F. V. Hayden. He edited the publications of this bureau from 1876 to 1880, conducted zoological expeditions in the West, and published his "Birds of the North-West," "Fur-Bearing Animals," and "Birds of the Colorado Valley." After his retirement from the army he took the professorship of anatomy in the National Medical College in Washington, and did hard work in it as a lecturer during the succeeding ten years. Dr. Coues was interested in the phenomena of spiritualism, and at one time was a theosophist, and, although he lost interest in this during recent years, he never ceased to maintain the inadequacy of science to deal with the intricate problems of life. In 1884, while visiting England, he became a member of the Psychical Society, and after his return was engaged for several years as one of the experts on the Century Dictionary, with complete charge of the departments of biology, zoology, and comparative anatomy.

M. Emile Weyl, whose death is announced from Paris, was a well-known writer upon naval subjects, who for many years, up to the volume of 1898, contributed the chapter on foreign navies to the "Naval Annual." His acknowledged competence caused great attention to be paid to his writings, and he took a prominent part in creating a wave of popular interest in the French navy. He retired from the French naval service as lieutenant about the year 1884, and was afterwards a frequent contributor of naval articles to French papers. He was made a chevalier of the Legion of Honour after the Crimean campaign, and was advanced later to the rank of officer.

Mr. H. J. Carpenter, formerly at the Royal Observatory, Greenwich, and afterwards assistant at Durham Observatory, died the other day at the age of forty-nine.

At a recent meeting of the Paris Academy of Sciences a memoir was presented by MM. Vaschide and Van Melle on the nature of the

physical conditions of smell. The authors have a new hypothesis. They suggest that, instead of the sense of smell being due to the emission of particles from the substance, the effect is produced by rays of short wave-lengths. In support of their view the old objection to the "emission of particles" theory crops up—that the substances which give off the odours do not appear to lose any weight by the "emission."

The University of Glasgow will, according to the will of Mr. J. B. Thomson, of Kinning Park, Glasgow, receive £10,000, and the Glasgow Technical College £2,000.

It is intended to hold a congrès d'histoire des sciences at Paris in connection with the exhibition. Prof. Tannery is the president of the organising committee, and Dr. Sicard de Planzoles the secretary. The conference will deal with the progress of all branches of science. The secretary's address is Boulevard Raspail 10, Paris.

In the course of his Christmas lectures at the Royal Institution, Prof. C. V. Boys, F.R.S., referred to the behaviour of liquids flowing through tubes of varying cross-section. At first sight it would be expected that the pressure would rise at the narrow places and fall at the wide. But when the experiment was tried, the contrary was seen to be the case. Explaining this, he pointed out that the same amount of liquid was passing at both the narrow and the wide places, and, therefore, the stream must be running more quickly where the pipe was constricted than where it was wide. This implied that its speed was gradually increasing as it got nearer the narrows, which was equivalent to saying that the pressure behind it was greater than the pressure in front. The Venturi water-meter was described as one of the most beautiful inventions made in modern times to overcome an apparently insuperable difficulty. Its construction was based on the principle that if a water main was constricted at a certain point the pressure fell from the wide to the narrow place. From the difference between the pressures at the two points the velocity of the flow could be calculated, and thus, the size of the pipe being known, the amount of water passing could be measured, as was automatically done by this meter.

In another lecture, referring to artificial flight, Prof. Boys mentioned two important aspects of the problem—the art which the aëronaut had to learn of managing his aëroplanes when he was up, so as to keep his balance, and the mechanical question of getting enough power on the machine without making it too heavy. In the former respect, names which stood out were those of Lilienthal and Pilcher, both of whom were killed in their experiments with soaring machines, while in the latter Mr. Maxim was conspicuous as having constructed the lightest reciprocating engine ever made for its power. Prof. Boys showed pictures of the machines both of Pilcher and of Maxim, and gave a brief account of a trial he made with the latter, in company with Lord Kelvin and Lord Rayleigh.

The skill of Prof. C. V. Boys, F.R.S., with soap-bubbles, quartz threads, and sundry other scientific phenomena, is well known, and in his concluding lecture at the Royal Institution delighted his audience. The experiments had reference to what is termed "surface tension" of liquids—that property which makes a drop of water cling for a little time to the nozzle of a tap until at last its growing weight detaches it, instead of falling at once as a stream of sand would do; which makes water cling to the meshes of a fine wire sieve; which produces capillary attraction, and which accounts for the soap-bubble. Prof. Boys did not attempt to explain the way in which the elastic skin on the surface of a liquid produces capillary attraction, or how this elastic property, which is always pulling the liquid back into its original state after it has been disturbed, enters into the life-history of the bubble; but after the beautiful experiments he made there will only be a small proportion of his young hearers who will not want to find out further how it is done. The elastic skin of water and its properties were illustrated by methods which are peculiarly those of Prof. Boys. For instance, a finely-meshed sieve, with meshes previously greased with paraffin, had a piece of paper placed inside it so as to cover the bottom, and water poured in. The paper was then withdrawn, and the water still remained in the sieve, refusing to run out—being, in fact, upheld by the "elastic skin" of water on its surface, which clings to the meshes as if it were a solid. The sieve was shown to be able to float on water, for a similar reason. Another experiment showed water supported in a small test-tube by this same elastic skin, although the tube was turned mouth downwards. Prof. Boys gave a final touch of ingenuity to the experiment by surrounding the tube with an atmosphere of ether, showing that under these conditions the elasticity of the water skin relaxed and was no longer able to support the column of water. These experiments, together with others, led up to the elastic nature of the film of soap-bubbles. Prof. Boys experimented upon these with the facility of an expert. He blew bubbles inside one another; he showed how a bubble can be stretched, how it can be rolled up and down inside another without breaking; and how it can push another bubble about without ever really touching it. He concluded by showing that two bubbles can be made to coalesce into one by electrifying them; whereas, if one bubble is inside another, the small electric discharge will have no effect upon the inclosed bubble.

In the course of a lecture to "young people" at the London Institution, Dr. A. H. Fison referred to the phenomenon of the persistence of vision, explaining why the image of an object formed on the retina did not immediately disappear when the object was removed from the sight, but gradually faded away until in about one-quarter of a second it had completely vanished. It was for this reason, he said, that the eye could not follow very quick motions, and that a red-hot poker swung round rapidly gave the impression of a circle of fire. After illustrating this persistence of vision with several experiments, the lecturer said it was the basis of a method of mixing colours—that known as Newton's whirling disc—which he proceeded to describe. If a disc, painted in stripes with the colours of the spectrum, were rapidly rotated, no single colour was distinguishable to the eye, but the mixture of all the colours gave the sensation of white. Dr. Fison showed several examples of this mixing, and pointed out that a given tint could be matched by several different combinations of colours, though the matching might not be correct in every light. The general law of colour mixture was next set forth, and it was explained that every colour in nature could be produced by the combination of red, green, and violet, which, on that account, were termed the primary colours.

The paper to be read at the meeting of the Society of Arts on Wednesday evening, Jan. 17, will interest many people, as the subject is "Ventilation without Draughts," by Mr. Arthur Riggs. The Cantor lectures on "The Nature and Yield of Metalliferous Deposits," by Mr. Bennett H. Brough, commence on Monday, Jan. 22.

According to the Vienna correspondent of the *Standard*, the case of Prof. Samuel Schenk, of the University of Vienna, whose theory concerning the determination of sex created, some two years ago, a sensation in the scientific world, and whose book on the subject was censured a twelvemonth later by the disciplinary Council of the College of Professors of the University, is again attracting attention. The Council addressed a petition to the Ministry of Public Instruction asking that the professor might be removed from his chair and from the management of the Embryological Institute at the University. This petition has now been acceded to, and Prof. Schenk has been removed from the Institute and given leave of absence, as professor, for an indefinite period, the Faculty of Medicine at the same time inviting him to apply officially for a pension. The professor has been at the head of the Embryological Institute for twenty-six years, and though his theory may be considered defective, and the publication of it premature, he can scarcely be held any more culpable than Prof. Koch, of Berlin, whose cure for tuberculosis was open to the same objections.

The earthquake in the province of Tiflis seems to have been very severe, as many villages have been destroyed, and the bodies of over 800 residents have been discovered and recorded. It appears that other shocks followed the major one.

It is stated that the South-Eastern and Chatham Railway has made arrangements with the Wireless Telegraph and Signal Company for the Marconi system to be used on the company's Royal Mail steamers between Dover and Calais, and also on their Royal Mail steamers between Folkestone and Boulogne—"an innovation of great importance for the safety of the travelling public by the short sea routes." One pole erected at Dover will command both fleets either in crossing the Channel or in port the other side of the water. Owing to the exceedingly short distance across the Channel, the ships' masts will be sufficiently high for a receiving pole across the Channel to be dispensed with. When the pole has been erected at Dover, communication by wireless telegraph can be maintained with the Ostend boats, if the Belgian Government desire; but in their case, the distance being greater, the erection of a pole at Ostend will probably be necessary. It is announced, however, that the wireless telegraph will be used for service purposes only, and will not be available for private messages.

It has been decided that the vessel which is to make the attempt to find the Antarctic Pole—or to explore the regions of the South Pole—shall be of timber, as iron would be possibly detrimental to the magnetic observations, which are really the objects of the expedition, though there is a hope that something may be done to examine, if not to explore, the land. The vessel is to be something like the *Fram*, and will be constructed to carry coal and other stores sufficient for three years, and will contain accommodation for five scientific observers, five officers, and a crew of about twenty men. The vessel will be rigged as a three-masted schooner, and will be illuminated throughout with electric light. The Howaldt Shipbuilding Yard, which is under a contract to have the ship built by May 1st, 1901, and fitted out not later than the end of August, 1901, has already begun the construction.

The scientific culture of the beet does not seem to have been acquired in California, as the average yield comes out, it is stated, at less than 8½ tons per acre, which cannot well be remunerative. The fact appears to be that the beet does well only on certain soils and in some climates; but in the United States the area last year was, it is stated, 144,100 acres, the yield of roots 1,220,000 tons, and the production of sugar 122,000 tons, which is a great increase on the two previous years. The actual results of last year's work cannot be known at present, but, looking at the vast area of the United States, it would seem that beet-roots for sugar-making could be grown profitably in some districts.

THE total output of the locomotive-building shops of the United States—outside of the railway shops—during the year just ended was 2,473 locomotives, the largest number yet recorded in a single year. The increase over last year is 598 locomotives, or about 32 per cent., and is about 10 per cent. higher than the next best year, 1890, when the total output was 2,240 locomotives. Of the 2,473 locomotives built last year, 339, or nearly 14 per cent., were compounds. In 1898 the output of compounds was 373, or 20 per cent. of the total output.

Incandescent Lamps Without Gas.—Many dwellers in the country who are debarred the luxury of gas will hail with pleasure the advent of a new lamp, capable of rivalling the incandescent gas-burner, but without the need for gas. Such a lamp has been devised by M. Denayrouze, and was recently exhibited before the French Society of Civil Engineers. The light of an ordinary fishtail burner is due to the incandescence of particles of carbon reduced from the coal-gas by the act of combustion, and rendered white-hot by the heat thereby evolved. According to St. Claire-Déville, there is only about from three to six per cent. of carbon in coal-gas, the surplus hydrogen being able to raise to white heat a far larger proportion than this if it were present. This fact is made use of in the Welsbach burner, which, from a given amount of gas, produces about five times more illumination than if burnt in an ordinary fishtail or bat's-wing, or even an Argand burner. Many burners have been devised to cause an incandescent illumination from alcohol or petroleum, &c., as the combustible, but, so far, with little practical success. M. Denayrouze has hit upon a combination of the two systems. He uses alcohol to which a hydrocarbon has been added; in heating the mantle carbon is deposited upon it, and along with the mantle itself is rendered incandescent, and thus a double source of light is provided. The lamp was a success; but the inventor kept to himself all details as to what form of carburetting agent was supplied. Still, it is probable that an invention of such value will be taken up by the manufacturers and placed upon the market, if in its present shape it is a really practical lamp.—*British Journal of Photography.*

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

ERRATUM—THE SOLAR PARALLAX—ATMOSPHERIC TIDES — BIBLICAL SCIENCE — BINOCULAR MICROSCOPES — PHOTOGRAPHY AT LICK OBSERVATORY: 57 M. LYRÆ; H IV. 13 CYGNI, AND 13 M. HERCULIS—LUNAR SEAS AND RAYS—FIELD ARMOUR — THE TWENTIETH CENTURY — THE MOON AND THE WEATHER — LONGITUDE — SUN'S ALTITUDE AND AZIMUTH — ARTIFICIAL OYSTERS.

[43189.]—WRITING, as I perforce always do, the second half of my letter (43145) in very great haste, I find that I made a most astonishing *lapsus calami* in the third paragraph of column one on p. 450, where it appears I must have written that when a clock showing *accurate* Greenwich time marked 10h. 2m. 10s. it was 10 p.m. at Greenwich!—an allegation which for pure idiocy it would be hard to beat. Of course, the "*Greenwich Mean Time*" should be "*Local* Mean Time." As "E. P.'s" star will not cross the Greenwich meridian until 2m. 10s. after it has been on that of Maidstone—and it will do so at 10h. 2m. 10s. p.m. there—at the instant of its transit at Maidstone, a clock showing *Greenwich* Mean Time should mark 10h. 0m. 0s.

I do not quite understand the sixth paragraph of your "Scientific News" on p. 448, in which it is stated that: "The parallax of the sun is, *according to M. Bouquet de la Grye*, 8·80″±·01. It is the words I have italicised that puzzle me, because this was the constant determined on at the International Conference on Fundamental Stars, which met in Paris in May, 1896, and which appears in the *Nautical Almanac*, the *American Ephemeris and Nautical Almanac*, the *Connaissance des Temps*, and the *Berliner Astronomisches Jahrbuch* for 1901 and henceforward. I remember Dr. Lescarbault's "discovering" the planet Saturn! but M. Bouquet de la Grye is a man of great astronomical eminence, and of very different calibre to the Orgères practitioner.

I remarked upon the fallacy underlying the craze on the subject of the Moon's Tidal influence on the Weather in the seventh paragraph of my letter (43145) on p. 449, and on the very next page (450) I find Mr. Munro returning to the subject in letter 43148. He is apparently in ignorance that years ago the late Prof. Daniel conducted an elaborate series of barometrical experiments at Box Hill in Surrey, and showed conclusively that there *are* semi-diurnal tides in the atmosphere due to the moon. But they can only be detected at a height, more or less considerable, above the earth, because at the sea-level the greater height of air accumulated beneath the moon would, on the whole, weigh no more than the shorter column elsewhere; since every particle under the moon (and, of course, the mercury by which we weigh it) would, of course, have its weight diminished by the moon's attraction opposing that of the earth. It is needless, moreover, to add that the *very* slight indications of a lunar atmospheric tide, even discernible on high mountains, are largely masked by a variety of extraneous causes. Perhaps in noticing Mr. Munro's letter I may be allowed to enter a gentle protest against his peroration. The trash which he criticises can no more be legitimately designated "absurdities in *astronomy*" than can the doings of the "Christian Scientists" and the "Peculiar People" be dignified with the appellation of absurdities in medicine. No *astronomer* ever penned any of the drivelling nonsense to which your correspondent takes such righteous exception. When anyone worthy of that designation does so far forget the rudiments of his science as to pen cognate stuff, it will be quite time for Mr. any Munro to talk about setting "the science up to ridicule" and lowering "it in the estimation of the laity." It is not so very long since an unfortunate creature at Portsmouth wrote to Sir John Gorst threatening him with the pains and penalties of an obsolete statute which made it illegal to teach in schools that the earth is round. I wonder whether this lowered astronomy "in the estimation of the laity" or not?

I venture to think that the signature appended to letter 43154 (p. 453) gives but scant idea of the real value of that communication, which is worthy of the serious consideration of all those who are so fond of lugging archaic Biblical literature into discussions which have reference to matters of pure science, and to them alone. I can entirely sympathise with those who are restrained from entering into a legitimate scientific discussion for fear "of offending many devout and worthy persons who are still deeply pained at any doubt thrown on the entire infallibility of the Bible"; but the amount of crass ignorance with reference to that collection of books is absolutely appalling. What Niebuhr did for Roman history has been done, and continues to be done, in separating what is purely legendary or mythical, from what may be regarded as historical, or quasi-historical, in the Hebrew records; but all this is caviare to the general, who read the Pentateuch as though it were an historical record in the same sense as a *Times* report of a public meeting or an inquest. Surely such who have so far proceeded in innocent ignorance may well pay deference to the publicly-expressed opinion of dignitaries of the Church, who have made a most special study of the books in question. Listen, then, to the Bishop of Worcester, Dr. Perowne, who (while Dean of Peterborough) said, at the Manchester Church Congress: "I hold it to be established beyond all controversy that the Pentateuch in its present form was not written by Moses"; or to the more recent utterance (albeit in somewhat more involved and ornate language) of the Dean of Canterbury, Dr. Farrar, in his luminous and instructive work "The People's Bible History": "The faintest semblance of harmony between Genesis and physical science can only be obtained by a licentious artificiality and casuistry of exegetic invention." Now let me reiterate: these are not the rant of screeching secularists in Hyde Park, but the deliberately uttered opinions of two very high dignitaries of the Church of England. The mischief done by presenting to people as necessary to their salvation the myths of the serpent, the ark, the pillar of salt, and all the rest of it, is absolutely incalculable. Your clever school-board pupil, when he finds out how absolutely mythical all this is, is but too apt to class the whole of the Book of books, in which it is bound up, in the same category; and so to root up the wheat with the tares, and make wreck of his faith altogether. At all events, let us, who write letters in these columns, resolve that they shall be strictly scientific ones, and that we will not be guilty of the childish folly of supposing that a question of pure physical or natural science can, by any possibility, be decided by a text. If people must drag Hebrew or other myths into the discussion of their theses, for goodness, sake, let them send their letters to the *Church Times*, *Record*, *Tablet*, *War Cry*, or *Sword and Trowel* as the case may be, and not to the ENGLISH MECHANIC.

[Since the above was written—and almost certainly in print—I have seen letter 43187, on p. 474. It seems to me that Mr. Garbett labours under the delusion that he proves a thing by simply repeating it. "The days of creation," he says, "were lengthy ages." Were they? If so, Exodus xx. 8—11 is pure nonsense. Again, "That the earth was formed before the sun is 'Biblical science,'" is true enough; but nothing can be more glaringly false than that it is "also recent *science* of yesterday"—or of any other day. It is the craze of a Biblomaniac. As for the sickening rubbish about the remains of the Ark on Mount Ararat, did not Mr. Bliss (in letter 42850 on p. 136) explain how the story about "Archdeacon Nouri," and all the rest of it, was a hoax perpetrated in 1883 by the *New Zealand Herald*? But it seems that the making of fools is not confined to the 1st of April.]

I know nothing of the particular form of microscope devised by Dr. Emil Berger; but "Myops" (query 97337, p. 457) surely does not imagine that it is the first successful attempt to obtain stereoscopic vision with that instrument! Why, as far back as 1851—49 years ago—Prof. Riddell, of New Orleans, devised a binocular microscope for exhibiting objects stereoscopically, or apparently solid. He was speedily followed by your correspondent, Mr. Wenham in London, and by M. Nachet in Paris. Then we had Stephenson's form, and later still the binocular eyepieces of Tolles and Abbe. The idea of there being any novelty in the mere obtaining of stereoscopic vision by a binocular microscope is simply ridiculous.

Reading the, evidently, necessarily curt reference to the work of the Crossley reflector at the Lick Observatory in your "Progress of Astronomy in 1899" on p. 462 suggests to me to say that the success achieved by Prof. Keeler with the two nebulæ you mention, and that of Mr. H K Palmer with the famous cluster in Hercules are of so highly interesting a character, and have added so appreciably to our knowledge of the objects that he has been photographing as to render them worthy of more extended notice than space probably prevented you from devoting to them. Taking, then, the *Astrophysical Journal* as my authority, and the groundwork of my remarks, I may say that the familiar Ring Nebula in Lyra (M. 57) has been photographed with the happiest results; albeit the focal length of the Crossley mirror is less than six times its aperture, and in order that the photographic and optical resolving powers of a camera may be equal, its focal length must be from 30 to 60 times its aperture. Of course, this short focus shortens the exposure, which was only ten minutes for the best general picture of the nebula, whose major axis on the photographic plate in the primary focus of the telescope is only 0·08in. If the focal length of the telescope were increased four times, the image would have a diameter of about 0·32in.; but then a three-hours' exposure would become necessary. Let us, however, see what Prof. Keeler has done with the instrumental means at his disposal. *Imprimis*, he finds the actual shape of the nebula to be oval, rather than elliptical with its more pointed end towards the N.E., and from both sides project faint fringes of nebulosity. The ring itself seems to be made up of several narrower bright rings, interlacing somewhat irregularly, and with the spaces between them filled with fainter nebulosity. One of these forms the outer boundary of the preceding edge of the main ring, and becomes very bright about the north end of the minor axis. The dimensions of the rings, I may here observe, are perceptibly greater in photographs than they have been found to be visually with a micrometer; but if the exterior fringes of nebulosity are chiefly formed of hydrogen, which is visually weak but photographically strong, this could be accounted for. Perhaps this, too, may account for the extraordinary actinic power of the little central star within the ring, which was faintly visible on a plate exposed for only 30 seconds. Prof. Keeler thinks it possible that such photographic strength may have its origin in the ultra-violet spectrum of the hydrogen series. Another ring nebula very much less known, H IV. 13, has also been photographed. This is a nearly circular ring, with a major axis = 42·5″ and a minor one = 40·5″. A star on the ring, first seen by Lord Rosse, was very conspicuous, but a second one that he figures does not appear on the Lick photographs at all. And last, but by no means least, we have Mr. Palmer's important research on the "Distribution of Stars in the Cluster Messier 13 in Hercules." Working upon a plate to which an exposure of two hours had been given, and which had been so lightly developed that the minute stars were not obscured by the brighter ones, and even the middle of the cluster was resolvable (!), over five thousand stars were counted on the plate. The stars on the plate, of which there are 5,482, are fairly sharply divided into two distinct orders of brightness, 1,016 being classed as bright, and 4,466 as faint. Without entering into detail, which must be sought in the *Memoir* itself (*Astrophysical Journal* for November, 1899, pp. 246-254), I may just say here that some of the results arrived at were of a very unexpected character. It might, for example, have been supposed that in the very middle of the cluster, where the stars are so very closely packed, the faint stars would have been hidden by the bright ones, and that where faint stars are scattered very thickly the bright ones would appear nebulous; but the most careful examination by Prof. Keeler and Mr. Palmer have sufficed to convince them that there is no true nebulosity in any part of the cluster; nor, I may add here, is it discernible in any single one of the clusters which they photographed. In Mr. Palmer's own words: "We do not, of course, assert that there is no nebulosity in this cluster, or in others of a similar character; but we think that the existence of nebulosity has not been proved." Lord Rosse's three dark lanes round the most compressed part of the cluster are easily visible on its photograph.

Premising that I do not see *Knowledge*, and that my acquaintance with Mr. Tepper's paper therein is derived solely from Mr. Elvins's letter (43162) on p. 470, I would say that Mr. Tepper must be a gentleman of the most vivid imagination. That both air and water have existed on the moon may, I think, be regarded as practically certain, albeit from her small mass she would not, so to speak, have much hold over an atmosphere; but that animals and plants akin to terrestrial ones ever existed we have not a vestige of proof. They may, or they may not; but we are in no position to assume definitely that they did. I would next remark that it is abundantly obvious that Mr. Elvins has never read Prof. Darwin's most masterly treatise on "The Tides," because that distinguished philosopher expressly contends that the moon did rotate upon her own axis rapidly in past time, and that tidal friction gradually impeded her rotation. It would repay your correspondent to read his book. Now, though, for (what are presumably) Mr. Elvins's own ideas. When he talks about large meteors falling vertically on the lunar surface and producing such formations as Copernicus, Kepler, and Tycho, has he ever reflected for one single instant on the size of those formations? Is he aware that the diameter of Copernicus

is 56 02 *miles*, that of Tycho 54·28 miles, and that Kepler is 21·71 miles across? What sort of a meteor, and what must be the size and mass of it, to make a hole 56 miles in diameter in the moon's crust, and what does he conceive would be the effect on the moon, not merely locally, but as an entire body, of the impact of such a stupendous planetoid striking her with ordinary meteoric velocity? Furthermore, it seems impossible that your correspondent can ever have examined the formations of which he speaks with adequate optical power, or he could never have supposed that their regular structure was the result of a fortuitous blow or blows delivered with planetary velocity. And if this idea be a wild one, what shall we say of a meteor or meteors furrowing out white streaks in carbonaceous dust while moving nearly horizontally across the moon! (?) Does your correspondent know what the lengths of these streaks, or the more prominent of them, are in miles, and does he suppose that the meteors could or would pass horizontally (of course touching the moon's surface) for anything approaching to such distances, without being brought to rest by friction? Why he—or Mr. Tepper, I don't know which—talks as though the meteors assumed the form of the blade of a stupendous plough-plane, and were carried across the face of the moon by cognate mechanism. Of course, I only know Mr. Tepper's hypothesis as expounded by Mr. Elvins; but in the form in which it appears it seems to me arrant nonsense.

Letter 43172, on p. 472, bears internal evidence that Mr. Lawler is not—nor ever has been—a soldier. Thanks to the Creusot Works, and Krupp's at Essen, the Boers have better artillery than we have, and I should like to know what he thinks would be the effect of a shell dropping just inside of his shield which unfortunate Tommy Atkins is delineated as pushing up a steep hill before him. Nicely out of breath would the rank and file be by the time they reached (if ever they did reach) the Boer entrenchments. Surely your correspondent does not think that the Boers would reserve their shell-fire until our infantry came to close quarters! or that they would ever face British troops at all under equal circumstances. They are much too artful for that. Securely hidden in their trenches, or behind masses of rock, they, good shots that they are, can pick off at leisure men to whom they are utterly invisible; but when they see the glint of our bayonets they promptly put into practice the dictum of Goldsmith: "He that fights and runs away may live to fight another day." The shields on trucks are all very well on an armoured train when it is attacked by rifle-fire only, but would terribly hamper and become a source of danger to men charging up to an intrenched position to take it. A 15-hand cob for each man would be of infinitely more service to a battalion of infantry in the Transvaal than all Mr. Lawler's shields put together.

I think that a very little consideration will show Mr. Stanley (letter 43180, p. 474) that there really never can have been a year 0. The first year of the Christian Era *must* have been 1 A D, and supposing such year to have commenced on Jan. 1, on June 1 (i.e., June 1, A D. 1), a child born on the 1st of January could only be 5 months old, and *not* 1 year and 5 months old as it would have been had the era begun with 0. We must go on to June 1, A.D. 2, before it could have attained the latter age. This being so, had our hypothetical child become a centenarian he could not have *entered* his 100th year until the year 100, nor his second century until the year 101, and so on. If, then, the second century did not commence until the beginning of 101, the 20th century cannot begin until 1901. Those who reckon from (180)0 beg the whole question.

"A. B. M." (letter 43182, p. 474), in his graciously patronising manner, opines that a "judicial quality" and "philosophical suspense of judgment on a matter in the course of elucidation is not always conspicuous in the utterances of 'F.R.A.S.,' and . . . may possibly be somewhat foreign to his temperament"—which, being interpreted, signifies that "F.R.A.S." refuses to accept, open-mouthed, any wild hypothesis which meteorological observations continued over a very long series of years have shown him to be absolutely unproved—not to say as absolutely unfounded—but which commends itself to "A. B. M." because, doubtless unconsciously, he *wishes* it to be true. Would your correspondent be surprised to hear that I have sat in a judicial capacity for many more years than I should care to count, and hear and adjudicate on more evidence in six months than, in all human probability, he has ever listened to in his whole lifetime?

Perhaps I may explain to "Argentine" (query 97352, p. 479) that it is impossible to determine Longitude without in some way getting Greenwich Mean Time to compare with the local instant of observation. The only way of employing a 6in. transit theodolite for this purpose that occurs to me would be to use it to observe some of the moon-culminating stars, of which details will be found on pp. 454 to 482 inclusive of the *Nautical Almanac* for the current year. I do not quite understand query 97353 on the same page.

As "Fleur-de-Lys" (query 97356, p. 479) says that he has no means of access to the back number of the ENGLISH MECHANIC to which I referred him for an answer to his original query, I will myself turn back to what I there wrote and give him the benefit of it: Call the Latitude ϕ, δ the sun's Declination, P his hour angle, Z his zenith distance, and A his azimuth. P M is an arc which we shall use in our calculation, and we get it by the following equation—

(1) tan. P M = cos. P. cot δ. Then—
(2) cos. (P M + ϕ) cot. P. cosec. P M = cot. A.
(3) sin. (P M + ϕ) sin. δ sec. P M = cos. Z (or sin. altitude).

Let us imagine that in London (lat. 51° 30′) on June 20 that the Sun was 2h. 20m. past the meridian (= 36° in arc), his declination being 23° 27′ 16″ N., what were his azimuth and altitude? First we want our angle P M (equation 1).

P = 36°	= cos.	9·907958
δ = 23° 27′ 16″	= cot.	0·362643
61° 47′ 45″	tan.	0·270601

Note that had the latitude been North and the sun's declination *South*, cot. δ would have been negative and P.M. must have been taken in the second quadrant, and instead of being 61° 47″ 45′ could have been 180°—61° 47′ 45″ or 118° 12′ 15″. Then by equation (2)—

P M =	61°	47′	45″		
ϕ =	51	30	0		
(P M + ϕ) =	113	17	45	cos.	9·597123
P =	36	0	0	cot.	0·138739
P M =	61	47	45	cosec.	0 054891
Azimuth West of South	58	17	52	cot.	9·790753

By equation (3)—

(P M + ϕ) =	113°	17′	45″	sin.	9·963068
δ =	23	27	16	sin.	9·599905
P M =	61	47	45	sec.	0 325492
					9 888465
Z D	39	19	48	cos.	
Or altitude	50	40	12		

As query 97358 on the same page is primarily addressed to my very competent brother correspondent, "Arcturus," I will not answer it unless he declines to do so.

Query 97363, p. 479, reminds me that I have been told that if you order oyster-sauce at any of the cheaper London restaurants, you get mussels.

A Fellow of the Royal Astronomical Society.

THE SATELLITE OF NEPTUNE.

[43190.]—"ELL HAY," in your issue of to-day (Jan. 5) gives most of the particulars asked for as to his observations of the satellite of Neptune, but omits to specify whether it was held steadily or merely glimpsed. In his original letter he stated the reflector ($5\frac{1}{4}$in.) "showed the satellite, though still very faint," and my remark referred to its being seen steadily with so small an aperture. Ward only glimpsed it with the 4·3in. Wray refractor, though he appears to have seen it on several nights early in 1877, and gave remarkably close approximations of the positions and distances by eye estimation, without knowing, at the time, the positions from the ephemeris. By the way, may I ask, who now calculates the ephemerides of the satellites of Jupiter, Saturn, and Neptune, since the decease of that admirable computer, the late Mr. Albert Marth?

Can any of your readers give the positions of the Satellite of Neptune on the nights of Nov. 12 and Nov. 18 last, when "Ell Hay" estimated the position-angle as 250°, and distance as 12″ approximately? Of course, the satellite would not be in the same exact position on both nights, as one revolution is a little under six days, but they are close enough for the present purpose to identify it from a faint star which might happen to be near the planet. The observation of Nov. 18 was certainly remarkable, as the moon would be only about 10° to the west of Neptune at midnight, and she occulted him on the following evening between 6 and 7 o'clock, but it was cloudy here.

With reference to the remark of "Ell Hay" regarding the proportional areas (30 to 18) of his $5\frac{1}{4}$in. Newtonian, and the 4·3in. refractor used by Ward, the proportion would be reduced by the loss of light by reflection in the Newtonian, and consequently less favourable to "Ell Hay," who must have exceptionally keen vision to have seen the satellite (even under best conditions of the polish of mirror), especially so near to the moon, when the latter was only a day and a half past full.

There is a light test at present available for the $5\frac{1}{4}$in. in the field near the triple star ι (Iota) Orionis. It is a faint pair of stars numbered 719 and 725 by Bond, when plotting the stars seen with the 15in. Merz telescope of the Harvard Observatory in the region around the Great Nebula of Orion half a century ago. The magnitudes were given as 14·8 and 12·3 respectively in Argelander's scale. This pair was picked up by Ward, independently, in 1878, with the 4·3in. refractor, and measured by Dr. Copeland, with the 15in. Grubb refractor at Dunecht, of which full particulars are given in *Knowledge* for January 4, 1884, with diagrams.

Neptune.

LUNAR ECLIPSE OF DEC. 16.

[43191.]—THE chief features of interest in the recent lunar eclipse as noticed by me were:—

(1) The penumbral shadow was noticeable only across the equatorial regions of the moon, more particularly the northern, while the poles remained quite bright and white by contrast.

(2) The limb of the true shadow showed decidedly circular before reaching Aristarchus.

(3) The colour of the shaded portion of the moon was dark black-grey during the earlier and later phases of the eclipse, and became lighter and of an ochreous colour as the phase increased, being a bright orange-ochre at mid-eclipse; the shades of colour then recurred in the reverse order as the eclipse waned.

(4) The details of the features of the moon were curiously irregular in visibility, at one time being quite distinct, at another totally invisible, without any apparent cause, such as interference by clouds. This phenomenon occurred only during the early and late stages of the eclipse, while the shadow was of a dark grey colour. During the middle portion of the eclipse all the prominent details were plainly visible.

(5) The colour of the shadow was more ochreous with higher powers, more grey with lower powers.

(6) The penumbral shadow immediately after the eclipse in the region of the last contact of the true shadow was of a decidedly ochreous tinge with a power of 75.

(7) In the one occultation I observed (12.58), the star appeared to hang just *within* the moon's dark limb for an appreciable moment before disappearance.

(8) The uneclipsed portion of the moon appeared to be larger than ·005.

I was using a 5in. refractor with powers of 40 and 75, and occasionally 150.

Rontenburn, Largs, N.B. **N. Maclachlan.**

LUNAR MARKINGS BY METEORS.

[43192.]—I AM interested to see that Mr. Elvins (in letter 43162, p. 470) suggests that the rays and ring formations on the moon may have been caused by meteors. With regard to the lunar rings the subject was very lengthily discussed a short time since in the E.M., between myself, supporting the meteoric theory, and "F.R.A.S.," Mr. Ellison, and others opposing it. If Mr. Elvins is sufficiently interested in the subject, he will find the discussion referred to in Vol. LXVI. pp. 297, 318; Vol. LXVII. pp. 150, 173, 175, 219, 246, 265, 335, 360, 381, 402, 404, 476, 525, 548, 569; Vol. LXVIII. pp., 12, 140, 234, 325, 349, 393, 439. The theory had been suggested by Proctor, but I was not aware of it when I raised the discussion.

With regards to the suggestion that the rays were caused by meteors ploughing up the surface, I think the fact that the rays are more visible under the direct than under the oblique light of the sun is against it. All superficial disturbances are more apparent under oblique illumination. These lunar rays always appear to me like reflections of sunlight from the lofty peaks of the ring mountains, only that they do not spread like rays of light, and that they in many cases follow the rotundity of the moon far out of the reach of straight lines drawn from the reflecting points. Is it possible that as these rays are reflected in vacuum they may possess the peculiarities of rays produced in vacuum—i.e., that the light does not disperse, and is, I believe, under certain circumstances subject to lateral deflection by magnetic attraction?

R. P.

THE QUADRANTIDS—SUNSPOT COLOURS.

[43193.]—A BRILLIANT meteor was seen here at 11h. 45m. on Jan. 2, 1900, as bright as Sirius, of the same colour as that star, and leaving a faint train. It came from midway between θ and ι Draconis, shooting up under γ Ursæ Minoris towards Polaris. The sky was then watched until 12h. 45m., and five more meteors were recorded, all Quadrantids. The peculiarities of those meteors seen were thin blue-white colour and the faint train some of them left.

In the report of the recent B.A.A. meeting several members remark on the colours surrounding sunspots. I have sometimes seen them by projection, but never direct. I conceive that the atmosphere has something to do with their appearance, for they are more pronounced on some occasions than on others. On one occasion I was showing a group of small spots to a friend (projection method)

and the colours were so pronounced as to cause comment. Red seems to be the predominant colour, at least, so far as my short experience shows.

Erratum.—In letter 43164, p. 470, in first column of table, 1889 is erroneously printed for 1899.

Earlsfield, S.W. **Silverplume.**

THE QUADRANTIDS, 1900.

[43194.]—IN accordance with my endeavour to supply notes on the seven principal meteoric showers of the year, I forward a table giving particulars of twenty-five meteors observed here on January 2.

No.	1900.	G.M.T.	From.	To.	Mag.	Dur.	Description.
		h. m.	° °	° °		s.	
1	Jan. 2	11 38	122½ + 34½	127 + 40	4	—	Swift.
2	,, 2	11 38	115 + 15	111 + 7½	3	—	Swift.
3	,, 2	11 42	232 + 63½	238 + 73½	1	—	Slow.
4	,, 2	11 42	228 + 70	210 + 86	2	—	Slow.
5	,, 2	11 45	170 + 63½	106½ + 28½	4	—	Rather swift.
6	,, 2	11 47	315 + 73	357½ + 58½	2	—	Rather swift.
7	,, 2	11 53	325 + 76	8½ + 57½	1	2·0	Slow.
8	,, 2	11 54	35 + 80	140 + 87	4	—	Swift.
9	,, 2	11 55	202 + 52	163 + 54	3	0·2	Very swift.
10	,, 2	11 59	192 + 76½	72½ + 45	1	2·0	Rather slow.
11	,, 2	12 0	165 + 57½	196½ + 59	4	—	Rather slow.
12	,, 2	12 12	239 + 65	260 + 75	4	0·8	Slow.
13	,, 2	12 25	111 + 27½	108½ + 10	1	0·2	Very swift.
14	,, 2	12 32	307 + 69	346 + 51½	1	—	Rather swift.
15	,, 2	12 36	287½ + 73	341 + 61	3	0·5	Rather swift.
16	,, 2	12 43½	55 + 41½	67 + 17½	2	0·2	Extremely swift.
17	,, 2	12 45½	42½ + 51½	55 + 33	4	—	Swift.
18	,, 2	12 45½	49 + 51½	58½ + 39	3	—	Swift.
19	,, 2	12 47	25 + 33	33½ + 28	4	—	Very swift.
20	,, 2	12 50½	105 + 12	87 + 20	4	—	Swift.
21	,, 2	12 52	83 — 8½	83 — 10	3	0·4	Rather slow.
22	,, 2	12 54	275 + 67½	320 + 64	2	—	Rather slow.
23	,, 2	12 54	287 + 75½	350 + 67½	3	—	Rather slow.
24	,, 2	12 59	190 + 71	92½ + 45½	3	—	Swift.
25	,, 2	13 0	247½ + 57½	260 + 58	2	—	Rather swift.

The watch kept was from 11h. 30m. to 13h. 0m., and the time of observation with a sky practically free from cloud was 1h. 15m. Clouds prevailed chiefly about 12h. 20m.

The radiants found were—

22° + 67° (Nos. 8, 16-18)

230° + 54° (Nos. 3-7, 10, 12, 14, 15, 22-25).

To the latter, the Quadrantid radiant, belonged four out of the five first magnitude meteors recorded.

A flash, probably due to the appearance of a bright meteor, was noted in a break in the clouds at 12h. 23m.

Other watches, proposed with a view to ascertaining the duration of the shower, were useless on account of unfavourable weather.

Walter E. Besley.

Clapham Common, Jan. 5.

METEOR.

[43195.]—BRILLIANT meteor seen here at 2.57 p.m. like a ball of burning zinc, emitting yellow sparks; seemed to come from S.W. to N.E. Vanished almost direct under moon. **Thos. Parker.**

Penshurst, Tuesday Evening, Jan. 9.

SCHAEBERLE, ABERRATION, ETC.

[43196.]—"A. S. L.'s" opinion that this matter is "made too much of" is that of most who are able to judge. It is a theoretical rather than a practical aberration; otherwise our o.g.'s and mirrors could not divide to the theoretical limit. Theoretically, it is present in every optical lens, single or compound, and it has been shown it must be in a greater degree with a refractor than a reflector, and it is well known that the reflector will give a smaller image of a star than a refractor of same size.

I think there is a very simple way of testing whether this aberration is of practical importance or not. I will ask "A. S. L.'s" opinion. This aberration by the longer rays from the edge of any lens causes an increasing enlargement of image, and consequently an overlapping from centre to edge. Now if we put an eccentric stop—say an 8in. or 9in. stop—on an 18in. mirror or o.g., the one edge of this 9in. stop touching the centre of the lens and the other the margin, should not the image of a star be, not a round one, but an oval one? The bulging out and the rings also eccentric and enlarging towards that edge corresponding with the rays coming from the edge of lens. Theoretically, such an image and result ought to happen, but practically nothing of the kind does happen, for a star is not only round, but the rings are concentric and regular as if no stop were used.

To give "A. S. L." some of my own experience of glass discs, I may say at once that I have found cast ones the best on the whole, though for ordinary purposes and small sizes good plate discs will do, especially for long focus. The plate when rolled induces a strain in the texture not easily tempered out. The cast discs of the good light plate metal are harder, and therefore take a better polish and give more light. They are less labour to shape up, too, as the edging is the trouble with amateurs. The *very* green discs have too much soda in them, and will actually corrode on the surface. I once had the mice get into my boxes where I keep finished mirrors, and their urine spoiled me £100 worth of mirrors; it corroded the surfaces, the same, I suppose, as fluoric acid would.

I commenced, nearly forty years ago, with plate discs; I then tried cast-flint discs; these were easily annealed, but for large sizes were too heavy and too soft. I then went to cast plate, and Chance took a deal of trouble to suit and please me: but good discs were costly and very rough. I am now on the last of a batch of 18in. discs, which cost me £9 each, but they are good. To get neater discs and cheaper I went to the Continent. But soon I was called upon to make some large Cassegrains, &c. I soon found, to my cost, that the discs, though very well annealed, would not stand the boring out the centre hole. So after that I had all specially prepared, and had the hole cast in them. I found they would not stand even the truing of the hole (which I did with a diamond tool), unless very specially made. I have recently made a 20in. photographic mirror of 90in. focus, a fellow disc to a 20in. I made for Dr. Roberts; the discs were very fine, and would bear turning like a disc of metal.

G. Calver.

THE LUNAR RAYS: A NEW THEORY.

[43197.]—MR. A. ELVINS (letter 43162, p. 470) has suggested that an interesting discussion may arise in "Ours" respecting those mysterious bright markings on our satellite which are known as the "lunar rays." We hardly know enough about the constitution of the moon to assert anything as a fact, and all the theories which I have read concerning the rays fail to account for what is actually observed with the telescope, and become untenable when considered in connection with all the attendant circumstances. For instance, the theory that the rays are cracks in the lunar crust, through which semi-liquid matter has welled up, seems scarcely tenable when we observe that the rays run in an unbroken line across not only the plains, but over the highest mountain rings and down the other side, and then straight on. The idea that they are deposits of volcanic dust from a line of lunar craters also fails, as I should expect to find that on the sheltered side of the mountains there would be a considerable break in the rays. Moreover, a continuous line of craters (which must all have been active about the same period), extending many hundreds of miles, and, in at least one case, extending some two thousand miles, seems very improbable. The theory of a deposit of cosmic dust ploughed into furrows or scattered around by the impact of meteors may account for some of the shorter rays, and for the radiating rays; but can we for a moment imagine a meteor ploughing a straight furrow for some two thousand miles over a spherical surface having so sharp a curve as that of the moon? Again, all these theories fail to explain why so many of the rays have disappeared in the equatorial regions, although the northern and southern portions are so plainly in evidence. Many of the rays look as though they had once been continuous, but had since been destroyed where they passed over the equatorial part of the moon.

Other theories being therefore dismissed as unsatisfactory, I venture to propound a new one, in the hope that discussion may bring out something that satisfies the requirements of the case.

It is believed by many of our scientific men that the moon is intensely cold. Prof. Very suggests that its night temperature is – 360° Fahr.; others have, I think, suggested at least – 500° Fahr. But there is good reason to believe that, in the moon's daytime, when it is exposed to the direct rays of the sun, it is subjected to an intense amount of heat in the equatorial regions.

Assuming that the moon once possessed an atmosphere—an idea which has something to support it—the question naturally arises: "What has become of that atmosphere?" Some have suggested that it may have been driven off into space; others that it may have been withdrawn into the interior of the moon, or round to the side which we never see.

Latter-day science has, however, demonstrated that our own atmosphere may be liquefied, and, from what I have read, I gather that it may be solidified by intense cold, at a temperature not so low as that which has been attributed to the moon. If, therefore, while it possessed an atmosphere the moon became sufficiently cold, it seems not unreasonable to suppose that its atmosphere may have been precipitated upon the lunar surface in the form of a dry powder not unlike very fine snow. Whilst the atmosphere existed, there were doubtless strong currents of wind blowing in various directions, especially in a line with each side of the mountain rings and peaks. This would, I think, cause the formation of a more dense stratum of atmosphere between the lines of the currents, and result in a much thicker deposit of atmospheric powder between those lines; and as the deposited matter would fall from a considerable altitude, and more thickly *between* the currents, there would be no break in the rays on the mountain sides sheltered from the wind. In the same way, wind currents blowing in various directions between the peaks of isolated mountain rings would form the radiating streaks which are now such conspicuous objects on the lunar surface. The intense heat to which the equatorial regions of the moon are exposed would melt or evaporate all but the thickest layers of atmospheric deposit, and many of the thinner layers in regions a little cooler. This evaporation, which may still be proceeding on a small scale during the lunar days, might produce that misty appearance which some observers have occasionally noticed in some of the lunar formations.

Thus, by this theory, we may account for the formation of the rays, both straight and radiating; for the fact that they cast no visible shadows; that they pass unbroken over high mountains, and are even seen in the interior of crater plains; that many of them follow the lines of successive mountain rings, and we also account for their relative fewness in the equatorial regions.

Last, but not least, we solve the problem of what has become of the lunar atmosphere! **Mark.**

THE TWENTIETH CENTURY?

[43198.]—IT seems to me that Wm. F. Stanley, (letter 43180, p. 474) confuses his argument by attaching a value to zero, instead of regarding it as a mere mathematical line, having, in chronology, no duration! When a child is three months old, it is a quarter of *one year* old, not a quarter of 0 year, which would be absurd. It only enters its second year *after completion* of the first, and would only enter on its second century, no longer a child, *after completion* of 100 years, entering this *on the beginning* of its 101st year. And as 100 years *must be completed* before the second century begins, so with the centuries 1900 years *must be completed* before the twentieth century begins.

Similarly, zero on the scale of a thermometer is an imaginary mathematical line, which, in practice, our senses, and the want of delicacy in our instruments, or rather, I should say, the intrinsic nature of such a line, preclude us from accurately observing, yet the fractions above or below zero, are not fractions of *zero*, but are fractions of 1° above or below zero.

Some people insist that we have already entered the twentieth century, and refuse to think the matter out, relying on the fact that the Prayer-book so decrees it, that the Act of Parliament (24 Geo. II. c. 23) declares that "the next century is from the year 1800 to the year 1899 inclusive," and that the German Emperor has given his adhesion to this. To such, I would commend the lines of Peter Pindar:—

"Thou think'st that monarchs never can act ill.
Get thy head shaved, poor fool, or think so still."

H. B. F.

[43199.] — THE letter of your correspondent, Wm. F. Stanley (43180) may be regarded as a fair sample of the persistency of error. It has frequently been pointed out that the year 1900 is the 1900th year; or, in other words, the number expressing it bears the same relative value as that used to designate the day of the month. Thus, when we write the present date 8/1/1900, we mean the 8th day of the 1st month of the 1900th year, and just as the day will not be completed till mid-

night, or the month till midnight of the 31st of January, so the 1900th year, that is, 19 centuries, will not be completed till the 31st December next. And whilst it is now 7 p.m. of the 8th of January, the time elapsed of the present year is 7 days 19 hours, and since the beginning of our era 1899 02135 years, the fractional part belonging to the 1900th year.

It may be pointed out, however, that in some parts of the *Nautical Almanac* we find a nomenclature which at first sight seems at variance with this way of stating the case, and which may possibly lend encouragement to views like those of your correspondent.

Turning to the *N.A.* for 1900, at p. 294 and sequitur, the mean places of stars are given for the epoch January 0 + ·313 day; and similarly at page 592 we find the year 0 A.D.; but when we examine these dates we discover that the symbol January 0 stands for mean noon of December 31, and the year 0 A.D. is what is commonly called in chronology 1 B.C. Again, on page 1 and pages 290 and seq., precession is reckoned from 1900·0, and it is clear from the context that this denotes mean noon of January 1, 1900. Why this is so stated is not clear, as, according to the common interpretation of the calendar, 1900 plus a fraction would denote that the date is in the 1901st year. Perhaps our friend, "A Fellow of the Royal Astronomical Society," will kindly enlighten us on this point.

Referring to Mr. Allen's letter (43161), the greatest phase of the lunar eclipse was observed here (latitude 53° 40′) in a clear sky, and the most striking feature which attracted my attention was the profile of the Doerfel and Leibnitz Mountains, which came out with a distinctness I had never before seen. About 1.15 a small star was observed close to one of the peaks of the Doerfels, and I had hopes for several minutes that I might witness an occultation by the mountain, and a subsequent re-appearance. In this I was, however, disappointed, as the star cleared the peak by a few seconds of arc, and disappeared behind the limb several minutes later. An observer several miles further north than my station might have witnessed an interesting sight. I observed the eclipse with a 5in. refractor, power 80. J. Watson.

[43200.]—In this discussion there is an aspect which I have not seen referred to. Searching where possible as to the order of chronological data, I could not in any case find that there was a year "nought," but always as "one," at the commencement of any great change. Take one instance: over a hundred years ago the great French Revolu- commenced its year one. Similarly from the instant our Queen began her reign it became: "In the first year of the reign, &c."

The year before our Saviour's birth has always been numbered B.C. 1, and the following year as A.D. 1; and, counting as we do as to our earthly rulers, the King of Kings began his reign at his advent as the year one.

In no chronological or legal case can I find reference to a year 0 or ½, &c.; but they are counted in the natural way—1, 2, 3, never 0, 1, 2, else 0 becomes 1. W. London.

DO ANTS HEAR?

[43201.]—The above question (p. 447) may be made either an academic or a practical one. I do not think it is quite rational to deny to any family of living creatures the possession of so elementary and vital a sense as that of hearing among themselves. As a beginner with the microscope, I remember conveying in a clumsy sort of way to the stage of that instrument a small party of ants (I have no doubt they were ants) which had lodged in a blossom of azalea I had put into my vasculum when in the country.

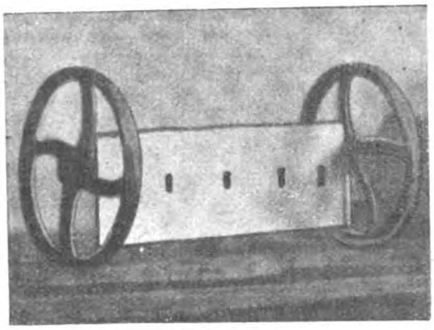
I had no sooner placed them on the stage than they naturally darted off in all directions. Wishing to secure one, at least, of the insects as an object, I turned it over on its back by means of a dissecting needle, when it lay helpless. Immediately I had done so, one of its fellows, which had been rushing off in a diametrically opposite direction, returned, gave the needed assistance to its fallen brother, and then (without sufficient judgment as it seemed to me) returned precisely as it had come. I felt so interested in this observation of intelligence and pluck, that I repeated the experiment with the same result. In each case the distance and direction of each from the other made it appear a necessary condition that these insects were able to communicate by the sense of hearing. Carlos.

A SIMPLE HYGROMETER.

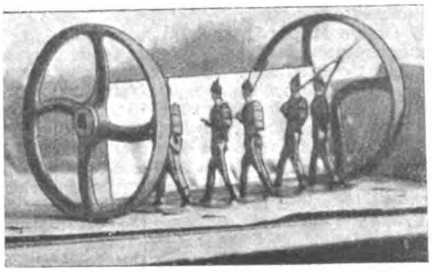
[43202.]—The "piece of twine" (p. 474) is not, any more than the catgut of the old-fashioned weather-house, a hygrometer. All that can be claimed for it is that it is, in a sense, a hygroscope; but even then, much depends on the kind of twine, and the process of manufacture. Some twine will not even act as a hygroscope. A simple hygrometer would be a very useful piece of apparatus in connection with many processes of the arts and manufactures;—mere hygroscopes are well known. See Ganot's "Physics" for an explanation of the discrimination. S. R.

PORTABLE SHIELDS.

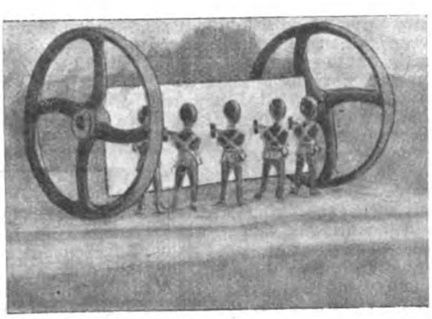
[43203.]—The sketches of Mr. Lawler (letter 43172) are somewhat similar to a design I brought



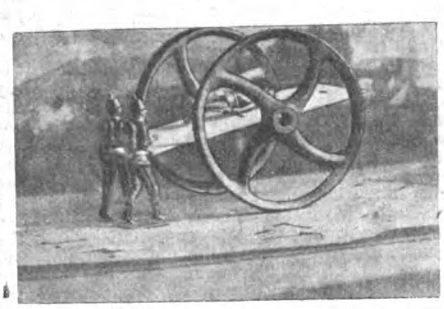
Portable Shield. This will swivel to allow passage over rough ground, or it may be lifted by two men over any rocks.



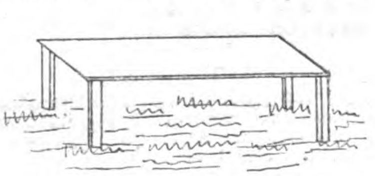
In use when advancing.



Firing.



Wheels may be taken off the ends and placed at the sides to make ambulance cart or waggon.



May be used also as camp table.

out five years ago, and which competent military critics told me would be invaluable in a war with the Boers. I send sketches. I may say that the War Office did not accept it when submitted for examination recently. Walter Bagshaw.

FIELD ARMOUR.

[43204.]—The number of repulses sustained by our troops in the course of the war in South Africa prove the truth of the statement put forward by your correspondent, Mr. Lawler, that the use of defensive armour of a portable kind is urgently needed to neutralise the immense improvements that have been made in offensive, that is, portable hand-carried weapons, whose motive power is in gunpowder. These have been made so accurate in aim, so quick in repeating the discharge with such an extended range of fire, that fighting in the open against cover means defeat to the attacking force.

To make defensive armour still more easily carried than already proposed, I venture to ask you to make known the following suggestion—to wit, to furnish each soldier with a shield carried wholly by himself, and consisting of two plates hinged together at right angles, wide enough and high enough to protect his body and head.

I would further corrugate vertically the two plates in corrugations about ½in. wide, so that the shield would not only catch the bullets at an angle of 45°, but that the sharp edges of the corrugations would eat or rasp off the leaden point or nose of the bullet striking it. This deflecting angle of 45° joined with the rasping action of the small corrugations will enable the shield to be made of correspondingly thin steel or iron.

I would supplement this short shield, which only covers the head and body, leaving the legs uncovered, by strips of steel covering the main bones of the legs, leaving the fleshy parts unprotected, as the present small-bore long range do not disable a man when they pass through flesh only. There would be a joint at the knee to cover that vulnerable part.

I expect that the armour may be made light enough to be carried at the rate of three miles an hour, the carrier's arms and ammunition being carried by another soldier following in his shelter close behind him.

Plymouth. W. B.

[43205.]—The army owe Mr. Lawler a deep debt of gratitude for his invaluable invention of iron shields for use at the front (43172, p. 472). I presume he has already communicated with the Commander-in-Chief on the subject. If the latter does not immediately insist upon Sir Redvers Buller and Lord Methuen "sitting tight" until they have been furnished with a sufficient number of Mr. Lawler's shields, he will be failing in his duty to the army and the country, and the country will insist upon knowing the reason why.

What I like about Mr. Lawler is that he does not claim impossibilities, for instance, as he admits "the ground would not permit of its (the shield) being always wheeled." Undoubtedly such is the case—e.g., at Belmont and at Colenso the troops would have found the wheels almost, if not quite, useless. In one respect, though, I think Mr. Lawler's scheme is open to criticism. His shield is not more than 4ft. high, otherwise, as he truly anticipates, it would be too heavy to carry. Therefore, to get the full benefit of it the troops also should be not more than 4ft. in height. This seems rather small for Englishmen. Sapper.

[43206.]—O'Dermid W. Lawler's sketches are somewhat comical, and I pity the two little fellows who are engaged in pushing the (necessarily heavy) shield up the hill. I say nothing of the military aspect of the case, but I am sure if the proposer had had (as I have had) to scramble up and down the rocky country out there, he would know such a scheme of defence is impossible.

Personally, I think armoured trains, traction engines, and entrenching ploughs are of very doubtful utility, and, what is more, I fear that neither such things as these, nor the bravery of our soldiers, can avert the eventual loss of the Cape and Natal colonies. Such was my expressed opinion before a shot was fired, and I hold it still.

A. S. L.

[43207.]—I beg to suggest that our infantry in South Africa be supplied with steel shields of sufficient thickness to stop a rifle bullet. These shields could be used to form breastworks or temporary shelters behind which our men would be perfectly safe from rifle-bullets. If every man, when assulting the enemy's position, carried one of these shields, our troops would be able to get close up to the trenches without serious loss of life. In the Peninsular War our men would rush up to an enemy's position with sandbags and form temporary shelters, but we never hear of our men in Africa doing anything of this kind.

The shields could have spikes at the bottom corners for sticking into the ground when it was necessary to use them as stationary breastworks, and they would have two handles at each side, and then they would be very useful as temporary stretchers. The size of the shields carried by the front row of soldiers might be about 5ft. by 2½ft., and, if necessary, two men could carry the front shield,

The size of the other shields might be about 4ft. by 2½ft., as they need not be quite so large as the front row.

Steel shields would be invaluable to our men as cover, and they could stick them into the ground at any point and shoot from behind with perfect safety. Hundreds of these shields could be carried to the front in one waggon and then handed out to the men. Surely something might be done in this way to cover our men when in the open.

7, West Avenue, Derby. **W. B. Garniss.**

A HINT TO VOLUNTEERS AND OTHERS.

[43208.]—ANYONE going to the front will do well to take with him a length (say 3ft.) of small india-rubber tubing. That used for infants' feeding-bottles will do; but a stronger kind of about the same bore can be bought from dealers in rubber—an inch of glass tube should be inserted in each end, or a bit of large-bore quill. This will enable the user to get a drink from a very shallow stream or pool when there is not depth enough to dip a flask or cup in it. I have found this very useful for the purpose.

West Didsbury. **M. Cole.**

TELESCOPICAL DISCUSSIONS — TO "GEE," "HIPPALUS," ETC.

[43209.]—FROM "Ell Hay's" letter of last week (43168) it is made to appear that the substance of my letters on the Gregorian telescope has been to indicate its defects—defects which "E. H.'s" own caricature of that instrument only "fail to bring into prominence," we are told, "because it is too small." Could anything be cited as a more complete inversion of the whole substance of my Gregorian letters, or of the facts given in verification of them by other contributors, many of whom have shown a larger acquaintance with the subject than I can lay claim to?

The last reference is peculiarly interesting when read along with the letter of its author's genial and friendly opponent (42531). When I do take up the suggestion given to me in 43168, I shall not forget the *notes* to which the writer of 42531 refers. In this "Ell Hay" may feel satisfied—there need be no fear of plagiarism. **H.**

THE MOON AND THE WEATHER.

[43210.]—IT appears, from what "A. B. M." says on p. 474, that I have "rather missed" (!) the "point of the passage." I said plainly on p. 427 that I failed to see any "argument" in the passage quoted by "A. B. M.," and I see that I am not the only one who has failed. But why does not "A. B. M." point out the "point of the passage" that I have most decidedly missed—not "rather"? In these pages we have had plenty of weather prophets, from the sage of Hackney-road to the philosopher of Peckham Rye; but we have grown older, and there are now few who believe in "forecasts" of mere weather: it is important to hoist the storm-signals, even if the forecast is wrong. Many of those who work in London live, say, five miles north, some five miles south, &c., and they have compared notes to such an extent that they are convinced of the futility of attempting to predict weather for even so small a place as England. **S. R.**

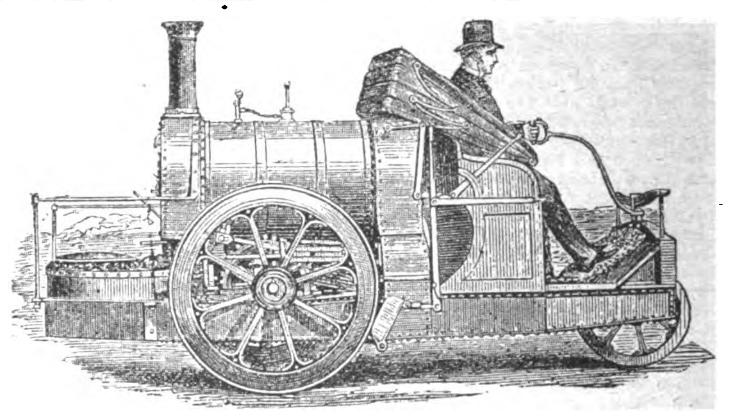
RICKETT'S ROAD LOCOMOTIVE.

[43211.]—As some of our readers are interested in motor vehicles, &c., on common roads, perhaps the inclosed cutting may be of interest. It is from the *Illustrated London News* of Sept. 15, 1860, which came into my possession recently. Hoping that it will be of use to you.

John W. Faulkner.

"RICKETT'S ROAD LOCOMOTIVE.

"Some time back we gave an illustration of a steam-carriage which was driven from Buckingham to Windsor Castle. The accompanying engraving represents a similar one, built for the Earl of Caithness, with which his lordship, accompanied by Lady Caithness, the Rev. W. Ross, and Mr. Rickett 'travelled north;' in fact, drove from Inverness to Barrogell Castle, a distance of 150 miles, virtually in two days, and which is considered the boldest and most difficult enterprise recorded in the annals of road locomotion. A trial trip to a point 150 miles ahead, with a full load of passengers and luggage, over some of the most mountainous districts of Scotland, the party for the most part unacquainted with the route, and the supplies of coal and water therefore uncertain; sometimes ascending hills of 1 in 7, towering up to a splendid sea view, and again descending the winding roads cut in the hill sides, crossing the mountain gorges at an acute angle by a narrow bridge, down an unprotected gallery of rocks, without the slightest accident or danger, certainly speaks well for the noble conductor, and also for the inventor of the carriage. It is stated that his lordship travelled the first stage from Inverness to Beauly, a distance of 14 miles, in one hour and twenty minutes, notwithstanding



frequent stoppages for horses and once for water. After leaving Beauly, on those parts of the road where some distance forward could be seen, he attained a speed of 18 miles an hour, and could have kept it up for any distance with ease and safety. He drove up the hills without difficulty, and, proceeding down the very steep declivity near where the road joins the other from Tain, the control his lordship had over it was most satisfactory, and enabled him to descend at any rate he pleased with perfect ease and safety.

"On the Monday he started from Golspie at an early hour, numbers assembling to see if it would manage the steep ascent leading to Dunrobin Castle; but, as usual, drove right on, amidst hearty cheers, to the town of Helmsdale, about 15 miles, when, on stopping for water, egress from the carriage was almost impossible from the crowd of Gaelic fishermen assembled. The town is situated at the foot of 'the Ord of Caithness,' a noted mountain, which, it was said, would bring the engine to a stand if anything could; and oft was the cry repeated, 'Ye'll ne'er get o'er the Ord!' The ascent commences immediately on leaving the town with an incline of about 1 in 10, and continues for five miles frequently 1 in 7. Winding up the precipitous route, the deep, strong, but regular beat of the engine told that, though severely taxed, the task was not more than it could manage, and without once stopping or flagging it reached the summit, when the party congratulated themselves on the crisis of the enterprise being so satisfactorily passed. For the descent into Berridale Glen his lordship had provided a special drag, but found that, with the party walking down, the ordinary screw-brakes were quite sufficient to keep it perfectly under control.

"At Wick, about seventeen miles from his lordship's residence, the arrival of the carriage was anxiously expected. Horsemen went out to meet it, and the firing of cannon announced its approach. The whole town appeared to have turned out, for the streets were thronged, and, being situated a hundred miles and more from any railway, steam on the highroads was hailed with enthusiasm. His lordship stopped more than an hour for refreshment, and then, amid the gathering shades of night, drove on to Barrogell; but the nights are not dark in that treeless county, and his lordship drove as merrily as by daylight to within a few miles of John o' Groat's.

"These carriages are designed by Mr. Rickett to carry three persons at 10 miles per hour on any ordinary roads, which they appear satisfactorily to accomplish. They require about the same space as a horse and chaise, carry sufficient water for 10 to 15 miles, and coal for 30 miles, weight 30cwt., and are well mounted on springs, the only noise being that of the escaping steam, which can be stopped instantly when horses appear frightened. The arrangement is such that the carriage and the engine are distinct, and the duties pertaining to each divided. The fireman keeps up the supply of power by attention to the fire and water, while the person occupying the front right-hand seat turns it on as he thinks proper, having absolute control in the use of the steam and in guiding the carriage.

"In the engraving the splashers are taken off the wheels in order to show the machinery, which when working is protected from dust and dirt.

MOTOR-CAR.

[43212.]—I HAVE read with much interest the first article on a small motor-car in the ENGLISH MECHANIC of Jan. 5. As one who has had a car for some time, may I venture to make one or two criticisms on the general design?

(1) The flat cords so largely employed will not, I fear, be satisfactory. In my case they are used for three purposes, one of which is to move the throttle-valve, which is opened by pulling out a stop, and is closed by the pull of a spring when the stop is pushed in. I find that the constant bending round the pulleys breaks first one strand and then another, till at last the cable breaks in the road, much to the inconvenience of the driver. If this is so, it will be worse in the hard work given to it by the writer of the articles.

Then the spring tension of jockey pulley will, I fancy, give a lot of extra friction on the belts. Mine has a fixed pull by a lever with many notches, and I find that, after starting, the pull on the jockey is very much decreased, as the belt with the slack side at the top tends to wrap itself round the pulleys, and so takes the weight off the jockey; but with a spring-tension, the weight of the drive would have to be added to the constant spring-pressure.

Again, much more slack will have to be allowed for, or there will be great loss of power when on the top speed, and I do not think a 3in. belt will answer, as, when on the top speed, the low-speed belt will, of course, be driven by countershaft over pulley or engine-shaft at considerable speed; and even with a much narrower and slacker belt I have found this absorb a considerable amount of power in slipping friction.

I am sorry to see the writer falling into the common fault of providing such a small chain-pinion on countershaft, as the acute bending angle of the chain as it passes over this causes much noise and very rapid wear to the chain; he might double both wheels with advantage, and follow the good lead of all the French racing cars.

Then as to steering, a chain is not reliable for this purpose; and I am sure a pinion and two racks will be found better and safer practice.

These few remarks are based on the actual experience of an owner of a car, who has been through the mill of practical work; and before setting out to make a car, I would advise the amateur to satisfy himself that an actual car has been made to the drawings, and is giving good results. So much depends on dimensions, which, in spite of calculations, can only be found by actual use.

I am only an amateur, and in no way interested financially in the manufacture of motor-cars.

Country House.

DIAGRAMS OF LOCOMOTIVES AT THE SOUTH KENSINGTON MUSEUM.

[43213.]—THE authorities of the South Kensington Museum have placed in position the first six of the long series of the intended locomotive diagrams. The illustrations are all drawn showing the left-hand side of the engine, and the scale throughout is ½in. to the foot, as follows:—

Liverpool and Manchester Railway. — Eight engines, built 1830 to 1834.

Leicester and Swannington Railway.— Eight engines, built 1832 to 1839.

Great Western Railway.—Seven engines, built 1837 to 1855.

Robert Stephenson and Co.—Ten engines, built 1825 to 1851.

Charles Tayleur and Co., Vulcan Foundry.—Ten engines, built 1833 to 1853.

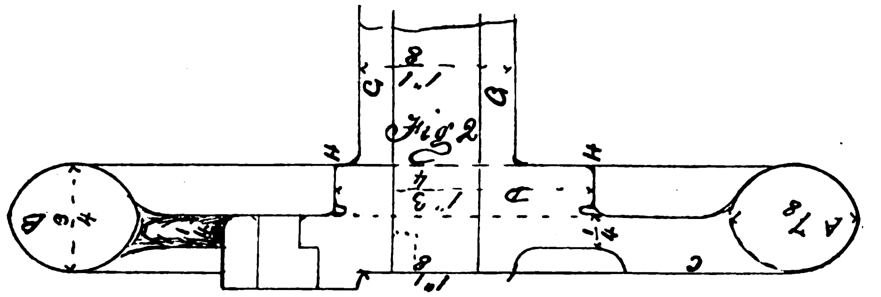
Edward Bury and Co.—Ten engines, built 1830 to 1849.

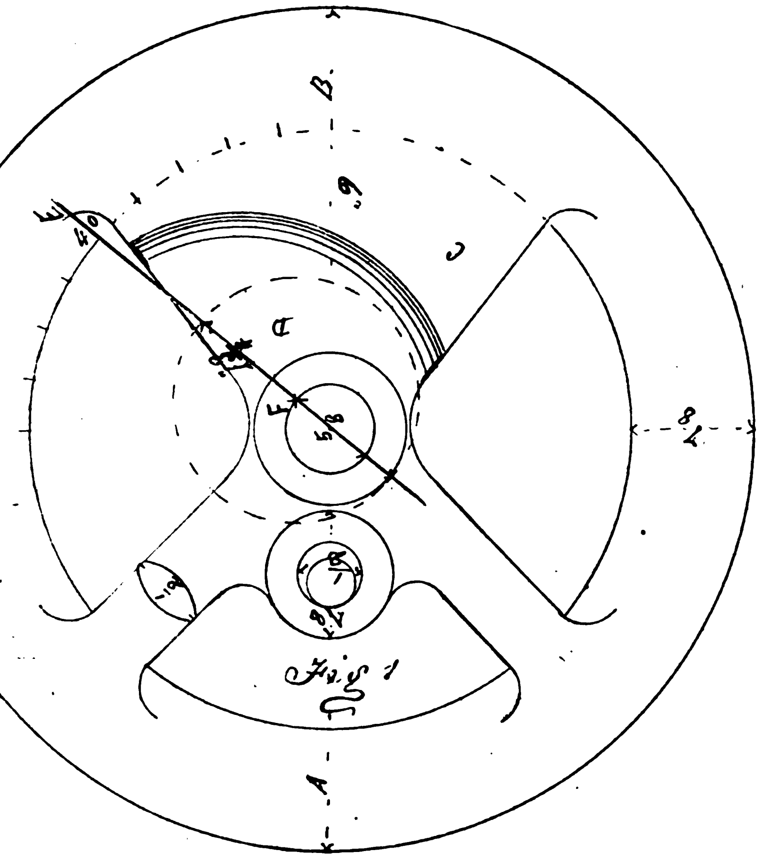
Thus the six diagrams give 53 illustrations.

One of the most interesting engines on the lists, to my mind, is the Dreadnought, of 1830, having coupled wheels and an intermediate crank-shaft; but in a short time, when it is said the Stockton and Darlington diagram will be framed, that must be of especial interest. **Observer.**

HOW TO BUILD A LIGHT ENGINE FOR VARIOUS PURPOSES.—III.

[43214.]—THIS is a front view of the flywheel, Fig. 1, with boss for crank eccentric and balance-weight cast in one. This is designed for the bracket engine, the boss upon the back side, G G, being an elongated bearing, as it is run on a pin; but when wanted for the others, is not continued farther than H H, so that I am killing two birds with one stone. The section, Fig. 2, is through A B, and letters refer to the same parts in each. C is the balance-weight,





and it can be tried with the connecting-rod, and if found too heavy, a hole can be drilled in its thickest section. D is the eccentric, E being the angle for setting out, and F the centre. Dimensions are given for all parts; but, if you think proper, you can augment your diameter, all other things being the same, unless you require a longer stroke; then, of course, you will want other things altered. But if you have made provision in your entablature for a larger diameter flywheel, still retaining your stroke, you can augment your power by having a larger diameter cylinder, and of piston to fit, all other things being the same—i.e., if you, in the first instance, make cylinder-seat upon bracket large enough, and clearance under for flywheel. I mention this that you may make this large enough in the first onset that you may at a trifling expense augment your power. The old gear will be always saleable. This is worthy of consideration all round.

Jack of All Trades.

SODOM DESTROYED BY THE LEONIDS.

[43215.]—THESE are the last few lines that I can spare for Mr. Garbett. He first appeared with a coarse personal epithet and allusions to Lyell and Darwin, which I noted, and with crass assertiveness he drifts into Bible legends. These are beyond the pale of exact modern science, and are not to be discussed therewith. The student of geology truthfully studying facts from the stone-leaves or stratifications of the earth's crust, acquires a knowledge of its formation during immense epochs of time; he gains no true information from ancient Scripture legends, and has to ignore them. So, also, must these be repudiated by the disciples of the tangible science of evolution from primitive forms of organic life to more advanced beings gifted with instinct or mind by the influence of surroundings. As yet we know nothing of the relation of mind to matter. This we may hope for.

Instead of shifting the supposed site of the City of Sodom north or south, to avoid a local difficulty, the very mechanical manner of its alleged destruction should decide the point. As a small illustration, a boy might fling stones over a hollow to destroy objectionable living things therein; but if the operation were performed on a Dead-Sea scale, the result would be apparent for evermore.

Mr. Garbett winds up by asking why "Gossip" or myself should not go and examine the alleged remains of Noah's Ark? Simply because I did not believe that this vessel ever existed. There are still millions that do so. Let them raise a small subscription for the search, with Mr. Garbett at the fore. If, instead of finding a few small decayed beams, they should discover the remains of a colossal vessel of enormous proportions, such as man had never before seen, their triumph would be a grand one.

F. H. Wenham.

IS THE THEORY OF GRAVITATION A FINALITY?

[42216.]—I DO not know on what authority your correspondent, Mr. Hugh Alexander (letter 43152), remarks that it is not true to say that *all* the celestial motions are explained by gravitation. True, we cannot explain by gravitation the rotation of the sun on its axis, and that of the earth and planets; but that is only owing to our inferior knowledge about gravitation. If one said to a person who knew nothing whatever about *universal* gravitation, that the same force which urges a stone to the earth also keeps the planets in their orbits round the sun, he would immediately answer, "How?" "Why?" This he would say because the bare statement of the fact is not self-evident; but we know that it can explain the revolutions of the planets, though we are not *yet* able to explain their rotations on their axes by gravitation, which statement does not assert that we shall *never* be able to explain their motions by gravity. As regards the velocity of the moon, I always thought that the moon did move faster when in conjunction than when in opposition, and as for the tides, they are thoroughly explained by gravitation. The reason why the moon generates tides simultaneously at the antipodes is simply that the moon pulls the earth, being nearer, away from the water on the opposite side of the earth to the moon. Your correspondent goes on to say, "The accuracy with which astronomers are able to predict the tides and eclipses is sometimes very improperly attributed to the theory of gravitation." Now the great law of periodicity comes from gravitation, and therefore we use this law of periodicity to calculate eclipses; but we cannot use this law to calculate perturbations. Gravity can explain every perturbation of the moon—and if it can do that, it can explain all the motions of all the celestial bodies—so accurately, that it seems to me absurd to take away that which explains everything, or, at least, may in time be shown to explain everything, and to place in its stead that which explains half. Up to the present we have never met with anything in the celestial bodies that violates the laws of gravitation; why, then, not let it continue? Gravitation, moreover, has nothing whatever to do with physical appearances, nor would the physical appearance of a body alter its attractive force on another body. But if the attractive force of the sun were to change, it might alter the physical appearance of the planets; for instance, if the sun were to pull the planets with a force about 1,000 times as strong as it is now, the physical appearance of the planets might then change from beautiful scenery into dripping. Gravity cannot in any way be related to magnetism, for magnetic attraction is only produced on certain bodies, while the attraction of gravitation is produced on all bodies. Your correspondent in the first sentence says, that mathematicians tell us that "all the celestial motions are explained by the one *law of universal gravitation.*" The italics are mine. Now a stone does not fall to the earth on account of the law of gravitation, nor does its gravity or weight explain why it falls. The laws of nature cannot be the causes of nature. It is often said that gravitation is attraction, and that bodies fall to the earth because the earth attracts them. Now the word "attract" simply means to "draw towards," and to say, when two bodies move towards one another, that they are "drawn towards" one another, is simply to describe the fact, and certainly cannot make us any wiser than we were before. Gravity must exist; but what it is we do not know. It may be a form of electricity, or of some other force; but gravity there must be. The law of gravitation simply states what will happen under certain circumstances. If the theory of gravitation is not a finality, it certainly is not even an initiality.

N. M. Munro.

AIR-SHIP OR AEROPLANE.

[43217.]—I NOTE Mr. Challis remarks that the future of aërial navigation—that is, the capability of travelling in the air rapidly in any direction desired—rests with the use of an extension of wings or aëroplanes, and not with inflated gas vessels.

It is well known that in the year 1856 I made three full-sized arrangements of separated aëroplanes somewhat differing in form, each capable of sustaining the weight of a man, but they all failed for want of equilibrium. This was the weak point in the machines of Lilienthal and Pilcher, whose experiments ended fatally. These performed gliding flights to an extent of near 100 yards; but the only motive force was that from the impulse given at the first start. The whole attention of the occupant of the machine was absorbed in balancing the arrangement during flight—he can do nothing else.

If, instead of wastefully consuming the power due from elevation as a descent from altitude, he could have used his own personal strength for forward propulsion, he would have prolonged his flight considerably—how far no one can state; but this would be the next step in advance, and have given some important data.

I cannot see why we should arrogate to ourselves as Britons the sole ability for success when other nations, and particularly Americans, are working in the same direction with unrivalled mechanical skill.

F. H. Wenham.

ERRATUM.—In letter 43173, p. 473, "Where is the Image Formed?" beginning of twenty-fifth line, for "other," read "ether."

C. A. Naylor.

THE Chicago, Burlington, and Quincy Railroad is putting electric headlights on some of the locomotives used on the fast mail and the Denver limited trains.

THE expedition of Baron Toll, organised for the exploration of the New Siberia Islands and Sannikoff Land, will set out in June next from a Norwegian port, whence it will proceed to the mouth of the Lena, on the banks of which, at a point above the town of Yakutak, it will pass the winter. During the summer of 1901 the expedition will begin its explorations towards the North, picking up *en route* a detachment which will be sent forward from the main body during March, with a sufficient supply of dogs.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96784.]—**Grate Front.**—Querist wants to make a pattern for a set of bars for register grate. Well, why not do so? It is simple enough if he is able to shape a piece of wood; if not, get one made, or else make the whole of wrought iron. The holes can be drilled, as there is no reason why holes in bottom bar should not go right through; nor is it necessary to screw bars in. Make the two horizontal bars about 1in. by ⅜in., the vertical bars about $\frac{5}{16}$in. Round, shoulder one end down to drop in bottom bar, which must have smaller holes than the top one. A. R.

[96951.] — **Inflammation of the Parotid Glands.**—Try (1) painting the glands with tincture of iodine every night until inflammation warns you to stop; (2) ointment of the biniodide of mercury; a little rubbed in every night sitting before the fire. Constitution must be kept up with exercise, good feeding, and tonics, if necessary.

Galway. M. B.

[97069.] — **Formula (U.Q.)** — In reply to "Glatton," my query to be arranged algebraically may be put: How much of a salt containing 5 per cent. chlorine, must be added, say, to ten gallons of water, to make it contain 2 per cent. chlorine? The water contains ½ per cent. of chlorine before the salt is added. My query should have read—line 5—"to make it contain so much per cent?" BAZIN.

[97157.]—**Silver-Plating Aluminium.**—Why is it desired to silver-plate aluminium forks and spoons? It can be done, but *cui bono?* The metal aluminium is very light, but I think it is liable to deterioration when used in the ordinary way as forks and spoons, which sometimes come into contact with vinegar and often with salt. The "advantage" of electro-plating aluminium is, I think, an unknown quantity. M. T.

[97159.]—**Piano-Strings.**—The work is done in a sort of "lathe," which is really only a wire-winding machine. Rig up anything that will turn a wire round, and then supply the covering wire by hand, or automatically from a reel. T. P.

[97160.]—**Automatic American Organ.**—If "Tuner" can refer to the back volumes of this paper—say, from 1883 to 1893—he will find about all there is to learn in connection with the "automatic" American organs. Several correspondents (Mr. Wenham, "A. S. L.," and others) had something to say, and if there is anything further or new, perhaps some reader will give it. The "motor" was a hand-crank; but, of course, clockwork might be used. C. KERR.

[97161.]—**Ship's Surveyor.**—As the querist asks for information as to the exam. under the Board of Trade, why does he not apply to that department? He can obtain all requisite information on application. If he wants to know how to become a surveyor for Lloyd's, he must apply to the secretary of that institution, White Lion-court, Cornhill, E.C. I have an idea that they want people who do not require to ask for information. A 1.

[97164.]—**Zinc Connection.**—See many replies in back volumes for hints, and if necessary repeat the query with fuller details. Wires can be screwed into zinc plates, and be protected with varnish; but it is useless guessing without details. Many plans have been given in previous numbers, and also in Mr. Sprague's work and other textbooks of practical electricity. J. M.

[97174.]—**Water-Power.**—Tables are published which give the power to be obtained from water at different "heads." It will be necessary for the querist to ascertain the "quantity" of water flowing through the 6in. pipe. Does he mean that the pipe is full? METOPS.

[97180.]—**Marine Navigation.**—The statement is one of many which creep into the newspapers of to-day. If four knots can be obtained with the exhaust steam from the auxiliaries, what a waste of steam there must be on the auxiliaries! I should think the statement is simply "rot." I have not yet discovered how to get something out of nothing, and I don't believe anyone else has. I suppose the author of the statement has been told that there is much waste in "auxiliaries"—as there is, very likely; but the exhaust from them will not run the engines of a liner. G. S. N.

[97257.]—**Coherer and Alternator.**—To MR. BOTTONE.—An alternator built as you suggest will answer nicely. There will be practically no advantage in increasing the number of pole pieces; two will be quite sufficient. Let these together embrace two-thirds of the armature. As you do not state the depth of the ring, but its diameter only, I am unable to give you any very exact directions as to the gauge of wire to use for winding; roughly, if your armature is 7in. diameter and 6in. deep, you will require about 6lb. No. 20 on it; the fields will take about 25lb. No. 16. At a speed of about 1,200 revs. per minute such an alternator should give about 2 ampères at 220 volts pressure. This would give you about 40 alternations per second. If you want quicker, you must increase the number of poles in pairs; four poles give 80, and 8 poles 160 per second, &c. S. BOTTONE.

[97256.]—**Windmills.**—If "Alternator" will refer to the description in *Engineering* to which I referred him, he will see that the particular size I gave has been experimented on successfully; I have also tried this size and found it answer the purpose of preventing false readings of pressure due to eddies in the current of air. If air blows across a tube (Fig. 1), there is a reduction of pressure behind

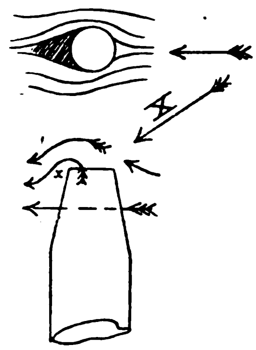


FIG. 1.

it in the position shown by cross-hatching. Air tends to flow into this partial vacuum from the nearest sources, one being the end of the tube as shown by arrows. On this account apparent vacua in a manometer may result from velocity only. In the same way currents such as X (Fig. 1) would show an apparent increase of pressure; the real pressure remaining unaltered. In Fig. 2 I have

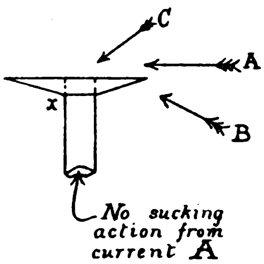


FIG. 2.

sketched a wooden disc with thin edge on the end of a manometer tube. Here the partial vacuum is found at *r* as before; but the end of the tube is shielded from it, and the reading of the manometer registers the true pressure of a current, A. A current B would, however, show an apparent reduction of pressure, and C would give an indication of increased pressure. These errors are eliminated by the wire-gauze sandwich shown on p. 431. The combination with a "pilot" tube, as suggested by me, does not appear in the original description. GLATTON.

[97284.]—**Geometrical Progression.**—We are told that "any biquadratic with numerical coefficients can easily be broken up into quadratic factors by anyone who is able to solve a cubic." This is misleading, for it means that the orthodox method of solving a biquadratic includes its resolution into quadratic factors, whereas the object aimed at has been direct resolution without recourse to cubics. For instance, how can we solve

$$x^4 + 12x^3 + 55x^2 + 113x + 87 = 0$$

by direct factorisation? Factorisation is the crux of equations, and it should be sufficiently clear that no equation of odd degree can be resolved into quadratic factors. For instance, a quintic, if directly resolvable, must consist of linear, linear and quadratic, or quadratic and cubic factors. To maintain that the roots of an equation may be expressed as so many linear factors or simple equations does not assist us in finding them. "Quivis" approves of "guessing" as a mode of factorisation; but, like some others, objects to assumption when made by anyone except himself. Referring to the G. P. in question, I never affirmed that $r = x$, but simply employed that postulate to show that under some circumstances a biquadratic might be solved by means of a simple equation, and that by a necessary property of G P. a second solution was virtually included without reference to quadratics of all. Thus the result $r = x$, which satisfies the problem, includes another—viz., $r^5 x$ = first term, and $\frac{1}{r}$ = rates. Although "C. P." employs a formula which "Quivis" thinks would be adopted by "every experienced mathematician," yet the original querist could not have been expected to know it, and "C. P." did not enlighten him as to its derivation. "Quivis" shows unfairness in appropriating my remarks *re* "A. O. S.'s" solution as his own; also in accepting the assumption that a r may be treated as integers in the indeterminate equation $a + 20r = 42$, while ridiculing the idea in "Ontario's" latest example. He should have reserved his irony for the latter, who made the assumption, and not for one who did not. And here "Quivis" reveals great illogicality, for he says my argument is worthless when "it states that r being integral and equal to $\frac{315 - x}{150 + x}$, which is equal to $2 + \frac{15 - 3x}{150 + x}$, then r is necessarily 2." I certainly do assert this, since for all positive values of x this second term must be a fraction, except it be o, and by the assumption r cannot be the former; whence it must be the latter. But "Quivis" goes on: "Please observe that the *same argument* shows that r being equal to $\frac{315 - x}{150 + x}$, which is equal to $-1 + \frac{465}{150 + x}$ must necessarily be -1, or, better still, r being equal to the fraction $\frac{315 - x}{150 + x}$ must necessarily be zero." Thus "Quivis" allows his bias to overrule his discretion, for (1) no assumption of a negative integer was made; (2) if it had been, we could not make $\frac{465}{150 + x} = o$; and as fractional values are excluded, we are limited at last to $x = 5$, which shows the error made by taking -1 for the quotient instead of $-1 + \frac{465}{150 + 5}$ $= -1 + 3 = 2$ as before. But since "Quivis's" own solution gives one value of $r = -1$, it is strange he should now scout this result, even although he obtains it by inconsequential reasoning. I must dissent from the final clause, since I cannot admit that any quintic can be expressed by quadratic factors. Leaving controversy, we may notice an interesting anomaly. If we take each equation singly, we get x expressed by five values of r, whereas if we subtract the second equation from the first we obtain an indeterminable involving four values only—viz.,

$$x(r + r^2 + r^3 + r^4) = 150.$$

But when x is found, only four values of r satisfy the problem, so that the equation is not a pure quintic, but a disguised biquadratic, by reason of the common factor $(r + 1)$, which should be eliminated. In conclusion, it may be shown that if a direct method of solving biquadratics were discovered, it would enable us to solve cubics without any resort to Cardan's formula.

West Norwood, Jan. 6. HENRY T. BURGESS.

[97284.]—**Geometrical Progression.**—If we limit the question to integral values for x and r, the simplest method appears to be obtained thus: We have—

$$x(1 + r^5) = 315 - 150 = 165.$$

Therefore— $$r^5 + \frac{165}{x} - 1.$$

Now, since x is an integer, the right-hand side cannot exceed 164 (which is less than 3^5). Hence r cannot exceed 2. Now $r = 1$ gives—

$$x = \frac{165}{2}$$

which is fractional, and $r = 2$ gives—

$$x = \frac{165}{33} = 5.$$

Hence the series 5, 10, 20, 40, 80, 160. If worked in a strictly formal way we get an easily solved biquadratic. (I do not understand how Mr. Burgess obtains a quintic.) We have—

$$x \cdot \frac{r^6 - 1}{r - 1} 315,$$

and— $$r \cdot x \cdot \frac{r^4 - 1}{r - 1} = 150.$$

By division—

$$\frac{r^4 + r^2 + 1}{r(r^2 + 1)} = \frac{315}{150} = \frac{21}{10}$$

Therefore— $$\frac{(r^2 + 1)^2 - r^2}{r(r^2 + 1)} = \frac{21}{10}$$

$$\frac{r^2 + 1}{r} - \frac{r}{r^2 + 1} = \frac{21}{10} \text{ (of the form } y - \frac{1}{y} = a\text{).}$$

This quadratic gives—

$$\frac{r^2 + 1}{r} = \frac{5}{2} \text{ and } -\frac{2}{5}$$

The first root leads to—

$$r = 2, \text{ and } \tfrac{1}{2},$$

which give for x the values 5 and 160 respectively.

The other root leads to impossible values from x and r. A. O. S.

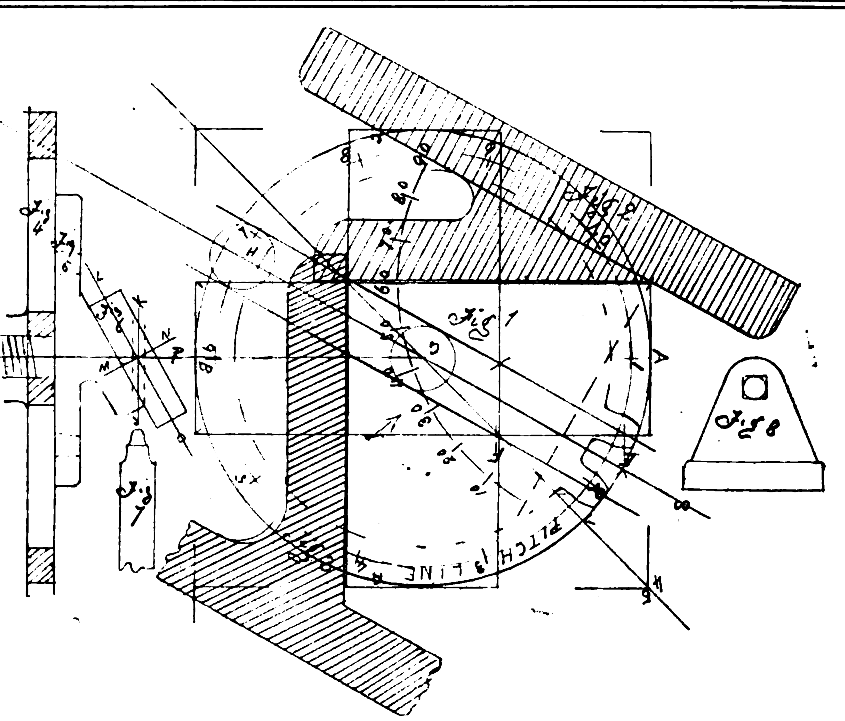
[97284.]—**Geometrical Progression.**—CORRECTION.—In my reply (p. 476), in the expression $\frac{4,265}{243}$ denoting the sum of the six terms, the figures 6 and 5 should change places.
Bath. M.I.C.E.

[97300.]—**Gas v. Petroleum.**—With reference to your correspondent's inquiry in your Dec. 22 number re Gas v. Petroleum, we beg to say that the comparative heating power is in the proportion of 1lb. of oil equals 20c.ft. of ordinary coal-gas.
FLETCHER, RUSSELL, AND CO., LTD.

[97308.]—**Soda and Uric Acid.**—Most of the readers of "Ours" must imagine by this time that uric acid is at the root of all the ills that flesh is heir to—a doctrine so confidently held by a lady who passed through these pages like a brilliant medical meteor some time ago. As a matter of fact, there is probably only one disease caused by uric acid, and that is gout, over-production of this poison being the product, and not the cause of "Bright's disease, &c." As so many correspondents seem to be interested in this question, perhaps I may quote the following:—In the metabolism of the healthy body uric acid and the neutral and acid urates play a very minor part. They are in the form, in reality, of a quadriurate, which, unlike the biurate, is easily soluble in the blood-serum, and it is in this form that the uric acid circulates in the blood, and is excreted by the kidneys. In perfect health the elimination of the quadriurate proceeds with sufficient speed and completeness to prevent any undue detention, or any accumulation of it in the blood; but in the gouty state this process is interrupted, either from deficient action of the kidneys, or from excessive introduction of urates into the circulation, or from some other cause, and the quadriurate lingers unduly in the blood, and accumulates therein. The detained quadriurate, circulating in a medium which is rich in sodium carbonate, gradually takes up an additional atom of base, and is thereby transformed into biurate. This transformation alters the physiological problem. The uric acid—or, rather, a portion of it—circulates no longer as the more soluble and presumably easily-secreted quadriurate, but as biurate, which is less soluble, and probably also, either for that reason or because it is a compound foreign to the normal economy, less easy of removal by the kidneys. The biurate thus produced exists at first in the gelatinous modifications, but with the lapse of time and increasing accumulation it passes on into the almost insoluble crystalline condition, and then precipitation becomes imminent, or actually takes place. The precipitation is particularly apt to occur in certain parts of the body where the circulation is feeble and the temperature low, and in regions where the lymph contains a relatively high percentage of sodium chloride (common salt), as in the synovial sheaths.
Galway. M. B.

[97308.]—**Soda and Uric Acid.**—In reply to "D. W. A." (p. 477), I was not troubled with headache, so do not know if lithia would affect it. If may interest him to know that I had a recurrence of hip-stiffness a few weeks ago, but the lithia cured it in one day; or, perhaps, I should say it had gone after taking the medicine for one day. "D. W. A." has, I presume, gone to a doctor first, and given him a chance of treating him before experimenting with lithia. Uric acid accumulations are not to be treated lightly. GLATTON.

[97318.]—**To "Jack of All Trades."**—Well, I have managed to crowd a lot of information in a small space, and if you cannot see your way after my making wheels, discs, setting out pitching, making angle-plates, and chucking the wheel for you for 10 teeth, and making tool—in fact, doing all but cutting of them for you—at which I draw the line—what must I say? Why, that you are nowhere as a mechanic. If you refer to sketch, you will find A, B, C, D; those letters represent the edge of wheel-discs, the same placed at right-angles to one another; where the line through the top angle and bottom of square is drawn represents angle 45°. If the wheels were cut at that they would have the same number of teeth, and, consequently, go the same speed. Now your discs work out to a pitch of $\frac{1}{8}$, $\frac{3}{32}$, or thereabouts: near enough for wheel-cutting. Now, just drop a pitch as shown at the top of E; draw a line through the centre where you will find G, and another, H, circles of pitches diameters; there you have the path of the cutter to do what you require. Take the pitch of that right and left, and draw a parallel line by the circles; this gives you the centres E and F where they cross the face of wheel-disc. Now, if you set your compasses to these centres, you will find by stepping it around the pitch-line, as shown from 1 to 10, i.e., 10 teeth. Now, on the other disc the angles are different. Refer to the disc C D, now refer to F, and directly below you will find another centre; now, if lined out accurately, take those centres F and the one below upon the left face of C D, and upon stepping that around should give you 20 teeth. This is shown as in Fig. 1. Fig. 2 shows one of the angle-plates, and an arc is extended and numbered to show the angle. Now, if one wheel is cut at an angle of 60°, the next to run into it must be 30°, so that the two form a right angle; for instance, if the plates are made right—the two angles bolted together—their feet will be parallel with each other. Fig. 3 is the angle-plate for the 20-toothed wheel. Now for position in cutting of them up. Fig. 4 is section of a face-plate of a lathe showing through centre of it the two long slots that are put in them at right angles. Fig. 5 represents one of the angle-plates in position with one of the wheel discs for cutting the 10-toothed one (see Fig. 6). It is bolted upon it with a centre bolt and bush with a washer. Now you will see the lines widen, the same as large sketch described above: this is the path of the cutter. Let it be a slide-rest tool, as Fig. 7, or a milling cutter. You see that it is parallel with the chuck or face-plate. To set your discs by you must put centre lines as shown around the side and across the face, as L, M, N, O, and the centre K must be set with a scribing gauge off the face of face-plate on both sides of the disc, and the same from the lathe-bed; both sides of disc level with and in line with the centre, as shown. Fig. 8 shows you the front view of the angle-leaf of the chuck tapered away to clear your tool. Now you must not go right round with your lathe, or you will make a mess of it. Don't forget that I mentioned this, and say I have spoiled your discs. Cut only one side of your wheel—the same as cutting a screw. You had better square under the head of your holding-down bolt, as shown at Fig. 7. Be particular about fitting your job. When once your cutter is set, do not shift it until your job is finished. Your wheel will want dividing out for 10 and 20. The same cutter does for either. Screw wheels are not new—they were originally invented by the Swiss for the Swiss mandrel for watchmaking, to take up back-lash. JACK OF ALL TRADES.

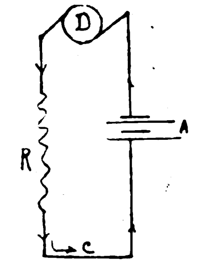


[97319.]—**Belts.**—"Why does an ordinary belt last a very short time?" If it had its due, it ought to last for years, even if it has such short centres and a great strain. I have seen a belt, working exactly the same way, driving a very heavy planing machine, and it lasted for three or four years, and then it was removed to another place. Now, we have a similar case in our shop again, the only difference being longer centres—about 15ft., I think it is—whereas the case before was only 5ft. centres. In our second case, we had a little trouble with the belt stretching such a great deal, but now it is going on famously. "Anyhow, what does W. Moore call a short time, and what's the matter with the belt? Does it break, or what?" I, myself, would think that a rope belting would be worse. APEX.

[97324.]—**Gas-Engine.**—So far as I remember, "Mousetrap's" engine is of the same make as mine. Strange to say, I also had a new crank put in, which had $\frac{1}{16}$in. larger throw than the old one, but it made no difference. The tremendous explosion which you mention is no doubt caused by charge firing before the end of stroke. As for the exhaust going off like a gun, this is probably caused by an accumulation of unburnt gas in exhaust-pipe which explodes when engine exhausts a charge which has fired, and which is still at a high temperature. I have tried inlet spring at various strengths, and find that for high speeds (above 300) it should be strengthened slightly to permit of its working quickly. Your exhaust-valve is probably all right; mine has only $\frac{1}{16}$in. lift, and that is enough. "Mousetrap's" experiences are exactly similar to mine of a year ago, and I must admit that the cause of all the trouble was the ignition tube. My advice is: Keep it hot enough and in the right place, and you'll have little more trouble. Engine shouldn't require to be turned 30 revolutions before firing; it should fire after the first compression. See that your exhaust takes place at the proper time. W. EWART GIBSON.
103, Ferry-road, Leith, N.B.

[97324.]—**Gas-Engine.**—I should hardly think that the new crank would have anything to do with the fault; but, anyhow, "Mousetrap" should look to the other details of his engine first. He should grind his valves in afresh with powdered emery, and see that they are properly down on the seat when fixed in their place. Then the ignition-tube wants looking to. See that the small hole leading to cylinder is quite clear. The spring on the inlet-valve can be tightened a little; and if there is a spring on the outlet-valve, that can be tightened as well. If the exhaust is as sharp as it was when it was running all right, it shouldn't be interfered with. The exhaust should be looked to, and also the air-pipe, to see that they are all clear. If "Mousetrap" finds that everything is all right as described, and it still won't work satisfactorily, he ought to get a man to look at it, and examine properly, for in my experience I have always had to look for the fault, and remedy accordingly.
APEX.

[97339.]—**Accumulators.**—If charging, current



required is 2 amps., R = 20w. If current required is 4 amps., R = 10w., &c. H. L.

[97343.]—**Influence Machine.**—If your plate machine has plates of the ordinary thick glass (nearly $\frac{3}{8}$in. thick) it will hardly be advisable to convert it into a Wimshurst, as the thickness of the glass will militate against its efficiency. If, however, the plates do not exceed $\frac{1}{8}$in. you can convert it into a good influence machine, if built on the lines directed in my book "Radiography." If well made, such a machine will easily give a 7in. spark.
S. BOTTONE.

[97345.]—**Wax Phonograph Records.**—To answer all your queries would take up too much space. I should advise you to get "The Phonograph, and How to Construct It," by the late

W. Gillett. It gives very clear instructions as to making the mould, and the right sort of wax to use, &c. It is published by E. and F. N. Spon.

H. F. L.

[97346.]—**Emery Wheels.** — Turn wheels of pine wood, coat with good glue, and roll in emery-powder, heated to 200° F. Several coats may be required. Is an impure variety of corundum, or pure crystallised alumina, found in Greece (Naxos), Tyre, Smyrna, Asia Minor. The wheels also formed by mixing powdered mineral with a plastic or liquid vehicle, moulding into shape, and then causing to set in solid form. Vehicle may be shellac, artificial stone, loam and water, crystalline limestone. REGENT'S PARK.

[97348.] — **Orientation.** — Sir J. N. Lockyer, Knt., Professor of Solar Physics, has written on Orientation in Egypt, &c. See back volumes of *Nature*; also Julia B. de Forest's "Short History of Art: Roman Art," p. 88, D. M. and Co. Batsford, of High Holborn, useful man to inquire of as to works thereon. REGENT'S PARK.

[97348.]—**Orientation.**—The most notable example in the world is found in the Great Pyramid, which contains several tubes or holes through immense thicknesses of stone perfectly smooth and true, and which for a long time were supposed to be merely vent-holes, but were found to be in exact line with several of the fixed stars, and were evidently intended for astronomical purposes. For a full description read "The Great Pyramid," by Taylor, a very interesting work. MONTY.

[97349.]—**Sore Throat.**—Dr. Ruddock, in his homœopathic book, gives following: Simple soreness uncomplicated by ulceration, quinsy, or syphilis: by Acon., when throat is dry; rough and hard dry cough; and by Bell. if redness with raw sensation; by Merc, if feels swollen, glands sore, enlarged, and slight deafness; or by Nux, if stomach disordered. If you do not mind a fee, consult Dr. Epps, of Great Russell-street; or cheaper at hospital, Great Ormonde-street. Breathe through nose. REGENT'S PARK.

[97349.] — **Sore Throat and Tongue.** — As "Comus" seems to prefer homœopathy, if he will get pilules of Capsicum, and let three at a time, thrice a day, dissolve slowly in the mouth, they will, most likely, improve the state of throat. If this be not strong enough, he may get, at any chemist's, tincture of capsicum; put $1\frac{1}{2}$ drachm of it into 8oz. of infusion of roses, or even plain water, and use it as a gargle—it may have a better effect. He should also improve the general health. After influenza, I have found the tincture of kreat. more effectual than anything. Also, in all affections of the throat, such as diphtheria, quinsy, &c., I have found that a poultice of fresh yeast spread on a cloth, and applied externally on the throat from ear to ear, and renewed as it gets dry, to have the best effect. He should use this as well. W. A. A.

[97349.]—**Sore Throat and Tongue.**—You suffer from a form of aphthous stomatitis, probably following on the influenzal inflammation. (1) Get some chlorate of potash and cocaine lozenges, and suck one occasionally. (2) Use frequently a mouth-wash of glycerine of borax and rose-water, and keep your teeth very clean with a soft brush. (3) Look after your diet.

Galway. M. B.

[97350.]—**Thermo-Dynamics.** — The specific heat of a substance is the ratio between the amount of heat required to raise a given mass of the substance through a given interval of temperature, and the amount of heat required to raise an equal mass of water through an equal interval of temperature. The unit of heat is the amount required to raise 1 gramme of water through 1° C. Entropy or heat-weight hardly lends itself to a definition. But it may be defined thus.—"When a body takes in or rejects heat, it is said to change its entropy." The entropy of a body may be found from the following equations. Thus for water—

$$\phi_{\omega} = \int \frac{\delta h}{\tau} = \int_{\tau_0}^{\tau_1} \frac{\delta \tau}{\tau} = \log_{\epsilon} \frac{\tau_1}{\tau_0}$$

where ϕ = entropy,
τ_1 = final temp. (absolute),
τ_0 = initial temp. (absolute).

For any other substance this quantity is multiplied by the specific heat of that substance, and for steam it is given by the equation $\frac{L}{T}$, where L is the latent heat, and T being the temperature (absolute).

Lasswade. J. WIGHT.

[97350.] — **Thermo-Dynamics.** — Property of body expressed as mathematical quantity which remains constant when a gas or other body changes its volume or does work without any heat entering or leaving it, but which, if a small amount of heat enters or leaves the body, is increased or diminished proportionately to this amount divided by the absolute temperature, sometimes called the thermodynamic function. Since heat always flows from higher to lower temperature, a body that gains heat always gains more entropy than is lost by the body losing that heat. Hence, with every flow of heat the total entropy of a system of bodies rises, and thus tends towards a maximum. Owing to a misapprehension of the meaning of "Clausius, the inventor of the term, "entropy" has been used also to mean available energy. Thermal capacity equals quantity of heat required to raise the temperature of a body 1° Centigrade. No good dictionaries where you live, I suppose. REGENT'S PARK.

[97351.]—**Coating Cardboard Cylinders.**—Dissolve wax (say, 1lb.) in turpentine (say, 3 pints). Mixture trifle thicker than turpentine. Lay on. Dry. REGENT'S PARK.

[97352.]—**Longitude.**—Perhaps this may aid, out of "Encyclopædia Britt." Latitudes and longitudes determined by observations of stars, sun, and moon. As earth rotates, zenith of any place (not on the Equator) traces among the stars a small circle having for centre that point in which axis of rotation meets the heavens. If a star is at this last point it would be apparently motionless, having always same altitude and azimuth, &c. The position of zenith at any moment may be determined by simultaneous observation of zenith distance of two known stars. For these distances clearly determine a point in the heavens whose declination and right ascension can be computed by spherical trigonometry. Thus both time and latitude obtained suitable for travellers exploring unknown country, it is desirable that the stars should differ in azimuth by a right angle (or about). If path of zenith or latitude be known, a single observation of the zenith distance of known star towards E. or W. fixes place or right ascension of zenith at sidereal time. Here pole, zenith, and star are angular points of spherical triangle, three sides known. Angle at pole, being computed, is difference of right ascension of the star, and zenith, &c. Expectations for the longitude depend chiefly on the moon observations. Of course if you have *Nautical Almanac* you will find angular distances of moon from certain stars in its path for every three hours of Greenwich time, and by observing distance of moon from one of these stars, you can infer corresponding Greenwich time at moment of observation. Comparison of this with local time gives longitude, &c. Latitude by measures of star's zenith on the meridian duly corrected for refraction, then the polar distance being known, latitude at once ascertained. The stars should be observed in pairs of nearly equal zenith distance north and south; this eliminates errors. Time best determined by measuring zenith distance (zenith) of stars situated not far from prime vertical; then, the latitude and polar distance being known, the hour-angle P. of spherical triangle found by calculation. Time may also be determined by observing transit of stars over the wires of the telescope of a theodolite set up in the meridian. Longitude also determined by astronomical methods as by observation of moon's motion, or differentially with aid of telegraph lines and travelling chronometers. Absolute longitude is travellers' great difficulty. Observations are of various kinds: (1) Lunar distance, (2) lunar zenith distance, (3) lunar transits over meridian, (4) lunar occultation of stars, (5) eclipses sun and moon, (6) eclipses Jupiter's Satellites. (1) and (3) helped by the *Nautical Almanac*. First requires sextant or other reflecting instrument; (2) may be done with ditto, or a theodolite; (3) with a theodolite. The last three require good astronomical telescope. First requires three observers—one to take lunar distance, the other two to measure zenith distance of moon and star; but as last two are not wanted with great accuracy, the several observations may be taken in succession by same person, and observed zenith distance afterwards adjusted to time of lunar distance. Effects of errors of observations in these methods:—In (1) error in time produces same error in longitude; in (2), error of 1sec. produces at least 30sec. of time in longitude and 1sec. of arc; in zenith distance, at least 2sec. of time in longitude; in (3) to (6), error of time produces same error in longitude. First method preferred by those more used to the sextant; second method by those with theodolite of good telescopic power, and gives very good results when observations are made at most favourable time, or when resultant of moon's motion is in Right Ascension, and in declination lies in the direction of observer's zenith. REGENT'S PARK.

[97353.]—**Altitude.**—Sometimes convenient in topographical and levelling operations, to apply small corrections to observations of height for curvature and refraction simultaneously. Putting d for distance, r for earth's radius, K for coefficient of refraction and expressing distance and radius in miles, and the correction to height in feet. Then correction for curvature $= \frac{2}{3} d^2$; correction for refraction $= \frac{4}{3} \mathrm{K}\, d^2$; correction for both $= \frac{2 - 4\mathrm{K}}{3} d^2$.

Errors are liable, and accumulate, though too minute to attract notice at any single station, as when work is carried on under uniformly sinking or rising refraction, from morning to midday or from midday to evening, or when instrument takes some time to settle on its bearings after being set up for for observation. May be eliminated by (1) alternating order of observation of staves, taking back-staff first at one station and forward first at next. (2) By working in a circuit, or returning over same line back to the origin. (3) By dividing a line into sections, and reversing direction of operation in alternate sections. Cumulative error, not eliminable by working in a circuit, may be caused when there is much northing or southing in direction of line, for then the sun's light will fall endwise on bubble of level, illuminating outer edge of rim at nearer end and inner edge at outer edge, and so biassing observer to take scale readings of edges which are not equidistant from centre of bubble. This introduces tendency to raise south, or depress north, ends of lines of level in the Northern Hemisphere. You may be able to compare these points with your own, and see which are best. REGENT'S PARK.

[97355.]—**Mercury Interrupter.**—The glass tube is drawn out into a fine point, like a sharpened pencil, by pulling out over the flame of a gas-jet or spirit lamp. The extreme tip of this point is then broken off, the platinum wire inserted, leaving as much projecting as desired, when finally the glass is melted round the platinum wire, to which it will adhere easily, by holding over the flame of a spirit lamp, &c. S. BOTTONE.

[97355.]—**Mercury Interrupter.**—The platinum requires no "attaching" to the glass. The tube is fused round the platinum wire, and holds it by the extreme closeness of the fit.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97357.] — **Linoleum Paste.** — Melt and mix glycerine with glue; boil rice flour (1lb.) to thick paste in water (3oz.); next mix glue in little water, add treacle (2oz.) to paste; boil to required consistency. Four parts by weight of glue allowed to soften in 15 parts of water cold for some hours; then moderately heat until solution is clear; 65 parts of water now added and constantly stirred. In another vessel 30 parts starch paste are stirred in 20 of cold water till thin milky fluid obtained without lumps. Into this boiling solution of glue pour, constantly stirring, whole kept at boiling heat. After cooling, 10 drops carbolic acid added to paste. Preserve in closed bottles, will keep for years. Isinglass 7lb., gelatine $5\frac{1}{2}$lb., water 5gal., acetic acid $5\frac{1}{4}$lb., rectified spirits 4 pints. Soak isinglass and gelatine in the water for about six hours, then melt by heat; add the acid; boil until half the quantity by weight; cool, add spirit, and bottle.

REGENT'S PARK.

[97360.]—**Wehnelt Break.**—You must not expect much more than half the length of spark obtainable with a mechanical break. A good deal depends on the shape and bluntness of the anode. Your acid is too dilute;—about 5 parts acid to 21 of water by measure is the correct strength, and if the solution is used warm a much lower voltage may be employed. A tube that gets white hot will soon be ruined. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97361.]—**Clock-Weight.** — There is no fixed ratio between weight of pendulum and motive-power; it depends on the finish of the clock, escapement, weight, shape and arc of pendulum, and firmness of fixing. If the two clocks are alike as regards escapement, arc of vibration, weight and shape of pendulum, and firmness of fixing, you will probably find that your clock has, say, pinions of eight leaves, and the Cooke and Son clock pinions of 10 or 12, as well as much smaller pivots, better depths, and lighter wheels. But if two clocks were built absolutely alike in every respect, I should expect them, when equally well fixed, to go and swing the same arc with the same amount of motive-power.

Ealing. F. M. MANN.

[97365.]—**Deafness.**—Chronic middle-ear disease is usually very intractable. You will not be able to do anything for it yourself; I should advise you to go to an eye and ear hospital for treatment. There is a tube leading from the back of the throat to the middle ear—the Eustachian tube; through this tube injections of a solution of caustic potash 3 in 2,000, a 2 per cent. solution of iodide of potassium, or a 1 per cent. solution of carbonate of soda may be made daily. If all these remedies fail, Gruber, the great Vienna specialist, gives, as a last and somewhat heroic measure direct injection without a catheter of a 1 per cent. solution of iodide of potassium. You will see that these suggestions need a specialist's skill, and that you yourself would not be competent.

Galway. M. B.

[97367.]—**Maximum Rainfall.**—"Pluvius" will have difficulty in obtaining information concerning maximum rainfalls for periods of less than an hour. To obtain even hourly values entails a large amount of labour, for they are, of course, derived from the curves taken off the self-recording rain-gauges, and are tabulated by means of a glass scale. In many of these curves, the time scale is

very small, and it would be difficult to tabulate intermediate values with any degree of accuracy. Moreover, such work would take considerable time, and the weather offices of different countries have not hitherto seen their way to devoting some of their energies to this desirable work, which, if undertaken for several stations where the records extend over many years, would, indeed, be no small matter. Engineers are, however, coming more and more to see the importance of information concerning the duration of individual rain showers, and the only way to get such information published is to agitate for it. NERPS.

[97368.]—**Reconstructing Organ.**—From the particulars you give, it is difficult to say what would be the best course to pursue, or what would be the probable cost of proposed alterations. Is the pedal action faulty, as well as that of the manuals? You say the pipes are good; but the chances are they will all want thoroughly overhauling and revoicing. The first thing I should certainly recommend is the carrying down of the swell manual to CC; this would be the greatest improvement of all. Your scheme for three manuals is not a bad one, and the third manual would certainly be a great addition; but I think, as your funds are only limited, probably the best course would be to have two new soundboards of full compass, new action throughout (tubular pneumatic for preference), new keys, as no doubt these rattle badly. Have the organ cleaned thoroughly, and the pipes revoiced. This would be far better than adding the third manual, and only getting the rest half-done. A question of this kind is difficult to answer without either seeing the organ or having further particulars; but if you will advertise your address in the "Address" Column of "Ours," I shall be pleased to communicate with you, and, when I had full particulars, could tell what your proposed alterations should cost, if carried out properly. DIAPASON.

[97371.]—**Prevention of Silver Oxidising.**—Your silver is not oxidised—it is sulphurised. You cannot prevent this with the existing condition of your atmosphere, except by giving the candelabra, after nicely polishing, a thin coat of clear celluloid varnish. When it is required to remove this, it can be done by washing over with amyl acetate.

S. BOTTONE.

[97371.]—**Prevention of Silver Oxidising.**—If very clean put in a tub of water in which some hyposulphite of soda has been dissolved. This will dissolve the black sulphide of silver; then clean and brighten thoroughly, and give a coat of collodion, put on with a camel-hair brush. If at a distance from a dealer in photographic materials, you can use the flexible collodion as used in surgery. Keep away from a light when using. M. COLE.

[97375.]—**Induction Coil.**—With such fine wire as No. 24 for primary, I should think you would find 50 sheets of tinfoil, 2in. by 4in., none too much for your condenser; 40 sheets 2in. by 2in. or 20 sheets 4in. by 2in. would give practically the same results. It is always better, when practicable, to wind a little floss silk over the joints. Paper cuts through so easily. A better plan is to paint the joints, after having cut off closely any snags of wire, with a little indiarubber solution. This, when dry, is an excellent insulation. A single pint bichromate cell will do all you require. Dry cells are practically of no use for coil-work, as they have such high internal resistance, and also because they run down so soon. Read Bonney's "Induction Coils." S. BOTTONE.

[97376.]—**Wheatstone's Bridge**—It is impossible to give exactly the length of any given gauge of copper or German silver wire that shall have exactly one ohm resistance. (1) Because the resistance varies with the temperature. (2) Because even the act of winding or unwinding the wire hardens it somewhat and increases its resistance. (3) Because no two samples of German silver wire have exactly the same resistance. However, annexed is a short table of the lengths of different gauges of copper and German silver wires that offer approximately one ohm resistance:—

Copper.		German Silver.	
No. 34	9·23ft.	No. 26	31·3in.
35	6·98	28	22·2
36	5·75	30	17·0
38	4·01	32	12·0
40	3·09	34	8·6
		36	6·5
		38	3·75
		40	2·9

Measured at 60° Fahr. S. BOTTONE.

A DOUBLE-TRACK drawbridge, weighing 600 tons, over the Chicago River, was recently shifted bodily a distance of 83ft. The method employed was to jack it up 26in. from its central pier, thus allowing a cradle to be built underneath it. This cradle ran on ways which were lubricated with tallow, and the weight of the bridge having been transferred to it, the whole was hauled bodily to its new position.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Bazin" has replied to 97069.

96967. Grinding, p. 281.
96969. Oscillations of Pendulum, 281.
96972. Motor Cycles, 281.
96978. Nervous Affliction, 282.
96979. Lens for Lantern, 282.
96980. Turning Taper Rollers, 282.
96984. Plugging Holes in Steam Jackets, 282.
96987. Series, 282.
96988. Zither Construction, 282.
96990. Boiler for Motor Cars, 282.
96994. Motor Cycles, 282.
96995. Great Central Newspaper Express, 282.

97133. Kelvin's Rule for Size of Feeders, p. 366.
97139. Rearing and Keeping Goats, 366.
97144. Acetylene Cycle Lamp, 366.
97146. Stanley Telephones, 366.
9714?. Britain v. United States, 366.
97148. Isle of Man Steamers, 366.
97153. Building an Alternator, 363.
97162. Dynamo as Motor, 367.
97163. Aluminium Gas-Engine, 367.
97167. Backstay for Use with Traversing Mandrel, 367.
97168. Flare Spots, 367.
97169. Oil-Engine for Launch, 367.
97171. Stone, 367.
97182. Extra-hardened Grammaphone Needles, 367.
97184. Portrait Painting in Water-Colours, 367.
97186. Speculum, 367.

QUERIES.

[97378.]—**To the Writer of the "Motor" Articles.**—I think there are several, like myself, who would like to make the sparking coil for tricycle motor. Would you please give a few particulars as to size, quantity of primary and secondary wire, condenser, and insulation? There are plenty of particulars of the making of coils in back numbers, so that the quantities for this particular coil are all that are required.—BUNNY.

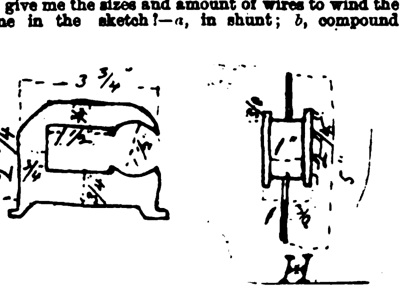
[97379.]—**Microscopic.**—I shall be pleased if some reader will tell me how to obtain a photo. of the eye of a fly, showing an object in each cell, or facet? I have taken one, showing the plain facets, but cannot manage the other. I should also like information as to how to mount the proboscis of a fly for the microscope. I have tried several times without success. I find it shrinks up when taken from the head. Canada balsam is the only medium I have tried for mounting.—W. R. WARD.

[97380.]—**Manchester Dynamo.**—Will some kind reader give me the dimensions of wire for a Manchester-type dynamo? The armature is made up of plates 2⅜in. diameter, with a hole 1⅜in. through. The armature is 3⅞in. long; the field-magnets 2in. diameter and 4in. long. The commutator has twelve parts. I would like the dynamo to charge accumulators.—THOMAS JOHNSON.

[97381.]—**Piston Speed for Launches.**—Can anyone give me a rule for the piston speed for small launch-engines? The formula 144 $^3\sqrt{}$stroke in inches does not apply to engines, say, under 50I.H.P. Any information will be gladly received.—C. E. L.

[97382.]—**Rats.**—I live in an old-fashioned country house, and lately we have been very much troubled with rats. Would any reader be kind enough to tell me how to get rid of them? I have a number of dogs, so I am afraid of putting poison down.—RATS.

[97383.]—**Dynamo.**—To MR. BOTTONE.—Would you kindly give me the sizes and amount of wires to wind the machine in the sketch?—*a*, in shunt; *b*, compound



wound. Also, the output and speed to be driven at in each case?—IGNORAMUS.

[97384.]—**Storage Battery.**—Can any reader give me any information respecting an "Epstein" storage battery containing 55 cells 13 plates? It was put in some years ago for a discharge at 50 amps. for six hours. The output has gradually fallen, until now it is practically *nil*. The battery has, so far as I can find out, received very fair usage. The appearance of the plates is good; they are not buckled, and the serrations are still distinctly visible—in fact, they (the plates) seem to have lost little or no weight. The S.G. seems normal, but the electrolyte turns very white, and foams a lot after one hour's charge at about 30 amps. I am told that this falling-off of output is very common in this style of plate. Can any reader give his experience in the matter, or any advice concerning the means of increasing the output? I intend to tackle it myself, having plenty of appliances to hand. What does Mr. Avery think about it?—ENGINEER.

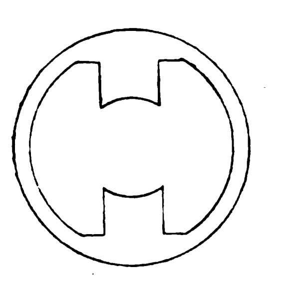
[97385.]—**Oxygen.**—In the Brin process of manufacture of oxygen where pressure is used, what pressure do you start at? How high does it rise before you begin to tap off your oxygen? How do you separate the nitrogen from the oxygen? What sort of retort is best to use? A sketch would oblige. What heat is required?—OXYGEN.

[97386.]—**Drilling Gold Quartz.**—I should be glad of any information which would enable me to safely bore a hole 2in. diam. and 2in. deep in a piece of gold quartz about 4in. long, 4in. broad, and 3in. deep. The sample is not homogeneous.—B. B.

[97387.]—**Frost on Window.**—Is there any solution that can be applied to window-glass to keep the frost off?—D. J. MCGREGOR.

[97388.]—**Match Composition.**—Can any reader tell me if the composition used for tipping matches has, or is being, used for other purposes than the above? If so, what are they?—ASHCROFT.

[97389.]—**Series-Wound Motor.**—Would Mr. Bottone or Mr. A. H. Avery be good enough to give me the size and dimensions of steel carcase, and diam. of armature, and gauges and quantities of wire, to construct



a series-wound 3B.H.P. motor to work on a 23?-volt circuit of the inclosed type, as per sketch, slot armature?—YOUNG ARMATURE WINDER.

[97390.]—**Electro-Deposit.**—Will some kind reader inform me whether it is practicable to electrically deposit metallic lead on cast-iron plates to a thickness of $^1/_{32}$in.? What apparatus would be necessary? I have plenty of power.—FUSE.

[97391.]—**Spun Glass.**—How is this done, and what kind of apparatus is desired? Any tips will be gladly taken by—CASENHEM.

[97392.]—**Tarnished Silver.**—How can I keep my Sheffield-ware silver candelabra on the sideboard without being tarnished (with gas, presumably), and having to be cleaned every few days?—CASENHEM.

[97393.]—**Telescope.**—I am thinking of getting an astronomical telescope, price to go up to about £16. Will some astronomical reader advise me of a good all-round instrument for home use? Would not a 3in. student's telescope with equatorial mounting be best?—F. B.

[97394.]—**New Moon.**—In *Whitaker's Almanac* of the current year I note there is no new moon in February. Will some of your astronomical contributors kindly state how long since there was a month in which the same occurred before, and when it will occur again? A similar answer with regard to the full moon would be interesting. —NEW MOON.

[97395.]—**Propellers.**—Will any readers kindly give me any information about propellers, the amount of slip, as it is called, or power that is lost? Is it the intermittent stroke of the blades where the power is lost? Also, could anyone tell what has become of patents such as Bovyer, Allison, Forrest and Myers, and others?—W. W.

[97396.]—**Gassner Cell.**—I have an exhausted dry cell—a large Gassner—and I want to revivify it. I have had two large Bunsen cells, in series, connected up with it—the carbon of Bunsen to zinc of dry cell—for thirteen hours, but this failed to waken it. Can anyone suggest a cause, and a remedy? Perhaps the cell is dried up. If so, will it be necessary to replace the mixture in the cell, and, in that case, what is the best?—C. H. W., Eccles.

[97397.]—**Aerial Ropeway.**—We wish to construct an aërial wire ropeway, 500 yards long, the carrying rope being supported on intermediate supports spaced 100 yards apart, the individual loads carried being one ton each, and the total number of loads on the whole length of rope at any one time not exceeding five, or a total gross load of five tons on the rope at once. One load on each span. Will any of "ours" kindly give calculations to show: (1) The horizontal strains on the terminal supports at each end? (2) The strains on foundations for these? (3) The weight required at the end of the carrying rope to give the necessary tension for the loads? (4) The vertical and horizontal strains on the intermediate posts, which would be about 16ft. high, each? (5) The horse-power required to drive the hauling rope for above, one end of the ropeway being 60ft. above the other, against the load, speed three miles an hour? (6) The hauling rope being an endless one, what weight will be required on the terminal pulley to give sufficient grip on the driving pulley?—ROPEWAY.

[97398.]—**Climate of China.**—What is the general climate of China, and what sort of weather do they have in the capital? I read that "Pekin, China, is frozen up for six months of the year, and the inhabitants enjoy ice-sledging at Christmas." Is that so, for the city is in about 40° N. Lat.?—F. F.

[97399.]—**Wireless Telegraphy.**—It is mentioned in some of the papers that wireless telegraphy cannot be practised with success in countries where there are ironstone mountains. Why is that?—W. M.

[97400.]—**Dynamos in Parallel.**—Can two dynamos be run in parallel, each designed to give 100 volts, but current for each respectively 350 ampères and 250 ampères?—ACC.

[97401.]—**White Brass.**—In the engineers' shop where I am at work they are using a metal similar to white metal for the main bearings of a crankshaft for a marine engine, and it is called magnolia. In another shop which I am acquainted with they are using similar

metal for the same purpose, which goes by the name of "white brass"; but I am told by a practical brass-finisher that he has never heard of such a metal. There is only one kind of brass, and that, of course, is yellow. Will any reader kindly tell me if they have ever heard of white brass; if so, I would like to know if it is a composition?—ENGINEER APPRENTICE.

[97402.]—**Windmill.**—Will someone who has a Chicago aërmotor, or knows their make, kindly give a sketch or sketches of the mechanism of this windmill, showing especially the arrangement for "feathering" or altering the angle of the vanes according to the velocity of the wind. I am told that, with a 14-mile wind, a 16ft. diameter mill develops 5 nominal H.P. Is this so? Also, that it stands a cyclone without being blown down, owing to its perfect feathering.—WINDMILLER.

[97403.]—**Accumulators of Woven Glass.**—Can anyone who has experience of these "glass" accumulators give particulars as to their efficiency and durability?—WINDMILLER.

[97404.]—**Wilson's Four-Cylinder Locomotive.**—Robert Wilson is said to have built an engine with four cylinders in 1826. Can any reader give me any particulars of how it worked? Was it simple or compound?—LOCOMOTIVE.

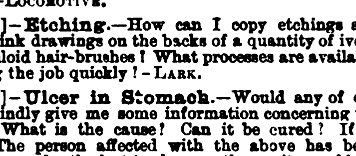
[97405.]—**Etching.**—How can I copy etchings and pen-and-ink drawings on the backs of a quantity of ivory and celluloid hair-brushes? What processes are available for doing the job quickly?—LARK.

[97406.]—**Ulcer in Stomach.**—Would any of our friends kindly give me some information concerning the above? What is the cause? Can it be cured? If so, how? The person affected with the above has been wasting away for the last twelve months; quite unable to keep any solid food down for the last three months. About seven weeks ago began to vomit a large quantity of what appeared to be congealed blood; this continued for several hours, and then ceased. Could this have been the ulcer broken in the stomach? The person in the mean time has been very low, and has lived on milk ever since. Is this sufficient to sustain life until the patient recovers from the effects, or will the ulcer gather again?—TEMPUS FUGIT.

[97407.]—**Carburetter.**—I have a 4½H.P. benzoline motor with a surface carburetter, and shall be very grateful if "Monty" or others of our practical readers can tell me what number or size Longuemar carburetter is suitable for this engine? Would this carburetter do away with the pure-air valve, and give as good, or better, results? Any information about the Longuemar will greatly help.—AMATEUR.

[97408.]—**Alignment of Machine Tools.**—Having a number of new tools to examine and test for alignment, I wish to know the best way to proceed. I have no gauges or trammels at my command, but would make them if some kind reader would give a few hints. The tools include centre, chucking, and turret lathes, horizontal boring, universal milling, radial arm drilling, and planing machines. Perhaps "J. H." could give an idea of the methods adopted in tool-shops? Is there any book published on the subject?—ANXIOUS TO KNOW.

[97409.]—**Axle to Motor-Car.**—Will the writer of articles on "Motor Tricycles" kindly advise what size live axles to use for 4H.P. two-seat motor-car? Also, if



differential gear will answer if placed between hub and spring, as per sketch.—MOTOR-CAR.

[97410.]—**Dry Battery.**—Can one of these batteries be recharged by attachment to the switch for lighting an electric lamp?—BATTERY.

[97411.]—**Edison-Lalande Battery.**—Could any reader oblige by letting me know how the Edison-Lalande batteries are worked, as I have several, and am in a fix? Fullest particulars, as I am some parts short.—G. B., Aston.

[97412.]—**Meridian Passage of Stars Locally.**—In your "Astronomical Notes for January" the writer endeavours to give an explanation as to how to find the local time of southing of any given star at any other station than Greenwich, and this chiefly for the benefit of your younger readers. Now, I am certain to 90 per cent. of such the explanation as given will only mean confusion, for local mean time to them at least will simply mean the time used locally, and which the writer will know is, for any part of England, Greenwich Mean Time. Why he has introduced local mean time in its true sense when such a thing is not in use, one is at a loss to understand. α Arietis will south at Falmouth 20m. 8s. − 3·30s. = 20m. 4·7s. after the time of southing at Greenwich, Greenwich Mean Time being used.—W. B. D.

THE output of coal in Great Britain this year is expected to reach 225 million tons, of which about 50 million tons is for consumption by our Royal and mercantile navies and for export.

THE first electric launch to be used on the canals of Venice has made its appearance. A syndicate has taken the matter up and secured this first launch as a type of what they wish to run for passenger traffic on the canals subject to the approval of the local authority. The launch, which is called the *Alessandro Volta*, provides accommodation for about 50 passengers. Its length is about 56ft., and width 10ft. It is equipped with 100 accumulators, and its mean speed will vary from seven to nine miles per hour.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 10, and unacknowledged elsewhere:—

S. R. BOTTONE.—A. Jacks.—J. W. Riding.—Turner.—Astronomicus.—Bolter.—J. A. C.—James Wright.—Major.—G. T.—G. B., Aston.—J. E. L.—Arcturus.—Jack of All Trades.—William Godden.—Photo.—H.—Davison and Reed.

MARK.—Can only refer you to the textbooks of astronomy. We have not the slightest idea "at about what date" it was "discovered that the moon does not shine of its own light." It is not impossible that Adam discovered it. (2) It appears to be definitely established that the whole solar system, as we know it, is travelling through space. (3) There is a "well-founded theory" that the "earth will ultimately come to grief." Please refer to the back volumes.

G. J. C.—Not now, except that a speed limit is enacted and local authorities can make by-laws. The inspector at the police station can tell you. Furious "driving" is a matter for the attention of the police. No license required unless you carry passengers and ply for hire.

R. MOORE.—There have been so many articles on the subject that we cannot recognise which you mean. You might look through the indices of the ten volumes preceding this. They are most likely in one of the free libraries near you.

INCOGNITUS.—Walker's is still a very useful dictionary. "Rhyme" means words expressed in "numbers"—that is, verse, poetry. "Rime" means hoar-frost, Anglo-Saxon "hrim." The second question is answered by saying that the best pronunciation is "wer," the e being sounded as in "met." To "run wild" would mean to go recklessly; to "obtain"—the "doctrine *laid hold of*," in the sense given. The "day wears" means that its duration is lessening. The "shoe gives" means that it yields. As to what it is necessary to do on London Matriculation papers, we must refer you to the papers themselves, or to such a work as the "London University Guide," published by the University Correspondence College Press, Burlington House, Cambridge.

MG. HPAW, Moulmein.—The tinned (or canned) provisions, whether meat, jams, fruit, milk, &c., are placed in the tin cans, the lids soldered down, and a hole left for the escape of air, steam, &c. They are then placed in a vessel, and subjected to a temperature high enough to drive out the air and vapour, when the hole is closed with a drop of solder, thus producing a sort of vacuum. Jams are preserved by boiling in sugar.

W. T. H.—There is an illustrated description of Joy's oil valve-gearing on p. 236, No. 1493, Nov. 3, 1893; of the gearing as applied to a locomotive on p. 572, No. 1481, Aug. 11, 1893; and the original as applied to marine engines was described in the back volumes. We think the inventor published a card of instructions, but the arrangement is described in most of the manuals.

OLD READER, Burton-on-Trent.—The material generally used for sealing cells is pitch; but for a full answer you must really give some more information about the "pocket accumulator."

J. W., Birmingham.—Letter is much too long and covers too much other ground. We cannot in these columns discuss the whole question of field tactics.

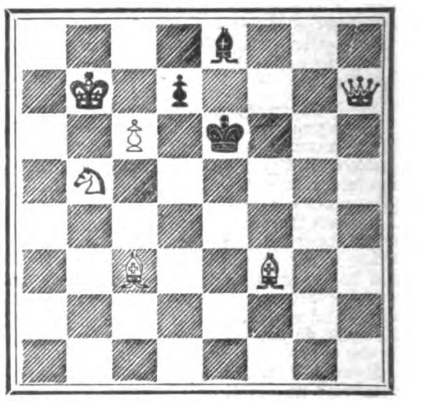
Carbide of Calcium.—A Russian engineer (M. Orlowsky, of St. Petersburg) has made an improvement in the manufacture of calcium carbide, which has for effect the prevention of the absorption of damp and the more regular and slower evolution of acetylene when in contact with water. He places the carbide just when it comes from the electric furnace, and whilst still hot, in a mixture of one part of tar and forty parts of petroleum residues. It is also reported that Herr Wolff, of Berlin, has patented a process for its manufacture which entirely does away with the electric furnace. A compound of lime, carbon, and powdered aluminium is mixed together, and then fired by a slow match or torch. The aluminium, it is said, combines with the oxygen of the quicklime, and the temperature thus caused is so high that the lime melts and combines with the carbon.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1709.—By J. JONES and W. SHINKMAN.

Black. [3 pieces.



White. [6 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Jan.* 22, 1900.)

Solution of PROBLEM No. 1707.—By J. GRAVES.

Key-move, B-B 2.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1707 (incorrectly numbered 1706).—Correct solution has been received from J. E. Gore, G. W. N., Quizco, Richard Inwards, Rev. Dr. Quilter, F. B. (Oldham), A. Tupman, F. Gowing, N. M. Munro.—Only solution as above.

H. B. F., W.-H., W. E. C.

THE British Chess Company are distributing copies of the wall-sheet "Laws for the Regulation of Games Played over the Board," being Part II. of the British Chess Code (revised edition). These are intended for use in Chess clubs, reading-rooms, Chess resorts, &c. Should any of our readers desire this wall-sheet, they are requested to send the address of the club or room in which Chess is played to the British Chess Company, Stroud, Glos., and a copy will be sent without charge.

AN American engineer, Mr. Chas. T. Porter, in the discussion on Prof. Thurston's paper, read before the American Society of Mechanical Engineers, described the plans which he has for the construction of a steam-engine which shall produce a horse-power for 9lb. of steam per hour. The plan consists chiefly in the use of high pressures, high ratios of exhaustion, high piston-speeds, and a system of reheaters by which condensation would be avoided.

The Food of Plants.—An instructive and entertaining glimpse of the mysterious processes by means of which plants secure their food is given by Mr. H. H. W. Pearson in the current number of *Knowledge*. He says: "It is more than 2,000 years since philosophers began to speculate about the food of plants and what we may term their 'digestive' processes, but it is only during the latter half of this century that really clear and definite notions concerning the food supplies of the vegetable world have been generally accepted by scientific men. . . . As far as is known, the first botanical experiment ever performed was conducted by Van Helmont. He placed in a pot 200lb. of dried earth, and in it he planted a willow branch which weighed 5lb. He kept the whole covered up, and daily watered the earth with rainwater. After five years' growth, the willow was taken up and again weighed, and was found to have gained 164lb.; the earth in the pot was dried and weighed, and had only lost 2oz. Knowledge was not yet sufficiently advanced to enable Van Helmont to interpret these striking results correctly, and he came to the erroneous conclusion that the increased weight of the plant was due to the water which had been supplied to the roots. He therefore looked upon this experiment as supporting the theory which he had advanced—viz., that plants required no food but water." Stephen Hales advanced the subject a great step by indicating that much of the increase in weight of plants was derived from carbon dioxide in the air. Vegetable cells contain a liquid known as "cell-sap," which is water holding in solution various materials which have been taken up from without by the roots and leaves. "These materials are thus brought in contact with the protoplasm, which causes them to undergo changes in composition which prepare them to be added to the substance of the plant. Thus it is in the protoplasm of the living cells of the plant that those 'digestive' processes are carried on which Aristotle believed to occur in the soil. We see, then, that the living cells are microscopic laboratories in which the digestion of the food of the plant is carried on."

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 19, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—III.

THE cylinder, which is of cast iron, is shown in Fig. 4, which is a side elevation showing the facing for the valve-box. Fig. 7 the square flange which goes next to the crank-chamber. Fig. 8 shows in the upper part a cross section on the line C D of Fig. 4, the lower part being a cross-section on the line E F (Fig. 4). Fig. 8 also gives dimensions for the studs, which hold the valve-box on to its facing. Fig. 9 is a section on the line A B of Fig. 6, showing the depth of the bosses and dimensions of the studs which hold the cover on to the cylinder. The bosses G (Fig. 4), shown dotted, run through the water space, connecting the water-jacket walls to the cylinder. The dimensions of the facing for water-inlet and outlet pipes shrinkage allowances, prints being put on for the bore and the various openings in the sides. For the water connections, plain cylindrical prints; on the valve-box facing, one rectangular print to include cylinder port and water-jacket opening, will be required. Observe in Fig. 5 that the interior of the cylinder is chambered out $^1/_{16}$in. larger in diameter for the combustion chamber. This, though not absolutely necessary, makes a better job of it, allowing the boring tool to be free from the cylinder port, and also preventing the piston from wearing the cylinder-bore to a shoulder. At the extreme back

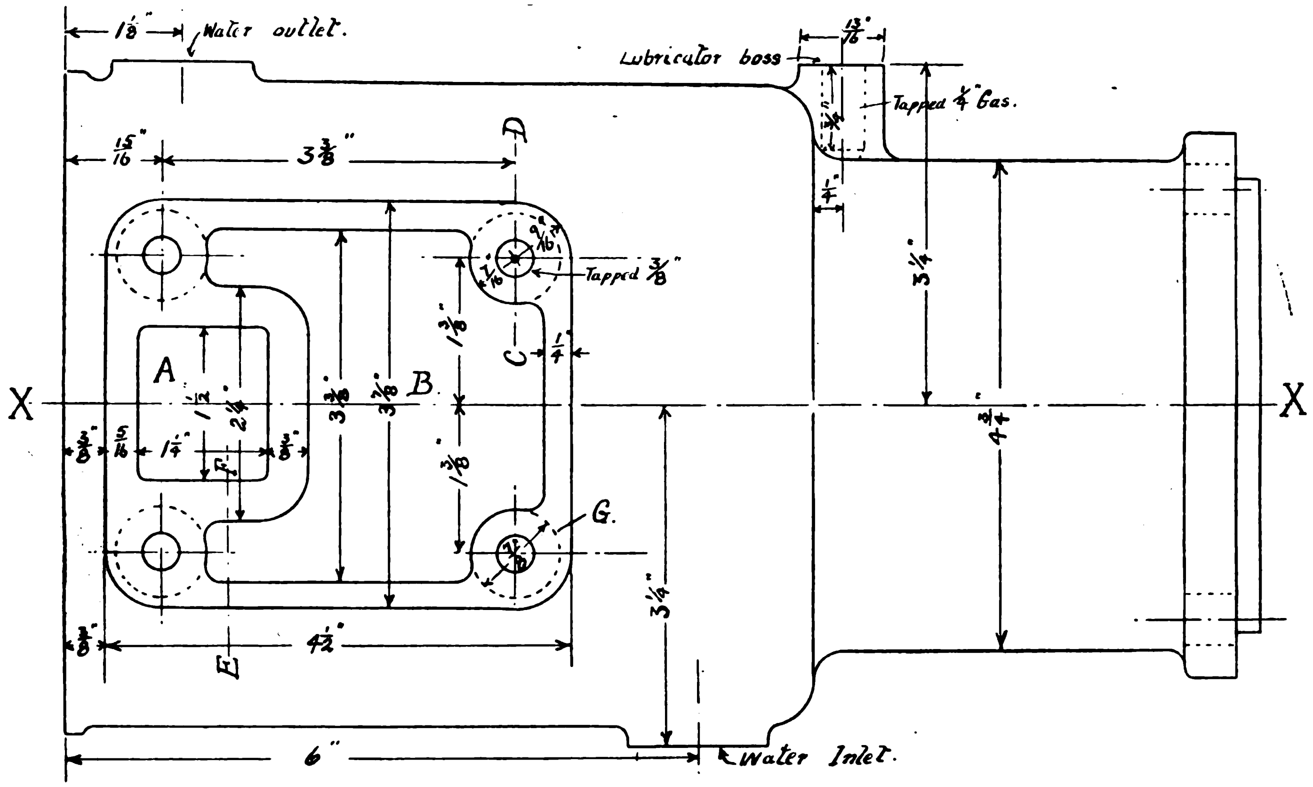


FIG. 4.

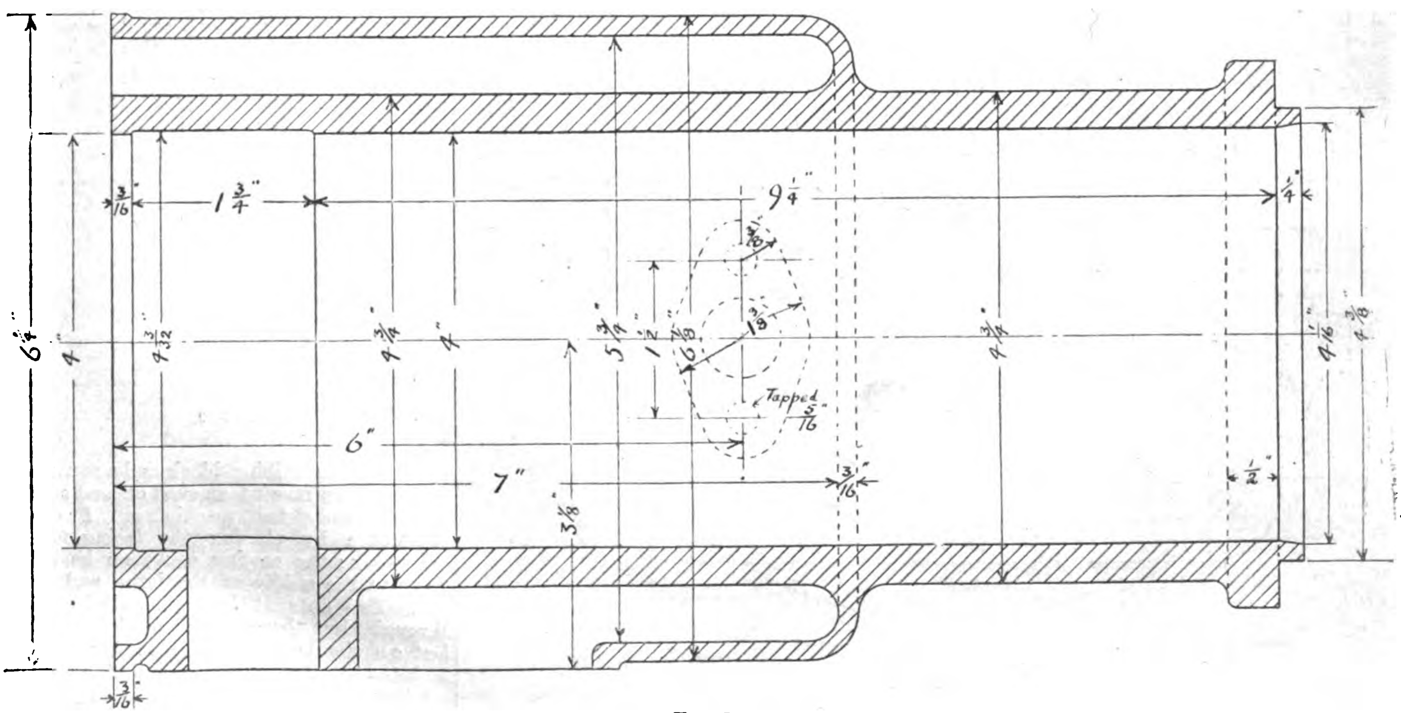


FIG. 5.

A is the port communicating with the combustion space, and B the opening to the water space around the cylinder. Compare this view with the sectional plan (Fig. 5) and the end elevations (Figs. 6 and 7). Fig. 6 is the combustion-chamber end, and may be obtained from Fig. 5, where the inlet facing is seen dotted. The central hole in these facings is $\frac{3}{4}$in. diameter, and is cored through into the water space.

The pattern for the cylinder will be made exactly as its casting, plus machining and end of cylinder, the bore is again reduced to 4in. for $^3/_{16}$in. in length, to form a fitting for the cover to check into. At the front, or crank-chamber end, the mouth of the bore is slightly enlarged to enable the piston and rings to be readily inserted. The cylinder

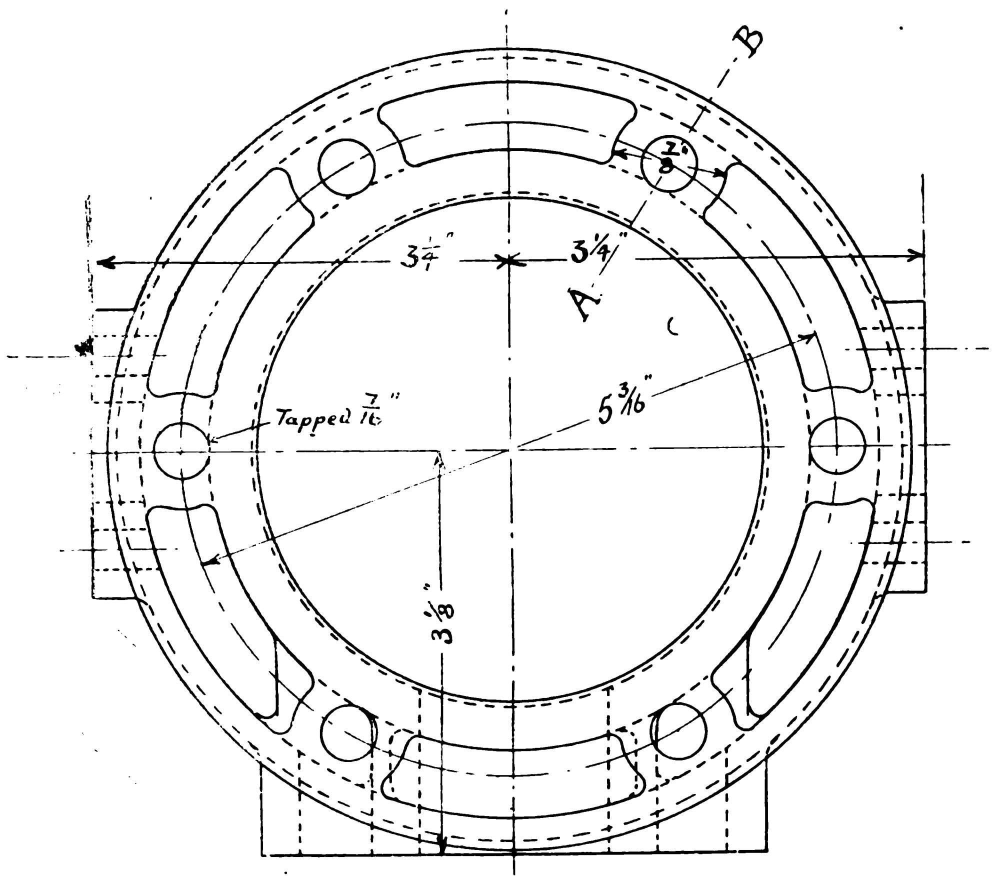


FIG. 6.

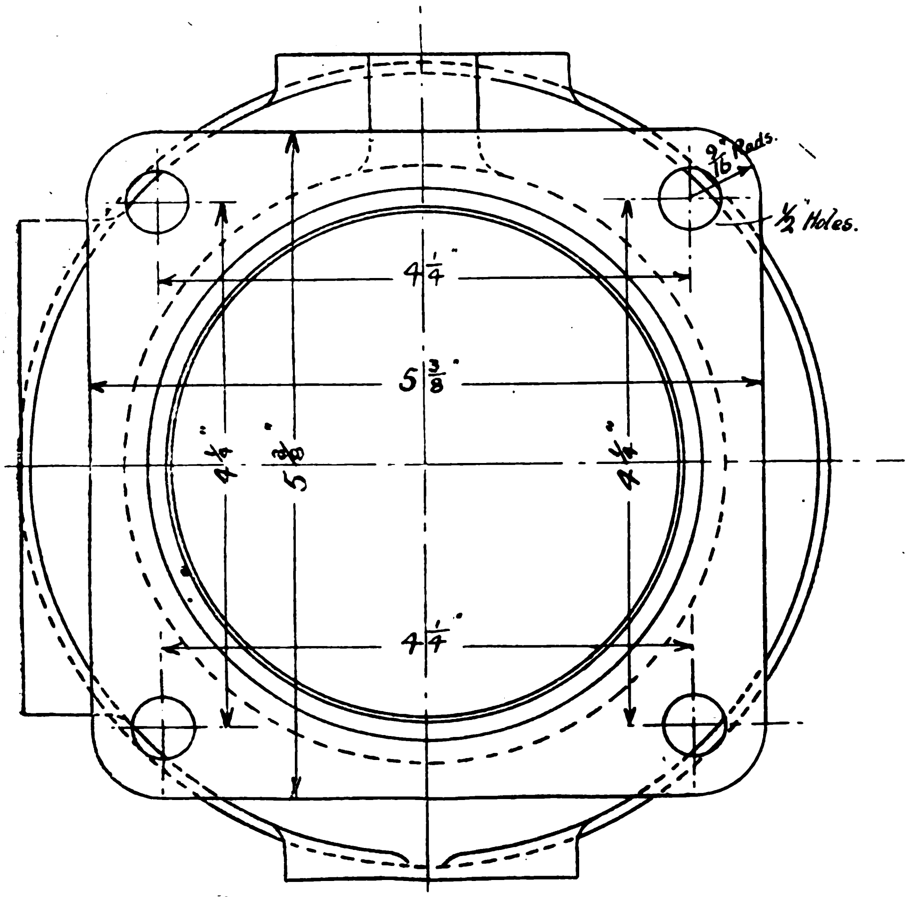


FIG. 7.

will mould with the facing for the valve-box on one side, and the pattern should therefore be jointed along the line X X, in Fig. 4. The water space is cored out, the print for the cover end being included in the print for the bore. This print should be a good length, say 4in. or 5in., to balance the overhanging portion. The hole through the jacket for water inlet will also enable the jacket-core to be supported. The use of chaplet nails for supporting this core is to be deprecated, as they tend towards leakage. To insure a sound casting, the cylinder should be cast in dry sand, and every care taken to avoid blow-holes. The bosses D, Fig. 6, for the cylinder-cover studs are arranged for in the jacket core-box. In this core-box a wooden cylinder to give the metal for the cylinder is arranged so that it can be withdrawn endways (in a direction away from the combustion-chamber) before the core-box is opened. The combustion-chamber end of the main cylinder core is carried inside of, and concentric with, the portion of the jacket core which lies in the space made for it by the large print on cylinder end. The cylinder core need not enter the jacket core more than an inch or

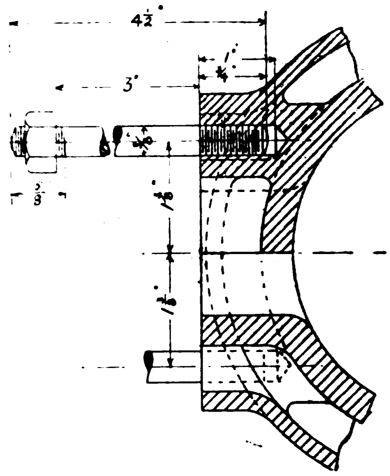


FIG. 8.

so, as this will be quite sufficient to centre and support it.

Having obtained the casting, whiten it with chalk, and proceed to mark it off for machining. Bridge the ends of the bore with a strip of hard wood; find the centre, averaging the metal to be removed, so as to keep the walls as even as possible in thickness. Mark out circles for the bore at each end and witness circles 1-16in. all round these, and centre-pop at about ⅛in. intervals all round each circle to avoid obliteration. Block up the casting on a level surface, getting the centres at each end exactly equidistant from the marking-off table. The facing for the valve-box should be vertical. Mark a centre line across this facing, and also across each end of the cylinder. By

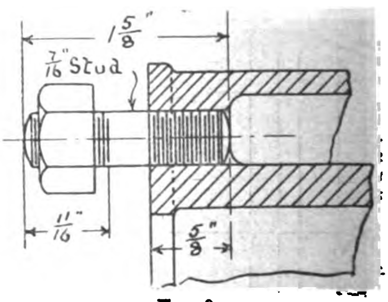
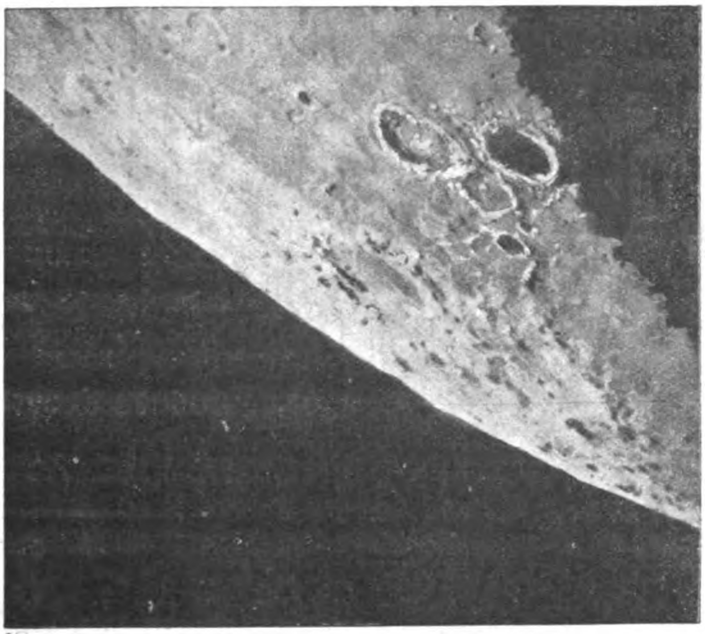


FIG. 9.

means of the scribing-block and a square, all the faces can now be marked off and centre-popped ready for machining. I should commence by planing the facing for the valve-box; the casting can then be bolted down to the saddle of the lathe and bored out. Two cuts at least should be taken through, but three would be better. The last cut should be just a scraping cut with a broad-pointed tool, using a fine feed to get the bore as smooth and true as possible. At the same setting the ends of the cylinder can be faced and the bore bell-mouthed, using properly-shaped cutters, or the cylinder can be mounted on a mandrel and the ends turned off to the correct dimensions. After boring, the remaining facings can be machined and their stud-holes drilled and tapped.



Atlas and Hercules.

The stud-holes on valve-box facing and for cylinder cover had best be left until the box and cover are drilled, and be marked off from them. The four holes in the square flange, can, however, be marked off and drilled at this stage. The lubricator boss is to be drilled right through $^3/_{16}$in. diameter, and then enlarged or tapped $\frac{1}{4}$in. gas for $\frac{3}{8}$in. in depth. The water-connection facings are furnished with two studs each, the studs to be $^5/_{16}$in. diameter and to stand up $\frac{3}{4}$in. above the facings. In drilling the holes for these studs you can drill right through into the water space, as there will be no leakage if the studs are made a good fit to the tapped holes.

THROUGH A SMALL TELESCOPE.—V.

By NORMAN LATTEY.

CONTINUAL cloudiness, with a persistence that seemed almost malicious, sadly interfered with observations of the moon during the period between "new" and "first quarter" of

Double Cluster in Perseus.

the present lunation. As, however, it is possible that clearer weather may attend the birth of the young crescent at its reappearance on the evening of the 31st of this month (the "new" actually occurs at 1.23 in the morning), it will be as well to draw the reader's attention to a few of the principal formations, which are the first to be slowly revealed after their immersion in the inky darkness of the long lunar night.

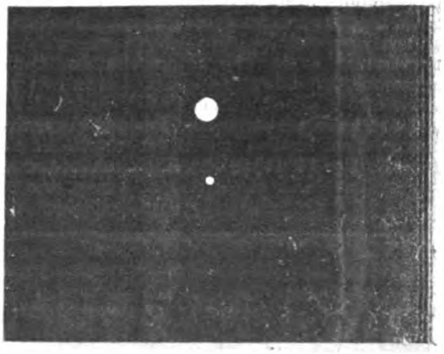
A reference to any map of the moon (Messrs. Geo. Philips and Son, of Fleet-street, London, publish a splendid one by the late T. Gwyn Elger, F.R.A.S., at 2s. 6d. unmounted) will easily enable the student to identify the various objects about to be described—that is, if he is not already familiar with their shapes and positions. The most conspicuous formation that will be noticed under a low power—40 to 60 diameters—when the moon is two or three days old is the Mare Crisium, just below the widest part of the crescent. Here lies a scene of almost supernatural beauty, and one which offers an entire evening's fascinating study of its precipitous cliffs and winding valleys encompassing the smooth level interior, pierced here and there with tiny craterlets. Among the prominent ring-plains situated on the surrounding heights is Condorcet, 45 miles in diameter lying at the base of Cape Agarum, that little promontory jutting out into the sombre depths of the *mare* on its north-western "shore." Condorcet is encircled by a lofty wall 8,000ft. above its floor, and possesses a decidedly dark interior.

Let us, however, now put on a higher power, about 120, and commence operations systematically at one end of the crescent, say the uppermost or southern cusp (it should be remembered that an astronomical telescope inverts and the north is invariably at the bottom of the picture, though the east and west retain their normal positions). Almost at the very tip of the horn will be noticed the western spurs of the loftiest range on the moon, the Leibnitz mountains, which stretch right across the pole. Of course, the remainder of this stupendous chain is at present steeped in darkness, but it contains one peak at least 27,000ft. high. Glancing further down, the eye is not long in resting on a striking formation, Furnerius, the first of a chain of four magnificent walled plains stretching northward for 600 miles towards the equatorial regions. As will be seen, Furnerius is an irregular inclosure of greater breadth than length, the latter being about 80 miles. Its rampart is very lofty, and on the eastern side of the floor will be perceived a smaller ring-plain containing a little central hill. Not far below lies a still more superb object, Petavius (the second member of the chain). Extending for nearly 100 miles from north to south, its grand double rampart incloses a broken convex interior, in the centre of which stands a closely grouped pile of central mountains, one peak of which rises 6,000ft. above the floor. The most striking feature of this colossal crater is a huge gash or cleft which cuts diagonally across the interior from the central mountains to the south-east wall. It can be clearly discerned with a 2in. telescope. The eastern rampart, which is intricately terraced, rises to enormous heights, especially where the companion ring-plain Wrottesley encroaches upon it. Here the peaks rear themselves up to 10,000ft. above the floor. The western wall is, however, comparatively much lower, rarely exceeding 6,000ft. in altitude.

In Vendelinus the third of this series, we have the most irregular formation of the four, with its low broken rampart, scored and hollowed by many clefts, rings, and depressions. The continuity of the western wall is completely broken by a good-sized ring-plain some fifty miles in diameter; and in the southern border is a wide gap partially closed up by another ring-plain. On the eastern wall are several high peaks, two of which cast spire-like shadows on the floor under evening illumination—i.e., immediately after "full moon," when night again begins to creep over the shining disc, warning observers that the lunar day is drawing to a close. Should an opportunity be afforded, drawings will be made of one or two of the foregoing features at that favourable period.

Langrenus, the most northerly of the quartette, may well be ranked among the finest objects on the Moon; but it, in common with the previous three, suffers greatly from the foreshortening effects of the moon's spherical surface, a circumstance which robs it of much of its stateliness. Its almost continuous ring ranging from 8,000 to 10,000ft. in height, is close upon 90 miles in diameter, and deeply terraced on the inner slopes. A brilliant central mountain adorns the interior plain, while bright streaks stretch out into the Mare Fœcunditatis from the eastern flank of this vast formation.

Crossing the Equator we once more find ourselves on the shores of the Mare Crisium (already referred to). But we must not linger. Several important objects have yet to be examined. The



ε Persei.

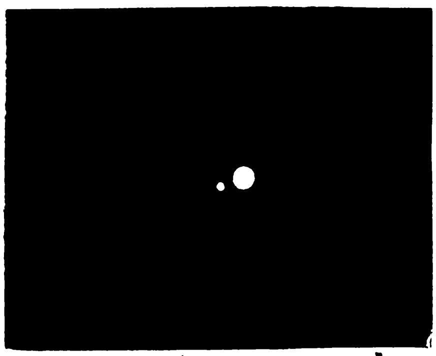
most notable in this district is Cleomedes at the north end of the *mare*, a large oblong inclosure 78 miles in diameter, its massive walls rising 8,000 to 10,000ft. above the interior. On the western wall under a rising sun, when about one-fourth of the floor is in shadow, three depressions curiously shaped like the figure ∞ can be easily distinguished. Still further north, and almost on the edge or "limb" of the moon, is Gauss, a circular-walled plain 111 miles across. Owing to its situation it also is much foreshortened into an elongated ellipse with a very broken border. A magnificent mountain chain stretches from north to south across the floor, which is sprinkled with several large rings, craters, hillocks, &c.

Hard by is Geminus, a smaller ring-plain with steep terraced walls towering up 12,000ft. to 16,000ft. It must be borne in mind that terrestrially compared, these altitudes far exceed anything we can boast of on the earth. Reduced to the moon's more diminutive sphere Mount Everest's 29,000ft. would shrink to a trifle over 8,000. Terrestrial peaks of more than ten miles in height would be required to rival the lofty summits of Geminus.

There are many more important features favourably placed during the first five days succeeding the "new," notably two fine ring-plains Guttenburg and Goclenius situated on the narrow strait dividing the Mare Fœcunditatis from the Mare Nectaris. There is, likewise, a remarkable pair known as Messier lying almost in the middle of the Mare Fœcunditatis. The latter undergo curious changes as the sun draws overhead, and are connected with two remarkably light streaks and dusky spots, the nature of which still defies explanation. It is to be hoped that meteorological conditions will permit of sketches of a few of these interesting objects at the next lunation. In the mean time we must conclude our survey this week with

Atlas and Hercules which lies on the terminator near the lower or northern horn when the moon is about four and a half days old. At the time of making the drawing, which is a copy of a photograph with the finer detail, lights, and shadows filled in at the telescope), Atlas, it will be noticed, is well within the lighted area, and its rather dusky interior clearly illuminated by the morning sun. Its much broken and irregular walls present a most complex circumvallation scored by innumerable ridges and clefts. Even in a small telescope it offers a striking and bewildering spectacle far beyond the power of words to describe or pen to adequately delineate. Hercules, its companion formation, is still struggling out of the embrace of night, its depressed floor, 46 miles in diameter, being yet steeped in blackness, but surrounded by a brilliant ring of light where the morning rays are tipping the lofty summits of the border. Viewed under a higher sun, Hercules presents a wonderful sight with its remarkable terraces, landslips, and depressions. Endymion, the ghostly-looking walled plain nearer the sharply defined rim, is also surrounded by lofty peaks, but they are better seen a day or so earlier.

Snatching a fleeting opportunity during a brief period of clear sky one evening, a few stellar observations were obtained—chiefly in that rich constellation Perseus lying between the W of Cassiopeia, and the glittering group of the Pleiades. The most conspicuous object in the latter is of course the double cluster which appears to the naked eye like a globular haze of nebulous light—as if a bit of the Milky Way had got condensed; a simile probably not far from the truth. This splendid twin cluster consists of a large number of 6½ to 14 magnitude stars aggregated together in two dense groups. The figure as nearly as possible gives a correct representation of what it looks like through a 4in. Cooke refractor stopped down to 3in. and armed with a power of 60. The object can easily be found, for it lies right on the confines of Perseus where that constellation borders on Cassiopeia (R.A. 2h. 11m. N. Dec 56° 36′) η Persei is a pretty 4-mag. star with a bluish companion of 8 mag. but its

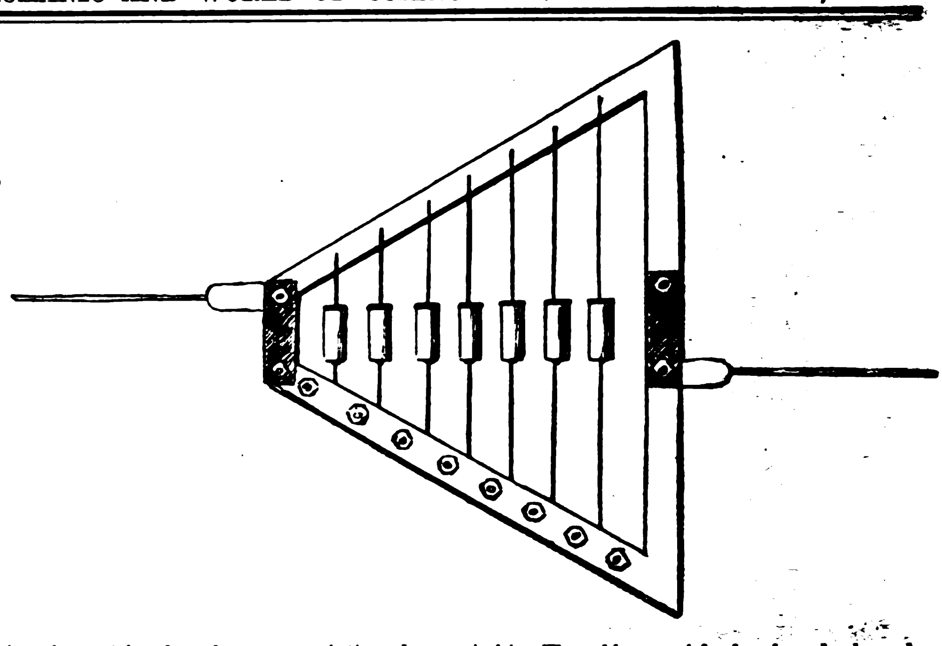


γ Ceti.

distance 28″ is too wide to conveniently represent here on our present scale. β Persei (the famous variable star Algol) "The Demon" of the Persians, is worth watching on account of its remarkable fluctuations. Shining with a constant brightness as a 2-mag. star for about 59 hours, it suddenly diminishes in lustre until in about 4½ hours it sinks to 3½ mag., at which, however, it only remains for some 15min., when it immediately begins to rise again. In about five hours the star recovers its normal brilliancy of 2 mag., all the changes being gone though within ten hours, although sixty-nine actually elapse between the successive minima. ζ Persei is a pretty specimen of a quintuple. The primary of 2½ mag. has four companions, one of 9½, two of 10, and one of 12 mag. On a dark, clear night the 9th and 10th mag. *comes* may be detected with a small instrument, but they need some looking for. ϵ Persei, on the other hand, is an object as easy as it is beautiful, with its 3½ mag. primary and 8 mag. companion, and the figure gives a good idea of the appearance of this star under a power of about 200.

Though rather low down in the south there shines an object γ in the constellation Cetus (The Whale) which is well worth examining. It can easily be found, for it is the nearest conspicuous star to α Ceti, which forms an equilateral triangle with the Pleiades and α Arietis, the apex of the imaginary triangle, of course, pointing downwards towards the horizon. An inspection will show γ Ceti to be a fine 3½-mag. star with a greenish companion only 2½in. distance. It may be a minute or two before the *comes* can be discerned, but steady gazing will ultimately show it quite plainly involved in the diffraction rings surrounding its glaring primary.

The instrument was again a 4in. photo-visual refractor by Messrs. Cooke and Sons, of York and London, its aperture stopped down to 3in. as usual.



A SENSITIVE COHERER FOR WIRELESS TELEGRAPHY.

A MODIFICATION in the construction of the old form of coherer, which exalts the sensitiveness and range of receptivity of the receiver, has just been perfected by Messrs. S. Bottone and Son, of Wallington. It consists, as shown in the cut, of a number of metallic cells, fitted with tightly-fitting ebonite caps. The cells contain filings of different grades of fineness, of an antimony alloy, having different electrical resistance. These cells are supported, as on stalks, by different lengths of platinoid wire, and through the caps, passing downwards so as to reach the filings, are inserted varying lengths of similar wires. Finally, the bottom and top sets of wires are electrically connected to two insulated half-triangular brass frames, each half being connected by suitable wires to the terminals of the receiver. Owing to the varying resistances in the cells themselves, and the varying capacity of the wire extensions, such a "multilocular polytonic coherer" is capable of responding, not only to very minute wave disturbances, but also to Hertzian waves extending over a very wide range.

THE STRENGTH OF RUBBER HOSE.

THE introduction of steam heating in railway carriages has made it necessary to provide rubber hose connections which shall stand the rather severe duty of this peculiar service. In the case of air-brake hose, the problem is confined to securing tightness against leakage of air under pressure, and endurance of the wear and tear of operation and handling. For steam heating connections, however, there are effects of steam and the action of hot water to be considered, and experience has shown the necessity of providing strict specifications and exhaustive tests, in order to insure satisfactory results.

A series of tests has recently been made at the Government Testing Laboratory at Charlottenburg, and the results are now made public in a paper in the *Mittheilungen*, by Prof. Rudeloff, and as the subject is one of international interest, an abstract of his paper is here given.

The requirements of the German Government for steam hose are very strict, and are in substance as follows:—

The hose is to be made with five layers of pure linen, with sheet rubber between, and is to be covered without with linen. It must stand an internal pressure of 150lb. per square inch, either hot or cold, without injury, and when subjected to internal pressure of 60lb. for four hours, should not twist. The rubber must be free from foreign substances. A temperature of 350° Fahr. sustained for four hours should not affect the strength, nor injure the hose in any way. The presence of hot water under pressure should not cause the linen to be easily separated from the rubber, nor the layers of rubber from each other.

Holding these requirements in mind, the tests made by Prof. Rudeloff may be considered in brief.

After a careful measurement and inspection of the samples they were subjected to an internal pressure of 150lb. with water at the temperature of the air, with water at 170° Fahr., and with steam pressure. A pressure of 60lb. was then maintained for three hours, and an inspection for defects then made, after which the sample was subjected to a heat of 350° Fahr., both with steam and with dry heat, and the strength of the material then examined. The adhesion of the linen to the rubber was also determined, both for the original condition and after exposure to the action of boiling water.

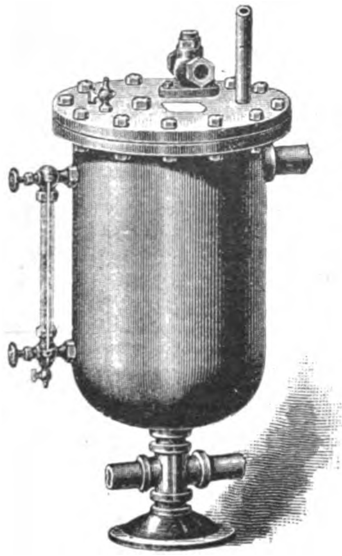
The specimens tested were about 22in. in length, 1⅜in. internal diameter, with walls ¼in. thick, and examination showed that the rubber penetrated the fibres of the linen so that it appeared to be of one entire mass. A number of samples were tested, and the results are tabulated fully in the original paper, together with a description of the apparatus used. The circumference of each piece was carefully measured near each end, and in the middle, both before testing and afterwards, as well as during the application of the pressure, and similar measurements were made of the length.

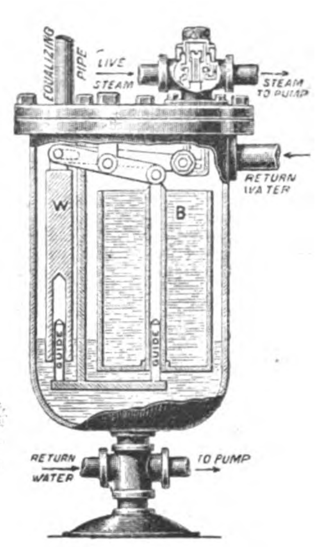
So far as resistance to cold water pressure is concerned, the specimens tested gave excellent results, the slight increase in diameter under 150lb. pressure disappearing entirely when the pressure was relieved. The corresponding tests with water at 170° Fahr. resulted in a permanent increase in circumference of about ¼in., but the hose appeared otherwise unaffected. The specimens, however, failed to resist satisfactorily the test of 150lb. steam pressure, as the circumference was enlarged nearly 1in., and the length diminished 0·6in., while the outer covering was loosened and partly destroyed. The twisting action which takes place consequent upon prolonged internal steam pressure was shown by the fact that one specimen twisted 15 degrees when under steam pressure of 60lb. for three hours, with a permanent twist of 8 degrees, and another specimen showed 9 degrees twist and a permanent set of 2 degrees.

The action of prolonged heat varied according to the manner of application. Rings cut from various portions and opened out were pulled in the Rudeloff testing-machine, both in the original condition and after heating. Exposure to steam heat at 350° Fahr. for four hours made the rubber much softer, the extensibility under given load being increased fully three times, and the ultimate strength diminished to less than one-fifth its original amount. Exposure to dry air at 350° Fahr. for four hours, on the contrary, made the rubber harder, and diminished the extensibility very greatly, although the ultimate strength was reduced nearly as much as with the steam.

When the material was exposed to the action of boiling water for half an hour the adhesion of the linen layers to the rubber was not appreciably reduced.

In view of the importance of producing hose which shall satisfactorily meet the requirements of the German railways, these tests should prove of especial value not only to manufacturers of rubber goods, but also to the engineering profession generally.—*Engineering Magazine.*





AUTOMATIC PUMP-GOVERNOR AND RECEIVER.

In the steam-heating system of a building an automatic device should be provided, which receives the water of condensation from the radiator coils and pipes, controls the pumps, obviates the objectionable "hammering" of the pipes, and returns the water of condensation to the boiler while still hot. A device of this nature is made by the Creamer Steam Specialities Company, Jansen Hasbrouck, proprietor, of 126, Liberty-street, Manhattan, New York City.

The apparatus, as our sectional view indicates, comprises a receptacle (into which all water from coils, &c., drains) containing an open metal bucket, B, and a weight, W, twenty times heavier than the bucket, both hung from the ends of a lever fulcrumed at its middle. A second lever is fulcrumed at the weight end of the first lever, and is connected with the vertical stem of the steam-valve. As the water of condensation flows into the receptacle, and into the bucket, through the return pipes, the weight descends, pulling down the corresponding end of the lever, thereby opening the steam-valve and automatically starting the pump. When the water within the receptacle has been pumped out, the distribution of weight is reversed, the filled bucket now being twenty times heavier than the weight; hence, the weight is raised, the steam-valve closed, and the pump stopped. As the water again accumulates in the receptacle the bucket is buoyed up, and the operation begins anew.

The apparatus is now in use in many large office buildings and institutions, in connection with pumps of all kinds. In old and new buildings it will completely obviate all those objectionable noises in steam-pipes which are occasioned by the collection of the water of condensation. The returning of this water of condensation in its heated condition to the boiler is another of the advantages incident to the use of the device.—*Scientific American.*

THE JEWEL OF THE DEEP.*

Although many fine pearls are said to have been comparatively recently discovered in Arkansas, pearl fishing in the waters belonging to the United States amounts to little at present. But there was a time, many years ago, when the rivers, bays, and various other places on our coasts were explored for pearls with an eagerness that could have been aptly termed pearl fever. As a result of this quest of the jewel of the mollusc many were found; but they were, except in a few cases, of small size and no great value. One of the largest found was the "Queen Pearl," which was sold by Tiffany to the Empress Eugénie of France for 2,500dol.

Not being able to find pearls in paying quantities in his own waters, the enterprising American sought to force the mussel to produce the desired jewel by inserting into its mouth a foreign substance, around which nacre was to be deposited to make the beautiful laminated globules. An exquisite specimen of pearls so produced is seen in the Smithsonian Institution at Washington, where are so many interesting things that had their home in salt or fresh water.

This forced jewel is attached to the upper, or hinged portion, of one-half of a fresh-water mussel shell, which was taken from the Ohio River. The pearl is very large—about 2¼in. in circumference—and is of a very deep pink colour. To cause its production, the shell of the mussel was slightly opened and a piece of wax inserted. The mussel, unable to get rid of this foreign substance, "made the best of a bad situation," and began to surround the wax with nacre in order to prevent irritation, and ere long a beautiful pearl was formed.

Some years ago a company was formed for thus conducting a pearl-making industry; but while the oyster performed its part of the work—in a small way—the aggregate result did not pay for the time and money spent in the work. One man alone spent 20,000dol. in trying to make the pearl oyster of the Torres Straits manufacture pearls at his bidding. From last accounts he was still enthusiastic over the enterprise, but found it easier to put 20,000dol. into the mouths of molluscs than to get them out.

John Chinaman has successfully compelled the mollusc to work for him, as is shown in the Smithsonian collection of pearls, mollusc shells, &c. Here is seen a shell covered with shining nacre, under which are little metal figures of Buddah. The Chinese priests insert the diminutive, but crude, figures of their god into the oyster's mouth, and when they are covered with nacre, cut them from the shell and sell them to their superstitious followers, who believe the images to be of miraculous production.

The Smithsonian Institution possesses a most interesting collection of mollusc shells, embracing almost every variety, from the smallest to those that weigh several pounds. Among the latter are some pearl oyster-shells nearly as large as dinner-plates. One of these was brought from the pearl fisheries of Ceylon, and is an exquisite specimen, having its inner surface covered with an almost transparent coating of nacre (mother-of-pearl) that approaches the colour of burnished silver.

The inner portion of pearl oyster shells, as is well known, is used for making pearl buttons, knife-handles, handles and backs for toilet articles, and a great variety of other things. Before being ready for the manufactory they (the shells) have their backs ground down to near the nacreous material, when they are cut into required shapes and sizes and made ready for market.

When the old Spanish galleon sailed the waters of the far east, the only product of the oyster sought by them was the pearl. They carried home for the royal and the rich many beautiful specimens of the jewel of the deep; and not only the Spaniard, but also people of other nations for hundreds of years valued the pearl oyster only for its little glistening spheroid, which the Arabs say is made from a drop of dew that falls into the open mouth of the mollusc.

But when it was found that mother-of-pearl could be utilised for practical and ornamental purposes, the once neglected shell soon became of more value (in the aggregate) than the pearl jewel. And it is well for the pearl-fishing industry that such is the case. There are many instances where thousands of pearl shells were taken which yielded only a few small pearls. But sometimes a day's fishing will gather a small fortune in the latter.

One of the very old fisheries is that lying near the coast of Ceylon, from which a vast number of pearls have been taken. Other important fisheries are those in the Gulf of Persia, the waters of Java, and those near Japan, the Isthmus of Panama, and the mouths of the Rio de la Hocha, in South America. There are other places where pearl fishing is carried on, among them being some in the waters near the Philippine Islands (principally in the Sooloo Sea and around the southern group of these islands) and near the coast of Lower California and the Mexican Pacific coast to the Guatemala boundary. But the first mentioned have given the best and largest products.

In some of these pearl fisheries large areas are covered, those in the Merguian archipelago, in the government of Burma, comprising 11,000 square miles. Pearls are found there, but the main industry is in gathering pearl shells. For some time past the oyster-beds have been rented from the Government.

The pearl fisheries of Madras and Ceylon are inspected every year by a Government official, who permits the banks to be worked only when they are in good condition. The great fisheries of Ceylon are carried on from four to six weeks each season, which begins in March. At sunrise the boats are on the fishing-grounds, and the divers—two in a boat—begin work. They are let down into the water by a rope, to which is attached a stone weighing about 40lb., and after working rapidly for about two minutes, are drawn up for a breathing spell. Besides a basket for holding his catch, the naked diver takes down with him a pointed stick to be employed as a weapon of defence against sharks. With this and the knowledge that the shark-charmer above (there is one in each boat) is performing his incantations, he feels perfectly safe, and seeks the molluscs as long as he can hold his breath.

It is said that the most beautiful pearls are found in the Persian Gulf. No doubt it was from these waters came the pearl which Cleopatra swallowed in a glass of liquid. History says that this famous queen disposed of in that remarkable draught about 40,000dols., the value of the jewel. In a later day—during the reign of Queen Elizabeth—this costly example of Egypt's frisky queen was followed by Sir Thomas Gresham, who, to win a bet with the Spanish ambassador, that he (Sir Thomas) would give a more expensive dinner than the Spaniard, beat into a powder a pearl valued at nearly 75,000dols., and drank it in a glass of wine.

Pearl fishing is of extremely ancient origin; but notwithstanding this, it is carried on in most places after the method employed a thousand years ago.

* By James Eastus Price, in *Popular Science*, N.Y.

RAILROAD SIGNALLING.

Progress in railroad signalling is indicated to a certain extent by the relative amounts of attention given to the various topics of discussion at the recent annual meeting of the Railway Signalling Club, held in Boston. The subjects introduced by the papers presented were: "Normal Safety v. Normal Clear Systems of Automatic Signals," by A. J. Wilson; "Progress in Signalling," by H. M. Sperry; and the "Possibilities of Three-Position Semaphore Signals," by Frank Rhea.

Mr. Sperry's paper on progress in signalling was an admirable review of the state of the art, and was suggestive in regard to recent improvements in constructive details which should find general use in the future. It was the best paper presented, and worthy of a thorough discussion, which it did not receive, but it developed the fact that the most important subject in signal practice is that of the proper colour for use at night on distant signals. The recent adoption of yellow for this purpose on the New York, New Haven, and Hartford R.R., and the fact that the meeting was held in Boston offered an opportunity for the members to inspect the colour under practical conditions, which was taken advantage of.

The result was a favourable impression upon most of the members. The best opinions seemed to favour the new plan. Objection was made that yellow was not sufficiently distinctive; this, however, was not a source of danger, because it was possible that the new colour would be mistaken for red under certain combinations of atmosphere and distance, but it was not likely that a red light could ever be mistaken for yellow. At short and even moderately long range, however, the distinction was sufficient, even if in doubt at a distance. The mistakes would therefore be likely to occur upon the safe side. This is the ground that we have taken in regard to the yellow distant signal light, and it was confirmed by the discussion.

It may therefore be said that the cause of the yellow light has gained ground. It is highly important that the colour should be exactly right, and that the glass should be made with extreme care. In connection with the shade of colour, it should be stated that Mr. C. Peter Clark, general superintendent of the N.Y., N.H., and H R.R., has found that the enginemen prefer a decided tinge of red in order that there may be no question of the doubt being on the right side in case of thick weather. The new colour has not yet gone through a winter, and it is possible that valuable experience may be had by viewing it through snow.

The first of the papers introduced the question whether block signals should stand at "danger" positions or at "safety" under normal conditions with the track governed by the signals unoccupied and ready for a train to proceed. To the enginemen there is practically no choice, because with both systems properly installed and in working order, they cannot see any difference. It was argued that the normal danger had two decided advantages. First, the signals were liable to freezing up in sleet storms, and it was safer to have them

held in the danger position, and if they stood normally at "all clear" they might freeze, and give misleading information of a dangerous character. Second, the signals are held at "all clear" by the battery currents, and there was an important economy in battery material and supplies in the normal danger system in which the batteries were only used while the signals were held at "all clear" for the passage of trains.—*American Engineer.*

WHY THE U.S. NAVY ADOPTED WATER-TUBE BOILERS.

THE reasons for adopting the water-tube boiler in the U.S. Navy are very admirably set forth in a paper by Admiral Geo. W. Melville before the Society of Naval Architects and Marine Engineers, in which the speaker first expressed his opinion that water-tube boilers are bad in principle, as a failure in a tube is followed by the opening of a fault, while in a fire-tubular boiler the pressure would continue to close a split tube; but on the other hand he considers that the value of their advantages has been sufficiently developed in the last two years to necessitate their use, if we do not wish to be left behind in naval design. In the fitting out of two ships of identical qualities, one with cylindrical boilers and the other with water-tube boilers, the latter will be somewhat the smaller and handier—will have less draft and will cost less, and the facility with which water-tube boilers can be removed or completely renewed without disturbing the decks of protected vessels is of itself enough to justify the adoption of water-tube boilers. The heating-surface has gradually been reduced from 3sq.ft. per horse-power against 2sq.ft., which is necessary with cylindrical boilers to 2·4sq.ft. of heating surface per horse-power. The writer dwelt to some extent on the failures of the water-tube boiler instead of showing only their good points, for in so doing he gets most information from them. He also stated that so far as he knows, there is not one failure that can properly be said to have occurred purely as a result of being a water-tube boiler. Admiral Melville heartily believes in water-tube boilers as compared with cylindrical boilers for navy use, and gives the following list of advantages: Less weight of water, quicker steamers, quicker response to change in amount of steam required, greater freedom of expansion, higher cruising speed, more perfect circulation, adaptability to high pressures, smaller steam-pipes and fittings, greater ease of repair, less danger from explosion; and it is evident that he considers the Babcock and Wilcox type as being specially favourable. He states the disadvantages as follows: Greater danger from failure of tubes, better feed arrangements necessary, greater skill required in management, units too small, greater grate surface and heating surface required, less reserve in form of water in boiler, large number of parts, tubes difficult of access, large number of joints, more danger of priming.

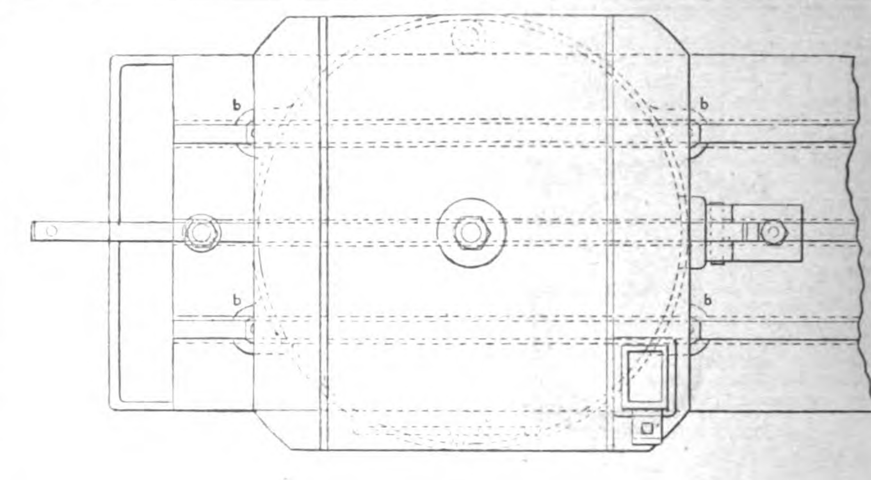
A DUPLEX MILLING FIXTURE.*

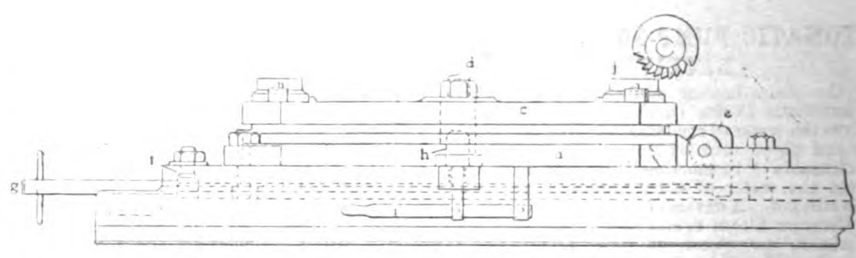
THE output of milling machines is frequently much below the actual capacity of the machine, on account of the time required to take the milled pieces from the fixture and put in others ready for the cut. This is more especially so when the work is cast or forged, requiring separate bolts and clamps for each individual piece, on account of unevenness.

The subject of this article is a fixture which was designed to avoid this loss of time. We call it a turntable fixture, for want of a better name, and refer to the drawing. *a* is the bed of the fixture, which is fastened to the platen of the machine (in this case a No. 5 Brown and Sharp, which has three slots) by the lugs and bolts, *b*; *c* is the table, which is fastened to *a* by the stud, washer, and nut, *d*, and adjusted to turn freely without shake. *c* has a groove turned as shown, to receive the end of clamp, *e*, which is in the form of a bell-crank lever; *f* is a T-bolt, drilled and tapped, and clamped in place by nut. The rod *g* is threaded at *f*, and continues to lower arm of *e*. *h* is a bolt with taper end, which is held in place by a spring, and fits in one of two steel bushings placed opposite in the table to serve as an index. *h* is operated by the lever *i*. *j* is the work to be milled.

When the cut is finished and the feed drops, the operator runs the platen back with his right hand until the work is clear, at the same time turning the rod *g* with his left, which releases the clamp *e*. He then draws the bolt *h* with left hand on *i*, and gives the table one-half turn, bringing the next piece of work into position to be milled, and runs it up to the cutter with his right hand, at the same time tightening the clamp *e* with his left, and throws in the feed.

He now has the time required to make the cut, in which to remove the milled pieces (the number of which will, of course, be determined by their size,





and capacity of machine), clean out the chips, and clamp in new ones.

If the operator is lively, or works by the piece, the time elapsing between the finish of a cut and start of a new one will be measured by seconds, and the increase output compared with a single fixture will be surprisingly large.

* By A. J. STRONG, in *American Machinist.*

LANTERN SLIDES FROM DIAGRAMS, &c.

TO produce a passable slide it is absolutely essential that the ground should be free from fog, and that the lines must be of a good black tone, so as to give a good contrast. How to achieve this desirable end is the object of these short notes.

The diagram or map should, if possible, be specially prepared, having good bold black lines, and drawn on paper, leaving a good margin all round. This will give more even illumination, and enable the sheet to be secured to a support with the drawing-pins well out of the view. This support must be perfectly vertical, otherwise the lines will be more or less distorted. The camera should be set sufficiently far from the diagram as to allow a good margin within the lantern-slide mask, and this margin should be even all round—i.e., if the diagram is oblong the mask should be cut to suit.

The exposure necessary is a simple matter, if the following instructions are followed out. I personally prefer a bright day, but no sun shining directly on the diagram; and by giving a short exposure, and obtaining the necessary density by intensification, it is not a difficult matter to keep the lines from veiling over if a full amount of bromide is used in the developer.

When the negative is afterwards intensified, care must be taken not to spoil the clearness of the lines, for if any fog is there at the commencement, this process only intensifies it, which is fatal to success.

The making of the transparency from this negative is a simple matter, as, given clear lines and a dense ground, a full exposure can be given without fear of fog, and the ordinary hydrokinone developer will give a good jet black line, and leave the ground bright, clear glass. By printing the title on the diagram before the exposure it will greatly add to the attractiveness of the slide, as its meaning is at once apparent, and it also enables the slide to be quickly selected from the others. In all cases of this kind of work it will be as well to decide from the start to make them ask oneself, and it should, as before stated, be proportioned to suit the slide, though in the series of slides on one subject, it will be found advisable to have all the openings as near one size as convenient; hence the camera should be set to give this result when making the negative.

Before leaving this subject I would just remind my readers that, if they wish to preserve their negatives in a good condition, a coat of varnish will amply repay the extra trouble; but it must be very evenly applied, or else the streaks will be visible in the slide in the form of fog. I have made hundreds of slides in this manner, and shall be glad to help any who desire further information.—W. E. A., in *Photographic News.*

SMOKELESS POWDER AND BLUE GLASSES.

SEVERAL letters have appeared in the *Times* and elsewhere recently about the above subject, and the following may be of interest. Mr. J. H. Steward says:—As many persons are under the impression that violet-coloured glasses will enable one to locate the flash of the explosion of smokeless powder from a rifle, I beg to inform you that, having experimented with different-coloured glasses during the last Bisley meeting, I could obtain no satisfactory results. I selected ranges varying from 50 to 800 yards and observed from a position that enabled me to obtain a lateral view of the flash. The best results were obtained with the cobalt-coloured glasses, but in no case could the flash be detected better than when looked at through an ordinary field-glass without coloured glasses. At ranges beyond 400 yards it was almost impossible to detect the flash. Without coloured glasses the bluish-tinted smoke could be readily detected at all ranges. This small thin cloud proceeding from the discharge was, however, only plainly visible when several rifles were fired at once. Owing to the rapidity with which the smoke was dissipated, one had to look with very close attention. With regard to the discharge from guns, the result might be as stated by Mr. Lascelles-Scott in his very interesting letter. I have made no observations with this weapon. A well-known general, however, informed me that he had no difficulty in locating the flash from a gun with the aid of the ordinary optical adjuncts.

Mr. Alfred H. Allen, of Sheffield, writes:—I observe that your correspondent, Mr. W. Lascelles-Scott, suggests that a cobalt-blue glass or other blue medium should be employed with field-glasses for observing the position of guns firing smokeless powder. Mr. Scott's ingenious proposal is open to some serious objections. It is based primarily on the assumption that smokeless powder contains picrate of potassium, and the visibility of the flame is ascribed to the presence of potassium in that or other form. Unfortunately for the success of Mr. Scott's ingenious proposal, smokeless powder, at least as used in the British service, contains no potassium either as picrate or in other form, and therefore the proposal would not be applicable to it. Secondly, if the Boer or other powder contained a potassium compound it would not be smokeless, and therefore the position of the guns firing it could be localised without the use of blue glass or similar contrivance. It is to be regretted that Mr. Scott did not think of this evident fact before making his proposal public. I may add that I have just viewed burning cordite through cobalt-blue glass as suggested by Mr. Scott, and could find no evidence of

the presence of potassium. The flame is far more visible without the use of blue glass than with it.

Mr. Frank Horridge: May I submit to you the following as a possible explanation of the contradictory views on the subject of smokeless powder and blue glasses? First, the Boer powder is probably a mixture containing a potassium compound, and does give off a slight amount of smoke, which one of your correspondents says is essential, and which the other says he has seen with powder used at Bisley of the smokeless kind. Secondly, the flash is not a true violet, but a blue-violet. Hence bluish or blue-violet glasses, preferentially the former, should be used to exclude the rays of sunlight. If you were to use pure violet glasses you would exclude the bluish rays of the flash, and under these conditions it is not surprising that violet glasses should have been found to be a failure. I think all will now agree that the sooner this matter is put to a practical test the better.

THE ALLOTROPIC VARIETIES OF IRON.

In order to explain certain peculiarities of steel, M. Osmond and others have been led to assume the existence of two allotropic modifications of iron—viz., Alpha iron stable at ordinary temperatures, and Beta iron stable at high temperatures. In a recent communication to the Paris Académie des M. Galy-Actié describes some experiments, which tend to confirm the hypothesis noted above. The metal used by M. Galy-Actié was almost chemically pure iron, carbon was totally absent, and there was only a trace of phosphorus. The iron was drawn into wire 8 millimètres (0·315in.) in diameter, and this wire was then cut up into 1,000 small cylinders 13 millimètres (0 51in.) high, which were annealed at 1,000° Cent. (1832° Fahr). These cylinders were then compressed, and a curve obtained showing relation between the compression and the the pressure producing it. The specimens proved very homogeneous; crushing commenced at a load equal to 18 kilogrammes per square millimètre (11·43 tons per square inch), there being a well-marked breaking-down point. The permanent set under this load was $\frac{1}{10}$ millimètre ($\frac{1}{254}$in.). If, after the set had appeared, the load was relieved and immediately reapplied, crushing only recommenced when the highest pressure previously attained was reached, and the new stress-strain curve exhibited no breaking-down point. If, however, some hours were allowed to elapse before reapplying the load, the cylinder would support without fresh crushing a load considerably in excess of the highest previously applied; and when finally crushing did occur, the event was characterised by a well-marked yield-point. It was thus possible to raise the yield-point of the material far above its initial value. All cylinders annealed after heating to a temperature exceeding 850° cent. showed a well-marked yield-point, but if quenched from this temperature and then tested at once, the yield-point disappeared, the stress-strain curve becoming uniform throughout. If, however, a certain time was permitted to elapse before testing the specimen, the yield-point would make its appearance, and this recovery of the metal to its primitive condition could be hastened by applying quite a moderate heat. If the metal was quenched from a temperature below 850° cent., the yield-point was always present. M. Galy-Actié interprets his experiments as proving the existence of the two allotropic modifications of iron. The Beta iron can be produced at ordinary temperatures, either by mechanical deformation or by quenching, but is essentially unstable, and gradually changes into alpha iron.—*Engineering.*

Guide to the Constellations.—A new and enlarged edition of "An Easy Guide to the Constellations," by the Rev James Gall, has just been issued by Messrs. Gall and Inglis, Paternoster-square and Edinburgh, and will be found useful as a present to young folk. The maps and the atlas render the subject clear, and the little work is a capital "stepping stone" to the larger atlases.

The partnership that has subsisted for some years between Messrs. Perken and Mr. A. Rayment (under the style of Perken, Son, and Rayment), was determined by effluxion of time on the 31st ult. Messrs. Perken will continue to carry on business at the same address under the style of Perken, Son, and Co., and we have no doubt will give the same satisfaction in their "Optimus" specialities and general business as they have done for so many years past.

An electric-transmission plant has been put in operation at Allegan dam, in Michigan, the current being conducted to Kalamezoo, a distance of 22 miles. A pressure of 25,000 volts is used. It is intended to increase this to 40,000 volts, if experience shows that the climate will permit. An extension to Battle Creek and Jackson, Michigan, by the end of the year will give the largest power-transmission line in the world—90 miles.

SCIENTIFIC NEWS.

FINLAY'S comet, discovered by Mr. Finlay, of the Cape of Good Hope, on Sept. 26, 1886, is due to return to perihelion next month. It has a period of about 6½ years, and was observed in the summer of 1893. M. Schulhof thinks that the chances of its being observed next month are very slight, but in 1906 he calculates that the comet will be very brilliant, and will approach the earth about the middle of August. Looking so far forward as 1910, the comet will make a near approach to Jupiter, and will thus afford an opportunity of estimating the mass of the giant planet.

The *Bulletin* of the Société Astronomique de France for January, 1900, contains, amongst other interesting articles, "Les Léonides," by Mlle. D. Klumpke; another on the eclipse of the sun on May 28 next, by M. A. de la Baume-Pluvinel, with charts; and one by M. C. Flammarion, with illustrations, entitled "Dessins de la Lune vue à l'œil nu." The 20th century question is touched upon in a note by M. Camille Saint-Saëns, in which he says: "Il s'ensuit que lorsqu'il s'agit de l'âge d'un être vivant, homme, animal, ou plant, le chiffre I. signifie une année qui finit, tandis qu'en chronologie le chiffre I. signifie une année qui commence."

The *Journal* of the British Astronomical Association (Jan. 13) contains the reports of the directors of the lunar section, the double star section, and the variable star section; some interesting correspondence on the apparent enlargement of heavenly bodies near the horizon, papers on the double canals of Mars, and the usual collection of notes. Particulars as to the proposed expedition to Spain and Algeria for the eclipse of May 28 are given, and (as a loose slip) wave-length scales for eclipse spectra.

Prof. W. Harkness has retired as rear-admiral, on reaching the age of sixty, from his position as astronomical director of the Naval Observatory of the United States. Prof. S. J. Brown has been appointed his successor. He was formerly at the Observatory of the Naval Academy, Annapolis.

Some remarkable meteors appear to have been observed recently, judging from notes in various papers. A correspondent, writing from Stocksfield-on-Tyne, says that on Jan. 7 he saw a meteor which "left the zenith and traversed the heavens in a southward direction, ending its course by exploding similar to a rocket. The path of the luminous body was marked by a long stream of light. The meteor and its phosphorescent train were visible for the space of two or three seconds." A "daylight meteor" was seen by another observer from Beckenham, Kent, at about 3 p.m. on Jan. 9. It was a brilliant meteor about 60° above the horizon, and in a general direction from a little to the north of west to the south of east. Although the sun was shining brightly at the time in a cloudless sky all over, the meteor was very distinct and apparently of a large size. It comprised a head, a brightly glowing body, which as it passed across the sky appeared to throw off, as it were, flakes of flame. The meteor, leaving a trail of bright light behind it, vanished, as it seemed, quite low down and very little above the horizon. This meteor seems to have been noticed by several persons, for we learn from a paragraph in the *Times* that several correspondents have written about a very bright meteor which was seen between 2 and 3 o'clock p.m. on Tuesday, Jan. 9. Mr. H. H. P. Bouverie writes from Glynde Place, Lewes:—"While shooting here to-day I saw a brilliant meteor which started from near the moon, that was quite bright at the time; it travelled for a short distance towards the north-east, and left a marvellously luminous path of white light. The time of its appearance was as near 2.55 p.m. as possible. I never heard of such a thing being seen in broad daylight." "A. C. E. S." says:—"At 2.55 in brilliant sunlight a remarkable meteor was seen by a party of five from Reigate-heath Golf Ground. The course of the meteor was south to north, and it traversed a considerable portion of the heavens. In appearance it resembled a kite with a tail of a luminous white colour. It was visible for about a second." The Rev. R. Hudson also writes, from the Drive, Brighton:—"The colour was brilliant white, like an incandescent gas light. There was a nucleus and tail of considerable length. The altitude was about half that of the moon, which was visible at the same time. The sky was cloudless and blue, and the sun was shining brightly. The general effect was that of the falling stick of a rocket, and, indeed, my first impression was that it was a peculiar daylight rocket, but a moment's consideration of the direction of flight convinced me that it was a very remarkable meteor."

A remarkable rainbow, too, appears to have been observed by several correspondents on Jan. 11. Mr. C. H. Swinstead writes to the *Standard* saying he was in Venice on the day in question, and it may be useful to those who study atmospheric phenomena to know that the strange appearance was visible there as well as in England. "What I observed was as follows:—At about 11 a.m. (Central European time) I happened to look at the sky, which was clear of clouds in all the upper regions, at least as far towards the horizon as the level of the sun, and I saw a brilliant rainbow against the clear blue. The arc was, perhaps, one-third of a circle, with its centre at the zenith, and its distance from that point about 15°. This bow had its convex side towards the sun. At the centre of the curve another fainter bow touched (or rather overlapped) it back to back, so that a pair of horns were visible at either end. This second bow had its apparent centre in the sun. At half-past eleven a third bow was also visible about half-way between the sun and the second bow and concentric with it. This was quite faint. At this time a small patch of vivid prismatic colour was also to be seen in the south-west, where the sun's rays darted through a gap in a little cloud. This was at a level of a few degrees below that of the sun. At half-past twelve the forked form still persisted, but the others had disappeared."

Many microscopists will regret to hear of the death of Mr. W. T. Suffolk, in his sixty-ninth year. He was treasurer of the Royal Microscopical Society for many years, and did much useful work in connection with the science.

The *Athenæum* says: Geologists will recall the name of an old correspondent in Edwin A'Court Smith, who died at his cottage at Gurnard, near Cowes, on Jan. 5, at the age of 89. Though possessing none of the advantages of education or scientific training, he was a born naturalist and antiquary, and of his own initiative, unaided save by his own hands, he carried on protracted and laborious excavations on the foreshore of the Solent, unearthed a Roman villa and various antiquities, and formed large fossil collections, whence the Natural History Museum and other museums have been enriched with rare specimens. Meanwhile, the fortunate discoverer endeavoured to support his family on the produce of his garden! Mr. A'Court Smith—he was tenacious of the noble strain—was a pathetic illustration of natural gifts crippled by circumstances. When his sight was dimmed and his natural strength abated by the burden of years, his enthusiasm for science never failed. His laborious unrewarded life belongs to the romance of science, and a stern, inexorable romance it is.

Another naturalist who, without the advantages of education, became widely known for his contributions to entomology and other branches of natural history, died the other day in Dumfries. Mr. William Lennon, who had reached the age of 81, besides much other work, discovered some half dozen beetles new to Britain, and a few new to science. For many years he was an attendant at an asylum.

At the Royal Institution to-morrow (Saturday, Jan. 20) Sir Hubert Parry, Mus.Doc., commences a series of lectures on "Neglected Byways in Music."

The annual general meeting of the Association of Technical Institutions will be held on Wednesday, Jan. 24, at Mercers' Hall, London. The president, Earl Spencer, K.G., will be in the chair, and Sir Swire Smith, the president-elect, will deliver an address.

The fifty-third annual general meeting of the Institution of Mechanical Engineers will be held on Friday, Jan. 26, when the chair will be taken at 8 o'clock by the President, Sir William H. White, F.R.S. The annual report of the council will be presented to the meeting. The election of the president, vice-president, and members of council, and the ordinary election of new members, will follow. The paper to be read and discussed is "Water-Meters of the Present Day, with Special Reference to Small Flows and Waste in Dribbles," by Mr. William Schönheyder.

It is announced that the bacteriologists of the

Liverpool School of Tropical Diseases have discovered the microbe of pink-eye, a disease which is the cause of great mortality amongst horses.

A "rare fossil" has, it is reported, been discovered at Harrogate in the thick shales that have been intersected in the formation of the Corporation's new reservoir at Scargill, about four miles west of the borough. When this specimen was submitted for naming to the British Museum authorities, they expressed an earnest wish that it might be given to them to enrich the national collection, so that there are now two specimens of this rare species in the British Museum, another being in the Woodwardian Museum, at Cambridge. As most geologists know, the genus of the Nautilidæ extend in range of time from the Lower Silurian beds to the present day. "The species under notice belongs to the carboniferous limestone; and the fact of its being found deeply imbedded, as an imported fossil, in the shales of Scargill throws a new light on the true character of these shales." Strange to say, the report does not mention the name of the "species under notice."

The Victor Meyer memorial lecture will be delivered to the Chemical Society on Thursday, Feb. 8, at 8.30 p.m., by Prof. T. E. Thorpe, president of the society.

At a meeting of the Royal Botanic Society last Saturday, the attention of the Fellows was directed to a curious stem of the *Testudinaria elephantipes*, or "elephant's foot," grown in the society's gardens. The stem bears a curious resemblance to the elephant's foot, but is remarkably light. The genus Testudinaria seems to be confined to South Africa.

The fish-hatching experiments at the Crystal Palace are reported to be very successful, and large numbers of the Salmonidæ have been obtained.

The new fish hatchery of the Fishery Board for Scotland at Bay of Nigg having been completed, the place is now being stocked with fish for the purpose of studying their nature and habits. The steam trawler chartered by the board returned the other day after a successful cruise in the Moray Firth, Dornoch Firth, Lybster Bay, and waters within the three-mile limit, there being no restrictions in the case of a vessel engaged by the board for the purpose of taking fish for scientific purposes. About 150 plaice, together with a number of haddocks and other fish, were secured, and were well preserved in the special tanks provided for the purpose, being deposited in the hatchery tanks in good condition. Another trip is to be made by the trawler, so that more fish may be obtained for the hatchery, where it is proposed operations should be carried on in a much more extensive scale than at Dunbar, from which the hatchery has been transferred.

It is to be hoped that the departmental committee appointed by the President of the Board of Trade to inquire into the rules relating to the granting of patents will arrive at some definite conclusions, and settle all the vexed questions. The official terms of the reference are—"To consider various suggestions which have been made for developing the benefits afforded by the Patent Office to inventors, and report." The committee is to consist of Mr. F. J. S. Hopwood (chairman), Mr. Edward Carpmael (president of the Chartered Institute of Patent Agents), Mr. C. N. Dalton (Controller General of Patents), Mr. J. A. Kempe (deputy chairman of the Board of Customs), and Mr. S. E. Spring Rice, of Her Majesty's Treasury; Mr. Arthur Neeves, of the Board of Trade, to be secretary of the committee.

The members of the Institute of Marine Engineers have been recently engaged in an interesting discussion on the circulation in water-tube boilers, which should be of use to makers. The author of the paper on which the discussion was based (Mr. Halliday) said that his advice to makers was to decrease the speed of circulation in water-tube boilers—not to increase it. In his experience the water-tube boilers in which the circulation was slow lasted twice as long as those in which the circulation was fast. Mr. Halliday contends that a high rate of circulation does not give the best results. The discussion was adjourned to Jan. 22, and when published in full should be of much interest to makers of quick-steaming boilers.

It is stated that the torpedo-boat destroyer *Viper*, built to the order of the Admiralty by the Parsons' Marine Steam Turbine Co., Ltd., in her second preliminary trial attained the high speed of 35·5 knots—a mean of four runs on the measured mile, giving 34·8 knots. That speed is considerably above the contract (31 knots), and the fastest run, it will be noticed, is extraordinary, rather beyond the anticipations, we suppose, of those best acquainted with the capabilities of the steam turbine.

Another roller-boat is being built in Canada—where is not mentioned. This vessel is a cigar-shaped craft, about 30ft. in length. The screw consists of a cylinder about one-half the length of the boat, situated in the centre, and passing entirely round the hull proper. This cylinder is supplied with fins, or wings, running diagonally round from one end to the other, and their rotation gives motion to the hull. The keel, connected at both ends with the hull proper, hangs below the revolving cylinder. The description does not seem to be very clear, and looks like a repetition of the previous accounts.

Cellulose packing has been used for stopping leaks caused by shot-holes in warships by the French and by Americans, because the material swells greatly when brought into contact with water, and therefore does well as a "cork," or for caulking. It is reported, however, that the cellulose will not preserve its properties for any length of time, but degenerates and becomes a "nuisance," from the sanitary point of view.

Some railway experts have recommended the use of yellow signals to indicate caution, and it is stated that they have been adopted on some railways in the United States and Canada. There is much difference of opinion as to the best colours for railway signals, and there is much doubt about yellow. It appears that the majority of people can see the "colour" in daylight for longer distances than any other; but some see it as red at night. That would not detract from the value of yellow, in one sense, as "red" means "danger" on all lines in this country; but the use of yellow might lead to quite unnecessary stoppages.

What is described as a new method of making oil-gas has been shown to a number of civil engineers and others interested in automobile and tramway traction. It is understood that a company is bringing out the invention, which is of French origin, in this country. It is thus described: "The 'gas fountain' consists of a plain tin oblong canister, with two tubes projecting from the top. The box, packed with a highly porous specially-prepared wood, is charged with a hydrocarbon liquid, such as petroleum. This is entirely absorbed by the wood. By means of a siphon arrangement of the tubes, air passing through the oil, held by the fibrous absorbent in a finely-divided state, is automatically turned into gas, the uses of which for motor, lighting, heating, and all other purposes to which gas can be applied were demonstrated.

A large portion of the "Stretton Collection" railway rails, drawings, and relics which was sent to the Chicago Exhibition of 1893 has recently been returned to this country, and we are glad to know that the owner has presented the whole of this interesting collection to the nation for the South Kensington Museum. Already a very considerable portion of this valuable collection is on view, and further instalments will be shown as soon as space can be arranged and the required frames constructed. The Science and Art Department has also commenced to sell to the public photographs of the locomotive sheets at a cost of eighteenpence each. When the complete collection is in position, it will form a perfect record of British locomotive progress. Mr. Clement E. Stretton, our readers will remember, has been a contributor to the ENGLISH MECHANIC for over thirty years past.

So far as I have encountered them, says Prof. Rostwell, a characteristic of great men is that they have time. They are not in a hurry; their work doesn't boss them, but they boss their work. They don't act as if every minute you stayed was valuable time lost to them; they don't fret and fidget. What time they do devote to you appears to be time that they can spare, and take things easy in, and be comfortable. The work seems to be incidental, and it seems as though they could turn to it when the time came and get through it with ease; and they always seem, besides, to have strength in reserve. It is certainly a characteristic of the great man that he has time.—*Popular Science*, N.Y.

LETTERS TO THE EDITOR

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

A METEOR—A POINT ABOUT THE CENTURY WHICH HAS BEEN MISSED!

[43218.]—On Tuesday, Jan. 9, at about 2.30 p.m., I observed from Warlingham a very conspicuous meteor. It passed from about S.W. to N.E., and vanished almost under the then position of the moon. It was, I suppose, speaking roughly, about 45° from the horizon. Its line of movement was curved downwards. The sky was absolutely cloudless, and there was bright sunshine, so that the meteor must have been a very brilliant one. Its colour was very white, reminding one of burning magnesium wire, or, as another person who saw it said, like an electric-arc light. It was of the usual form, rounded in front, and tapering to a tail, leaving a few sparks behind, but no cloud. I hope others of your readers will have seen it.

May I say one word, my first and last, on the vexed subject of the century? It is this: both parties are in a degree right. Your correspondent W. F. Stanley is absolutely unanswerable as to the proper numbering of the first year of the first century. It is due to the blundering old monk (I forget his name) who, in the 4th century, arranged our chronology, that the first year was marked A.D. 1, and the previous one B.C. 1, whereas it is obvious to everyone who sees as clearly as your correspondent W. F. Stanley, that the two years should have been B.C. 0, followed by A.D. 0. "There never was a year 0" says "F.R.A.S." No! *But there ought to have been. The ordinal number is always one in advance of the cardinal, in reckoning time*, and when Our Lord was "in His first year," He was 0 years old, not 1. Thus, as I said, both parties are right. Those who say Jan. 1, 1901, commences the 20th century are historically right, owing to the original blunder: but those who say 1900 commences the century would be right, if the years had been properly numbered to start with. As a matter of fact, the present year is really 1899—that is to say, the Incarnation (if it began, as supposed, at the commencement of the first year of the first century) is now only 1899 years old. If we are not to reckon the first year of the first century as A.D. 0, the second year as 1, and so on, we are clearly wrong to call the years commencing with 18— (say, 1850) as the 19th century. The principle is precisely the same. If the matter were of importance, the only solution would be to make the years ending in 00 commence the centuries, and to reckon the first century as having only 99 years.

Farleigh Rectory. **F. Bennett.**

METEOR—THE ANDROMEDA NEBULA—THE LUNAR SEAS.

[43219.]—The meteor seen by Mr. Parker on Jan. 9 was also seen here, although not by the writer. A friend of mine, unversed in astronomy, told me on Tuesday evening (Jan. 9) that he had seen a yellow meteor that afternoon some time between 2.50 and 3 p.m. It shot from the right-hand side of the moon downwards, disappearing under the moon. It is to be regretted that he is unable to give fuller particulars. He estimates its duration at between three and four seconds. I had not intended to make any note of this; but I do so now, as it corroborates letter 43195.

I would venture to point out a little slip, evidently unintentional, that Mr. Lattey has made. In his excellent article, on p. 484, he states that the Andromeda nebula is "a colossal maelstrom of glowing gas viewed almost edgewise . . ." and that "the entire structure is a vast mass of vaporous matter partially condensed into a fluid or viscous condition." I was always under the impression that the aforesaid nebula was stellar. Proctor, in "Half-Hours," informs us that the spectrum is continuous from blue to orange, and there is no indication of gaseity. G. F. Chambers, in the "Story of the Stars," sums it up: "This object is, however, probably stellar, . . . certain it is that it is not gaseous."

Without endeavouring to propound any new theory as to the probable constituents and com-

position of the lunar seas, I would suggest that, whatever the cause, it is identical with the phenomenon of the darkening of Plato's floor, and also with the more conspicuous shadings on the floors of some of the other ringed plains—Schickard, for example. The theory put forward by the writer of letter 43197 (p. 494) is not, I fear, so original as he fondly imagines. "The actual surface temperature of the full moon is estimated by Mr. Very to be something approaching 206° Fahr." (see p. 460 of the "E.M.," Jan. 5, 1900). This would be more than enough to fluidise the rays, were they constituted as "Mark" supposes.

Earlsfield, S.W. Silverplume.

THE MOON AND THE WEATHER.

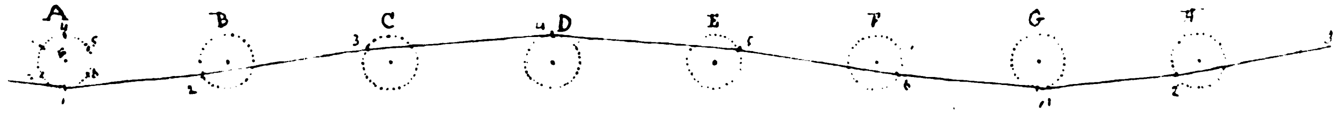
[43220.]—THAT the quartering of the moon regulates the weather (letter 43148, Dec. 29, p. 450), is a groundless opinion. The result of my observation is that changes have more frequently occurred at an octave—a mere chance. The real influence of the moon may be considered synthetically, by starting from our planet being considered, hypothetically, as a sphere of gas, then revolving it axially, with the effect of an equatorial protuberance. The effect of the sun's attraction being then introduced, the gaseous sphere will be altered in form to a sort of bi-semi-ellipsoid. That is to say, the half presented to the sun is of greater eccentricity than the other—egg shaped. The major axes being directed towards the sun do not partake in the revolution of the general mass, and the protuberances may be regarded as tidal, two tides in one revolution, the tide nearer to the sun being very slightly higher than the opposite one. Then the orbital motion is to be considered to be communicated to our planet (gaseous at present) with its axis adjusted to the obliquity with the Ecliptic, affecting the diurnal tides, with a motion parallel with the Equator, and also north and south, to and fro, annually. Such, the elementary conditions of the solar tide, obtain "mutatis mutandis" in regard to the moon, which complicates by producing other tides, more variable, and of greater force.

Assuming, hypothetically, that on any day it is equinox at noon, the earth at perihelion, moon at perigee, with their orbital major axes in a line with the sun, the combined tides would form the highest possible tide. At a point on the Equator, the next instant, both the sun and the moon acquiring declination, the two tides would proceed separately, and after any interval would be vertical at different points, which could be assigned by calculations relative to the positions of the several bodies; but no two points would be precisely circumstanced alike at the same instant, except after a very long interval, such as the Sothic period.

A portion of the gaseous earth, upon being condensed to water, other conditions arise, and another portion condensed to a solid consistency, further conditions arise. If the solid be of uniform spherical surface covered evenly with water, the air at the Tropics, heated and evaporated water would rise; cold and heavier air from the Poles would press towards the Equator to occupy its place, currents northward and southward would be generated, which would be deflected somewhat spirally by the diurnal revolution. And regarding the heated atmosphere at the Tropics as a cylindrical annulus, or sleeve encircling the earth, the position whereat the sun is vertical being heated most, the temperature diminishing gradually, easterly and westerly, and such sleeve being considered as consisting of a multitude of filaments or minute streams of air (with water vapour) moving in a Polar direction, parting with heat to the colder substratum, and in their progress conforming to the curvature, the most heated streams passing on the one or the other side, or between, the solar and lunar tides varying according to their several positions indicate "mixings" difficult to trace or describe. Moreover, the surface of the earth is not uniform. Land, seas, rivers, mountains, and valleys contribute to produce eddying currents and winds, to prevent weather forecasts being more than local.

Science has sought from the barometer evidence of an atmospheric tide, *overlooking* that air is an *elastic* fluid; the attraction of the moon over an area diminishes its weight, and the barometer would *fall*, not rise, but the lateral pressure effects equilibrium.

Letter 43152 (p. 452). Newton did not profess to account for "gravitation." He showed that its operation was in accordance with geometrical principles. The theory of gravitation explains why the moon does *not* always present the same face to us ("Libration"), and accounts for duplex tides, but not by "repulsion." The annexed diagram illustrates that, although the orbit of the moon is round the earth, its real path in space is a sort of elongate S, or slightly wavy from a straight line. The orbit A is greatly out of proportion in order to be clearer; the true orbit could scarcely be shown in so small a diagram to scale. The points 1 to 6 represent equal divisions, with their several places in a lunation A to G. M. O.



THE MOON AND THE WEATHER—HYGROSCOPES.

[43221.]—IN reply to "S. R.," the point of Prof. Angot's argument I take to be this: Different, or opposite, weather at the same time in two different regions, is not a sufficient reason for denying the possibility of lunar influence on weather; for both kinds of weather might be due to the same cause—viz., displacement of zones, or areas, of high pressure by the moon. Suppose—e.g., that with one position of the moon we found a tendency in a high-pressure system to take a more southerly position, A, and with another position of the moon to take a more northerly position, B, it is easy to see that two places, one in A, the other in B, might have, with the same position of the moon, the one a high barometer (with its associated weather), and the other a low barometer (with its weather). Similarly, with the course of rain-bringing depressions, which is largely ruled by the position of high-pressure systems: they might at one time take a course in more northerly latitudes, and at another in more southerly, and two regions might be oppositely affected accordingly. Some evidence of such lunar influence has been adduced by able meteorologists, and whether it is to be thought conclusive or not, it may seem sufficient to many of us (as against the dogmatic rejection of lunar influence) that a high authority like Angot considers the thing as at least within the bounds of possibility, if not even probable.

There are two mental attitudes in this controversy which it seems well to distinguish. One is that of the man who says: "It is preposterous to suppose the moon has anything to do with weather. This old popular notion has been thoroughly exploded. We know exactly what the moon can, and what she cannot, do. We know that her reflected heat is infinitesimal, and that any tidal influence she has on the barometer is so small, and so continually masked, that the effect of it on weather is virtually *nil*.

We may also dismiss the idea of electrical influence. If one man proves that the new moon brings rain, another proves exactly the opposite, and the evidence, as a whole, is a tissue of contradictions. Weather is a local thing, and how can one and the same moon produce opposite weather in different places? The subject has been thoroughly investigated, and we may consider that the last word has been said on it, and lunar influence shown to be an absurdity."

To people who talk in this way, it might be appropriate, if not sufficient, to point out that we really don't know everything about anything, or to say, as some eminent man (was it Cromwell?) once said, in a fiercely-wrangling assembly of Scotch divines: "I beseech you, brethren, to think it possible that you may be mistaken." It is fatal to close a subject as being thoroughly understood; and the history of science is full of cases in which those who did so have been stultified by some fresh revelation of the truth as it is in nature. It is only the other day we thought we knew all that is in the air; when, lo and behold, Argon turns up, and upsets all the textbooks.

We might go on, however, to argue that nobody at present knows very much about the causation of those movements of high-pressure systems; and we are certainly not in a position to say confidently that such cosmic influences as the moon, or the cyclical variation of sunspots, has nothing to do with them, especially as not a little is to be said for the *à priori* probability of such effects. But there is the further consideration that not a few serious meteorologists in these days are apparently not deterred by loud assertion that the subject has been finally closed from offering evidence of lunar influence to the great academies of science, and said academies think it worth while to publish their researches: witness the papers of Garrigou-Lagrange, Poincaré, and others in France; Ekholm and Arrhenius in Sweden, and so on. Nor should we here forget that high authority, "F.R.A.S.'s" lately repudiated friend, Prof. Hazen, who leans to the conviction that the moon determines how many thunderstorms we are to have. All this does not, of course, prove that the moon influences weather, but it shows that it is our duty to keep our minds open to fresh light on the subject; and it is chiefly for this I have been arguing.

This brings us, indeed, to the second attitude to which I referred, where one says: "I have studied the evidence adduced for lunar influence on weather, but I am not thus far convinced by it. I think such influence neither impossible nor improbable, and even if it seemed improbable, I do not forget that the improbable in science has often been demonstrated to exist; but I must await further evidence before I am convinced." Such a position we can all respect, and may even sympathise with.

With regard to "F.R.A.S.'s" last letter, I should be sorry to dispute his assertion that he possesses the "judicial quality" of mind. I only say that he has an unfortunate way of hiding it at times.

As to the "simple hygrometer," I am quite ready to agree to "S.R.'s" substitution of "hygroscope." Indeed, I used the former word loosely, and as perhaps better understood. Having experimented a little with the instrument, I have noticed the different quality in strings. But with some the pointer has gone round the greater part of the circle at least, which is, I think, a considerable measure of sensitiveness. A. B. M.

TELESCOPICAL—TO MR. CALVER AND "F.R.A.S."

[43222.]—MR. CALVER'S experience is so great as compared to mine that I fear I can add but little information to what he himself possesses; however, I will try to answer his questions.

I have used eccentric stops on a reflector, but do not remember to have ever tried one of the exact pattern that he describes, as the opening was always arranged to clear the central mirror. I have great doubts whether even the keenest-sighted observer could detect anything of the aberration in question with mirrors of ordinary proportions. If we take as an approximate rule that the focal length in feet shall be three-fourths of the speculum's diameter in inches, the amount of aberration appears to work out to an almost inappreciable quantity. Even in making this calculation I cannot help feeling that there is some uncertainty whether the usual mode of working does not exaggerate the real amount.

As regards "cast versus wrought" glass mirrors, if we adopt as a standard that the thickness is to be one-sixth of the diameter (as he used to recommend), Mr. Wassell's preference for rolled plate could obviously only apply to comparatively small mirrors. I remember his telling me that in cast discs he used to find soft patches which rendered accurate working practically impossible. He also noticed that the effect of ribs at the back was to destroy the homogeneity of the front face. I used to think that the best form would be that of a thick plano-convex lens, with the plane side hollowed out to the required curve as a mirror; the support being a central one. Practical experience, however, leads makers to prefer a plane surface for the back.

It may appear rather an absurd suggestion, but it has sometimes crossed my mind that bicycle balls (which are now made with such marvellous accuracy) might possibly be employed to support a large mirror, and so reduce to a very small amount the "sticking" that Herschel refers to, and which he used a sling to obviate.

I see "F.R.A.S" refers in his letter to length of focus of a telescope in proportion to aperture, though "from 30 to 60 times" seems rather a wide difference. His remarks refer primarily to photography, but the elder Herschel makes allusion to this matter without, however, dealing with it practically. I presume mechanical considerations of working the curves, have mainly fixed the proportion in both reflectors and refractors; but, perhaps, "F.R.A.S." could state whether, from purely optical considerations, there is any actual "best" proportion between aperture and focal length. The problem is also one that I am sure "H." could attack with advantage to both makers and users of telescopes. A. S. L.

WHERE IS THE IMAGE FORMED?

[43223.]—MR. NAYLOR and myself appear to be arguing the question from different standpoints: Mr. Naylor from a purely optical stand, from the eye outwards, for so alone can I understand the theory of diverging rays: but diverging rays are incapable of forming a reflected image of the source of those rays, be it a point or an assemblage of points—a line. Allowing that a point has dimensions, as a needle-point, we shall find it difficult to bring it to the test of measurement, but the rays emanating from it will follow the same laws as the

rays from a line. Here we agree. It sends out divergent rays, but the rad. vec. of rays which forms the reflected image may be considered as a bundle of parallel rays; those diverging from this bundle are lost to the eye or only taken cognisance of when reflected by objects around.

I have considered the matter as intimately connected with the question: What is light? And in seeking an answer to this, it is most convenient to trace the vibrations from their source till they enter the eye on their way to the place where they are modified into the phenomena of sight. Amongst the myriad sources from which, direct or reflected, an eye receives light-vibrations, the sun is a convenient one to deal with. A globe of some 800,000 miles diameter is sending vibrations diverging in every direction. I direct my eye towards it, protected by a dark glass, which certainly has no power to focus divergent rays, and the same holds good if I examine its reflection from a mirror, and I am conscious of a bright disc which subtends an angle of about 32 minutes, and seems to be about 9in. diameter; in fact my eye is at the apex of a vast cone of light vibrations, which, entering the pupil, reach the area of the yellow spot, and with this my diagram agrees.

Mr. N. acknowledges that "anything that applies to one point will apply equally to all points of the object"; but lower down he seems to contradict this truism, thus, "while I only dealt with one point, he has taken a line as his object," and he objects that I have taken one ray from each of two points. Well, my line is a collection of points, so fill in as many rays as may be convenient, or imagine the bounding rays filled in from all points of the line, it will only accentuate the fact that, rays from an object 8in. in length, reflecting an image of 4in. from a plain mirror, where there can be no question of focussing, and then entering a pupil $\frac{1}{8}$ diameter, must be converging rays. Could it be possible for an eye to receive the divergent rays from the sun, it would appear to be of a very different size to that which we now see it; its size would be commensurate with the distance which his rays diverge visibly into space. A distortion mirror gives a good idea of the effect of diverging rays. The convergent cone is all that we can receive; rays diverging from this cannot enter the eye, or only a few of them by artificial means.

I cannot agree with Mr. N. that the eye is the seat of consciousness, it merely receives mechanical effects at present considered as being vibrations of varying wave-lengths, the locale of modification not yet settled. As regards heat as either a painful or pleasurable sensation, it, like light and colour, is a luxury of intelligence; so also with sound—none outside an ear attached to a brain. The stick cannot feel the heat of burning, though its constituents are being driven apart by the violence of the vibration set up in it. The ship cannot know anything of the roaring wind, or the grinding of the rock under its bottom; it is the intelligence on board that hears and sees the danger. So also the coherer knows nothing of Hertz waves; it is simply a mechanical receiver of vibrations set up in the ether by certain material manipulations. Intelligence alone can appreciate them, and the same may be said of all other modes of motion. It is gratifying to find that we agree on two or three points; for the rest we must agree to differ. I hope readers have been edified by the discussion.

Fredc. H. Ewer.

POLISHING AND GRINDING MACHINE FOR GLASS SPECULA.

[43224.]—In response to inquiries, I now send you, as promised, a brief description of the principal details in the construction of the Wassell machine for grinding and polishing specula. The general arrangement of the various parts can be seen by referring to the photograph reproduced on page 383 in your issue of 8th ult., and the two rough sketches inclosed are intended to show how the necessary movements are communicated to the tool and speculum. No attempt has been made to draw these sketches to scale, but the measurements given may be taken as suitable for a machine capable of working discs up to 8in. in diameter. The four upright axles to which the various pulleys are attached pass through the bed and rest in sockets fixed to a bar underneath, which forms a portion of the framework of the machine. They are placed—taking them in the order in which they appear in the sketch—7in., 15in., and 22in. apart. The pulley B is driven by a $\frac{1}{2}$in. belt from A; the others are driven by $\frac{3}{16}$in. cord as follow:—D by C, F (the oval wheel) by E, and H (the speculum table) by G. The diameters in inches of these pulleys are A $1\frac{1}{4}$, B $8\frac{1}{4}$, C $2\frac{1}{4}$, D $8\frac{3}{4}$, E $4\frac{1}{4}$, G $1\frac{1}{4}$, and H 9. The wheel F, which is in the form of an oval, has the V-grooves cut deeply on its edge, the major and minor axes at the bottom of the grooves measuring $8\frac{3}{4}$in. and $1\frac{1}{4}$in. respectively. This wheel is screwed to a circular block which rotates on a spindle fixed to the bed. On the top of this block, the height of which must be determined by the position the tool is to occupy, is fixed a socket, M, in which the rod

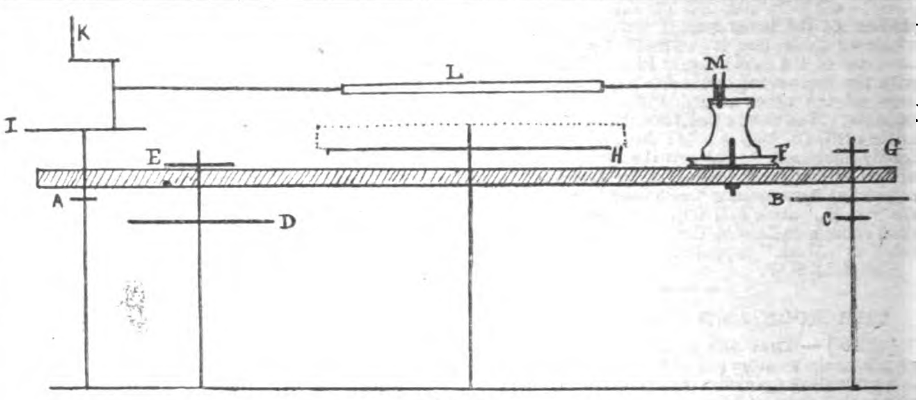


FIG. 1.

supporting the ring L slides backwards and forwards. This socket, which is placed eccentric to the short diameter of the oval wheel, must be free to turn on its axis, and will thus keep the same face constantly towards the operator. The ring L, which communicates the motion to the tool, has four $\frac{1}{2}$in. metal pulleys or rollers attached underneath. The side rollers are placed at right angles to the line of stroke, and the others about $1\frac{1}{2}$in. to the right and left (see Fig. II.) The plates supporting the rollers require to have slots cut for the screws which fix them to the ring, so that the distance between the rollers and tool, and consequently the speed of the latter, may be under control.

Having, we shall assume, made an allowance of about $\frac{1}{16}$in. of "play," the rollers will bear against the tool in the following manner: In the

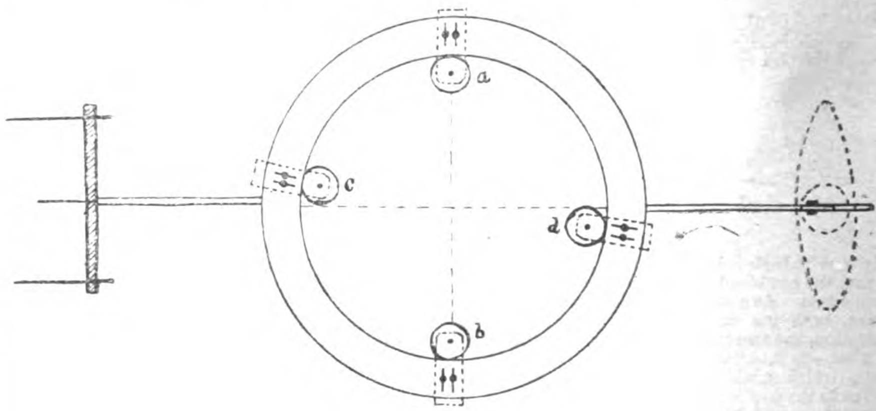


FIG. 2.

forward stroke C pushes tool round against *b*, and in the backward stroke *d* pulls it round against *a*. This motion is beautifully regular, and is perhaps the most ingenious part of the machine. As the ring moves backwards and forwards it is by the action of the oval wheel on the eccentric movement at M (Fig. 1) that the tool is carried from side to side with unequal velocity, whereby the action is prolonged at the centre, and the two extremes passed over more rapidly. The diameter of the circle to be described by M depends on its distance from the polisher and the amount of side motion to be communicated—say, $\frac{3}{4}$in. It will be understood that the extent of this movement of the tool from side to side is in no way affected by the action of the oval wheel itself, which merely regulates the amount of polishing at the centre and sides. The driving handle, K (Fig. 1) is fixed to a circular plate, I, the latter having a $2\frac{1}{2}$in. slot cut where the handle is attached, in order that the length of stroke may be regulated to suit different sizes of discs.

As stated in my former letter, the following figures give the ratio of the various movements:—48 revolutions of driving handle to 1 of speculum, 19 of ditto to 1 of oval wheel, and 240 of ditto to 1 of tool.

Tracings made by one of these machines appeared in your issue of July 23, 1897. These show with what precision and regularity the different curves are produced. If "Speculum" (letter 43133) would oblige by forwarding a tracing by his small Grubb machine, I am sure the Editor will reinsert.

Dalbeattie, Jan. 8, 1900. Alex. Smith.

FIELD ARMOUR.

[43225.]—In reference to my letter (43127, p. 472) and the remarks upon it (43189, 43203 *et seq.*), permit me to say first in regard to my critics "A Fellow of the Royal Astronomical Society," "Sapper," and "A. S. L.," that since I wrote on this subject I have learned that it is actually receiving the practical attention of one of the highest engineering experts in the country, a man who has had more to do with the wholesale manufacture of armour-plates than anyone I know.

I claim no priority of originality, seek no gain, and admit the inherent and obvious defects of field armour. If a shell burst behind a shield, or in front of it either, the shell would blast everything within reach. The same would happen if a shell burst behind entrenchments. Similarly if a sleeper, or even the historic cow, got in front of a locomotive, the engine might be derailed. In many rough places you could not carry the shield. The point is that it could go wherever artillery goes, and beyond. The war expert of the *Daily News*, a soldier, dealing with infantry shields, quoted a few days ago the criticism of Sir Walter Scott on gas-lighting: "Would you believe it?" wrote Sir Walter: "There are actually fools in London who are proposing to light the streets with gas, and other fools who are willing to allow them to do it." Military critics, however, are sometimes too prone to suppose that a humane invention is inspired by mere civilian terror of war. As for the nature of the ground, I assert that at the Modder, at Elands Laagte, and at Colenso, unless the war-artists and photographers are all untrustworthy, there was ample scope for shields. Shields would have taken us to Ladysmith and Kimberley long ago. Whether they should be 5ft. or 2ft. high I do not know. Even 2ft. is enough for cover.

I sympathise with Mr. Bagshaw in his conflict with the War Office. I am pleased that he invented the thing before I did. His wheels, I think, are too big, and would not do for steep ground; otherwise his idea is good. Will he try, as I have been doing, to get somebody to send the shield to the front? Then, War Office or no War Office, there is sure to be a general who will use it.

I like also the notions of "W. B." and Mr. Garniss, and would tender the same advice to them as to getting their inventions adopted. Indeed, I urge this upon them. I have done my part, and am astonished and delighted to find that (as I hinted) at least one expert is actually considering the invention feasible.

Modifying my original plan, I think now that ordinary waggons, or ordinary waggon-wheels with the shield itself as waggon body, might convey the shield to the scene of action. Then it could be erected on its own small iron wheels, the framework of which should extend farther to the rear than in front, in case of steep ground. Or if waggons are not obtainable, the small iron wheels and their frames

could be adapted as in Mr. Bagshaw's drawing, by placing them at the sides.

In conclusion, I would inform "Sapper" that I have not yet communicated with the Commander-in-Chief. It is not impossible, however, that the Commander-in-Chief may have already been made aware of the notion, although I do not know what he would think of it. At all events, neither he nor (I hope) any of the gentlemen who are proposing steel infantry-shields are deserving of such censure as that which is conveyed in the words of Sir Walter Scott which I have quoted; so that we have good ground to hope.

O'Dermid W. Lawler.

FIELD ARMOUR.

[43226.]—I SHOULD like to endorse the opinion of "A. S. L." (letter 43026) as to the employment of field armour in South Africa. Having seen eighteen months' active service in that country, and marched from Cape Colony to Transvaal and back into Natal viâ Zululand, I also know a little of what the country is like, and am sure that the "itinerant" fortifications illustrated in your last issue, and also that of 5th inst., would be utterly impracticable. There are so many objections to the use of these ideas that I am perfectly certain no military man would uphold them.

What our troops apparently require, in order to put them on an equal footing with the Boers, is "extra mobility." If they had to move about, dragging enormously heavy steel shields with them, it certainly would not increase their mobility. I read in an evening paper a short time back of the invention of an armoured mail cart; it was to protect four soldiers, two of whom were to push it, whilst the other two fired from behind it. The inventor entirely overlooked the fact that this arrangement would take away exactly half the effective firing line.

Ex-Soldier.

[43227.]—A LITTLE reflection should convince the advocates of wheeled armour plates that they would be useless encumbrances. In what state, for instance, would the infantrymen arrive at their position? Very much out of breath, and not very fit for accurate shooting; and then what a grand target for a shell it would make, and end up, I am afraid, with being a veritable death-trap. Could not your correspondents arrange for some motive-power other than man to get the target along?—even then, though, it would stick in the mud. Is it not a mistake to have the plate in a vertical plane, and would it not be better to have it lying at an angle with the ground?

The question of armour-plates and shields has no doubt been considered, but an infantry man wants certainly no more to carry. What he really does want is something to carry him. A man after marching a considerable distance is not physically in a fit condition to at once make good shooting, especially after being kept in a trying climate short of food and water. Men cannot fight well on starvation diet; there is no economy in this. We also need to see that men who freely give their lives for their country's welfare are well equipped. A question that may well be asked is, Are the "Tower bolt locks" our soldiers are given to use the best arm our English mechanics could devise? Personally, I think not. And then, again, why was R.M.L. artillery sent to the front? After this perhaps the old guns in the park may be rebored and sent out. Given modern quick-firing artillery, and plenty of it, and shell adapted for the exigencies of the case and filled with high explosives, then perhaps the cheering words of Major-General Hector Macdonald may yet be true, and they will bear repeating—viz., "Let me ask you to remember that whatever you hear, and no matter what people say, our generals are all right, and our soldiers will pull this thing through, and right well, too!"

T. J. Leney.

[43228.]—THE various comments on this subject show a certain amount of ingenuity; but they all seem to overlook the serious questions of weight, portability, and stability. A Mauser bullet will penetrate a plate of wrought iron ⅜in. thick at a range of 350yds.; so if a shield is to be proof at all ranges, it will be required to be made of the best quality of hardened steel of the same thickness. This will weigh about 15lb. per square foot; thus a shield 12ft. long by 6ft. high, protecting, say, ten men, will weigh, including stays and wheels, about 12 cwt. Now what effect would a 37 mm. Maxim, slinging about 3 cwt. of hardened steel shells per minute, each weighing about 1¼lb., have against this? Why, it would be simply so much pasteboard; while a 3in. shell would upset the entire show, and probably save the fatigue party the trouble of digging the long trench. My knowledge of North Natal is confined to a week's stay and two railway journeys; but from what I saw of the country, I should say that shields of this description would be absolutely useless. Many of our readers have doubtless visited North Wales and the rougher parts of the Peak of Darbyshire, and I can assure our readers that these parts are simply meadows compared to North Natal. Just imagine a party of, say, ten men moving half a ton of boiler-plate up Snowden, with instructions to keep off the path! This would be a fair sample of the work which the "armour-plated squad" would have to put up with. "W. B." suggests corrugating the face of the shield to break up the leaden bullets; but surely he overlooks the fact that lead-pointed bullets are barred at present. The Mauser bullet has a lead compound core, covered with a jacket of cupro-nickel (copper 90 per cent, nickel 10 per cent., I think). I do not propose to discuss the mistakes which have arisen, or to suggest remedies; but I do think that our officers at the front know quite as much about the subject as some of the scratch critics who write to the daily papers, and perhaps a little more.

Olytie.

MOTOR CARS.

[43229.]—I AM pleased to see a criticism by one who has had practical experience, though I do not entirely agree with him. Taking the points raised by "Country House" seriatim, I fancy in the first there is a misprint, as I do not know what he means by "the *flat* cords." My intention is to use round cords. As to the actual method of changing the direction of the pull on these cords, a bell-crank lever may be substituted for the pulley; but I prefer to retain the latter, using a short length of chain to take the bending stresses. I know of no better material for taking a strain in tension than good steel flexible cord. The steel must be of the best quality to stand the drawing down into wire; this is in itself a guarantee of quality. I am endeavouring to design the car so that as many parts as possible may be purchased ready made in the form in which they are required for use, as this, I think, will help to keep the cost low. Those who have sufficient mechanical skill to make and fit up levers and links to take the place of the flexible cords will have quite enough sense to enable them to alter the design without elaborate drawings or instructions. As this is expressly an amateur's car, I think that cords will give far better results in their hands than linkage work would do, as the joints in the links, &c., require to be very well made; otherwise backlash and lost motion will be painfully evident, whereas a screw adjustment at one end of the cord takes up all slackness. Next, taking the spring tension to jockey pulley. I have a precedent for this in the Cannstatt-Daimler belt-driven car, which is used at the present time by the Motor Coupé Co., London. I have had a lot of experience with this car, and the English Daimler gear-driven car, and greatly prefer the former. There are four belts and four jockey-pulleys, the belts being 2¼in. wide. The jockeys are applied by spring tension, and I never found any trouble arise from either the width of belts or the springs. The belts used are rather thicker than the majority of single belts, being between ¼in. and 5/16in. thick. If desired, I will forward a sketch of the jockey pulley gear of German Daimler car.

As to the diameter of the sprocket pinion, this, I take it, is a matter of opinion, and gave rise to a long controversy in the Cycling Press some time back. At any rate, so long as the ratio between the driving and driven sprockets is not altered, intending builders can suit their own fancy. The larger the sprockets, the greater the cost for material, cutting teeth, and extra chain. For the chain used in the steering, the belt-driven German Daimler is again a precedent. They used a very small sprocket (seven teeth, I think) and a 3/16in. chain, coupled by two light rods to the axle, which swivelled about its centre in the same way that the front axle of an ordinary carriage does. The strain on the chain was very much greater than in our case where the axle is fitted with pivots at each end on the Ackermann principle, as I described for the quadricycle in "Motor Cycles." In all I did nearly 3,000 miles driving on the belt-driven Daimler, and found no disadvantages on any of the above points. Its greatest faults were the water-cooling device (in fly-wheel rim), which threw the water about with reckless prodigality, the awkward position of starting handle and its cumbersome appearance.

A car has not been built to these drawings; but the design contains the best points of many belt-driven cars, with such improvements as I have found necessary by the best of teaching—i.e., long experience. The whole design throughout is practical. All dimensions deduced from actual practice, it having been my fate to be intimately connected (since before the legalising of the motor-car) with the Daimler, Benz, De Dion, Bollée, Peugeot, and Panhard cars, not only in using them, but in their design, manufacture, and testing.

The Writer of the Articles.

[43230.]—I AM very pleased to see article appearing on "Building a Motor-Car" in your valuable paper, and feel confident we shall learn many valuable hints on same. I would just like to point out to the writer *re* the foot-brake taking off the belts, that I have lately constructed a motor delivery van driven by 2½ belts with loose pulleys. It has three speeds, with separate belt for each, and by simply pressing toe on foot-brake throws the belt on to loose pulley; the same lever works the three belts, and whichever speed the car is travelling, you simply press foot-brake to stop it.

J. W. Riding.

Deeside Carriage Works, West Kirby, Jan. 9.

[43231.]—I AM very pleased to see in your last issue the first of a series of articles on "Motor-Car, and How to Build it," as I am sure there are very many of your readers who are quite capable of building any ordinary car with a little help such as the articles referred to would give, and at a cost probably something like one-fourth or one-fifth the advertised price of a good and useful car by one of the few well-known makers of to-day.

The car designed by the writer of the articles is very much like a "Benz," and perhaps still more like an "Accles-Turrell" car, in outward appearance, and, on paper, looks neat; but, at the same time, to me looks a little crowded, and might be improved by having a little longer wheel base. If the illustration is to scale, I suspect the wheel base to be rather short; but one cannot tell, as no dimensions are yet given, and no scale is attached. Another thing that strikes me is that there seems to be too much weight behind on the driving wheels.

Belts have certainly many drawbacks, but the author is, no doubt, correct in thinking that they are much better than gear for light cars, if of proper size, and judiciously arranged.

As to frame, the author proposes to use wood flitched with steel plates as being more easily worked by an amateur. This is, perhaps, correct; but I cannot think that flitched timber is best for the purpose, although it is used on "Benz" and other cars, and as many amateurs, and, no doubt, very many of your readers are quite as capable of working with steel angle, channel, H bars, or tubes, as with wood, I would suggest that the author gives dimensions of these also; the builder will then be able to use the material of his choice, and that which his experience and practice will best enable him to work.

The idea of using steel wire cords instead of rods is a good one, but I believe not altogether new; but the author seems to make further use of this material than has been done before.

The author claims that there is not at the present time a belt-driven car which can be stopped by putting on the brake only, or rather by a single movement of the brake lever, as in his design. He is wrong, and in proof thereof I would refer him to "La Voiture Darracq," illustrated and described in December issue of *Auto-Motor Journal*. This car has two foot levers: one disengages clutch between motor and car only, and the second lever disengages clutch and applies brake at same time. Also in the Accles-Turrell car, I believe, the action of putting on the brake at the same time slacks the belt, thereby enabling it to slip on the pulley.

Three horse-power seems to me to be too little even for a light car; am certain that most of the cars in use at the present day would be very considerably improved by the addition of from 20 to 40 per cent. more power.

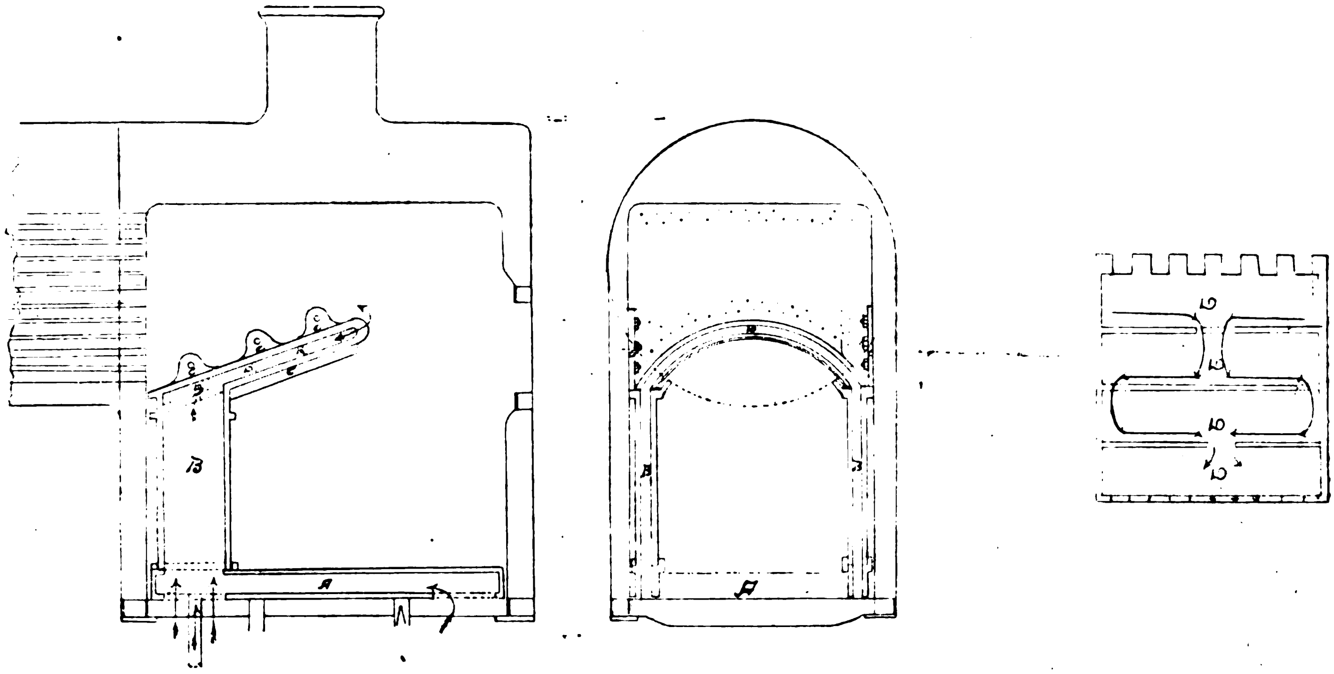
I notice in this week's issue of *Engineer* Mr. New, in an exceedingly interesting article on "Oil-Engines and Motor-Cars," states that the power should be 1¼H.P. per ton per mile per hour for a bad road of a gradient of 1 in 5. Now assuming that under these conditions—which are more common than one would think—we require a minimum car speed of four miles per hour, and that one car will weigh, say, about 9cwt., our power, according to Mr. New, should be 3⅜H.P. The author objects to a large power on his car as a source of vibration; but surely this is a matter of balance of motor, and I quite think that, ere long, motors will be so improved that we shall be able to place an 8H.P. or 10H.P. motor on a comparatively light car, and get therefrom even less vibration than we do from a 3H.P motor at the present time.

In conclusion, I would ask the writer of articles referred to to look upon these remarks as friendly criticism only, and I sincerely hope that you, Sir, will allow the subject of motor-cars and details thereof to be freely discussed, as I am sure that such discussion amongst practical mechanics will lead to vast improvements.

A. Jacks.

ORNAMENTAL TURNING.

[43232.]—MR. EVANS's design in last week's number is a very handsome one, and it would look well if executed in ivory or blackwood, as he recommends. As he very kindly offers to give all information in reference to it, I would be glad to know where one could procure the necessary material of the dimensions he names, as 5½in. is a large size for ivory. Also the probable cost of ivory required to complete the design, and if it could be had cut in the rough to the required dimensions, and *where?* Also the like information as to African blackwood, as to where it can be pro-



cured sufficiently large and sound, and the cost, &c. Referring to his remarks as to step-drills, the draw-back seems to me to be the keeping them in good order. I have a few made by Mr. Evans years ago; but have scarcely used them, preferring to use plain drills, square at the end (like a paring chisel), or round-mouth drill. With an assortment of these of different sizes, step-work can be very cleanly cut, and the necessary sharpening can, of course, be easily accomplished, with or without the goniometer. Of course, the design can be executed on a smaller scale, but I have taken the dimensions given by Mr. Evans; but whatever the size may be, any particulars as to material would be appreciated by **Spherical Rest.**

DETERIORATION OF ALMANACS.

[43233.]—In literature generally, in the size and print of periodicals and the like, there has no doubt been great improvement within the last thirty years. It is singular that one most useful publication—the almanac—has not kept pace with this improvement; at any rate, as far as the astronomical portion of the information goes. Take, for instance, the last year in which a large solar eclipse was visible from this country—viz., 1870. A reference to Francis Moore's almanac for that year will show the times of first and last contact, the greatest phase, the magnitude to the nearest minute of a digit worked out for 30 or 40 different places in Great Britain, also for Paris. A reference to any other year about this period when there was a solar eclipse, as 1867, 1873, 1874, &c., will show the same thing. Why cannot we have an almanac at the present day giving similar information? Some say that this was the work of Mr. Woolhouse, of *Nautical Almanac* fame, and that none will now undertake this most useful information. But, to say the least, the deterioration in almanacs of the present day in this respect seems much to be regretted.

Astronomicus.

AIR ARCH FOR LOCO. BOILER.

[43234.]—In reference to letter 43008, p. 297, Nov. 10, 1899, an "Air Arch for Loco. Boilers," we beg to inclose you a tracing for arch which we applied for and received provisional acceptance. The following are the principal features of our arrangement.

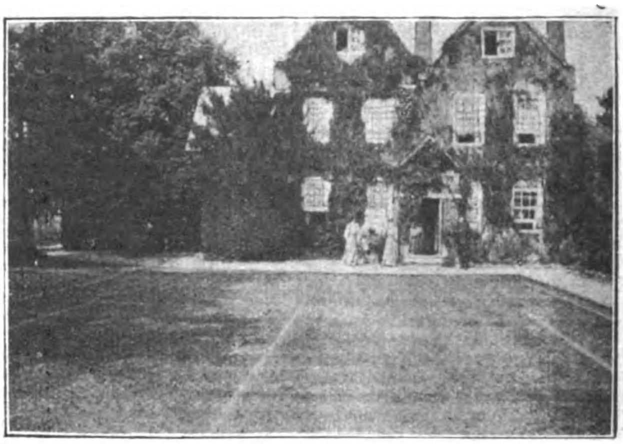
The air is conveyed along a hollow firebar A, open underneath at either end (so that whether the engine is running ahead or tender first the weather end of ashbox will be open) into a flat pipe B placed on to the top of bar A in a socket. The upper end of pipe is attached to a bar, C, the length of the width of the arch D, which is hung to the firebox sides with lugs, the pipe end B coming up through the bar A and forming a spigot. The arch (cast iron) is divided into four parts, D D D, each forming a compartment of its own. The first part, or that nearest the tube-plate, fits into the spigot of upright pipe B, then passes into part D 1, from there into part D 2, going into part D 3, and from there into part D 4, thence through outlet holes into firebox. The air in its passage from the inlet to the exit of arch attains to a great heat, and in coming into contact with the heated carbonaceous gases ignites and obtains a more perfect combustion, and, as a consequence, mitigates the smoke nuisance. To protect the upright pipe B and arch D from burning by closing the ashbox doors suddenly, there is a supplementary pipe E going through the bottom of the ashbox into the upright pipe B, keeping it and the arch D cool, and which in nowise interferes with the fires.

Davison and Reed (Patentees).

Preston, North Shields.

CURIOUS MIRAGE EFFECT.

[43235.]—The accompanying photograph was taken with a pocket Kodak last August. The time was about one o'clock, and the day intensely hot. I venture to think that it may be of interest to your readers from the fact that the central figure in the doorway had no existence. There are three ladies on the left-hand side as you look at the photograph, and myself on the right. The lady



standing nearest to the doorway turned round at the moment when the photograph was taken, so that her back is presented towards the camera, and an examination of the figure in the doorway leads me to think that it is the front view of the lady who has turned round.

With regard to the explanation that it is a double exposure: that cannot have been the case, as all the lines and detail are sharp, which could hardly be the case with two successive photographs taken while holding the camera in the hands. It is true that the middle line of the tennis court appears double; but that, I think, is due to its having been re-marked.

I put the appearance of the fifth figure down to the fact that the sun was shining on the wall, and had made it very hot. The strata of air near the wall would then have been heated to different temperatures, the hottest being next to the wall. The rays of light traversing the strata of air of different densities might then have been refracted sufficiently to come right round and enter the camera lens. The passage and the upright door-post are visible through the figure.

I shall be pleased to hear any other opinions as to the cause of the extra figure. **G. T.**

NOAH'S ANCHORS.

[43236.]—May I invite the attention of your readers to a photograph on p. 117, of the *Strand Magazine* for January of four huge anchors "to be found at Kaironan (*sic*, possibly a misprint for Kairouan, or Kairwan, in Tunis) in North Africa," and said by their guardian to be those of Noah's Ark, and to be of iron, bronze, silver (!), and gold (!!) respectively. They are said to be 15ft. long, and, judging from the figures standing by them, the shank must be about a foot thick. Their rings also, which are apparently adapted for a hemp cable, seem to be about 2ft. 6in. in diameter, and all appear to be in perfect preservation.

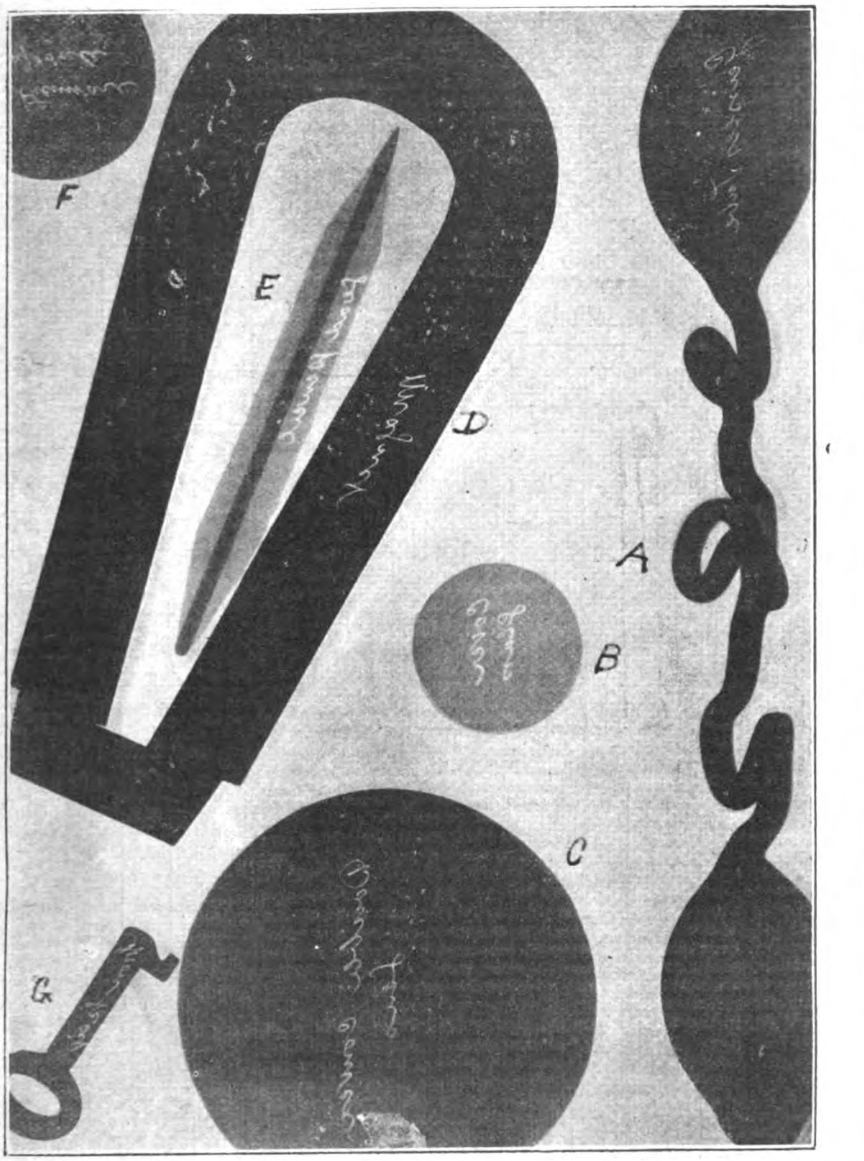
Irrespective of the question of their reputed origin, they would seem well worthy of attention, not only from their great size, much exceeding (if I may trust my memory) that of the *Victory's* anchor, now on the parade at Southsea, which I have always understood to be one of the largest that was made before the advent of the steam-hammer, but from their existence in an inland town—if I am right as to Kairwan. **Faber.**

AIR-SHIP OR AEROPLANE.

[43237.]—I am glad to see F. H. Wenham's letter (43217), for I quite agree with what he suggests—viz., that the next step for solving the problem of flight is to impart some propulsive force to the wings. This I know from my experiments (see *Aëronautical Journal*, Vol. I. part 4, Oct., 1897) is feasible by flapping the wings, and might be done for a short time by a muscular man in a specially-constructed machine. The machine would only travel slowly, when there should be no difficulty in obtaining equilibrium by lowering the centre of gravity as much as found necessary. I refrain from details, as their description would take up much space. **R. F. Moore.**

AN X-RAY CURIOSITY.

[43238.]—I send with this a radiograph of miscellaneous articles taken by myself recently; about



one item on which, if you find it possible to reproduce the same, I should much like a little information from some practical physicist. I refer to the Geissler tube marked A. The greater part of this article is made of—so far as the eye can judge—ordinary white glass; and the central twist, in juxtaposition with the A, is stained a bright pea-green. This central part appears to the eye every bit as stout in material as are the twisted portions of the white glass at either end of it. Now, can anyone tell me why the said pea-green glass is more transparent to the X-rays than any part of the white glass is? Even where the twist upon itself makes the thickness double that of the white, it is clearly less opaque. I presume the metallic colouring is responsible for the difference, but how?

The other articles shown are: B, a micro-cover glass; C, a double-convex lens; D, a magnet; E, a short length of blacklead pencil; F, an earthenware capsule; G, an iron key.

William Godden.

IS THE THEORY OF GRAVITATION A FINALITY?

[43239.]—LIKE Mr. Alexander (p. 452) I also do not consider the usual explanation of planetary motion to go far enough, and nearly 20 years ago enunciated a theory on solar emanation, which, I think, contains a probable answer to some of the questions he has a wish to inquire into. The theory was based on the antagonism of motion to attraction, and my reasoning and remarks were somewhat as follows:—

The law of gravitation gave the key to what had been previously inexplicable in planetary motion. It showed us how mass was attracted by mass, and how world was influenced by world; but it seems to have altogether overlooked the force which must result from universal attraction opposed to universal motion. Is it here we are to seek for the force that builds up a sunbeam?

If we rub a glass rod with a piece of silk it becomes warm through friction; but, independent of this, its attractive properties are greatly increased, and is found to emit light and heat when brought into contact with the earth. What has brought about this change? The answer is, Motion. But motion alone would never have had these effects unless there had been a prior mutual attraction between the two bodies. This imperceptible attraction was overcome by the motion, and the result was that the attraction was not only increased, but the surplus force appeared in a spark, as light and heat. If, under peculiar circumstances one magnet is revolved in front of another magnet, the same effects are observed, although in this case there is no contact between the two bodies. If we disturb the attraction which holds together the atoms of a chemical compound, whether it be in the solid, the liquid, or the gaseous state, we have this same emanation of light and heat. If, then, such effects can be produced in our laboratories, infinitely greater effects must result in the Solar System, as we have there the initial conditions of above experiments in the struggle which is continually going on between attraction and centrifugal force.

Taking the Solar System in its simplest form, it consists of a central body turning on its axis, the sun, round which at various distances is circling other rotating bodies, the planets. All these bodies are on practically the same plane, and are held together by attraction; but owing to their continual motion, the attraction is being continually broken. Now, it must occur to everyone who has had the slightest acquaintance with electric construction, that we have here all the elements of a huge electric machine, call it statical induction, or dynamo electric, it matters not; but for simplicity let us see in it a type of the modern dynamo, with the planets as so many field-magnets, and the sun as an armature flashing forth its surplus charge to its attendant planets. But we must have some proof that it really is what its arrangement would indicate, and we, fortunately, have such proof in the appearance that a comet is found to present in its approach to and recession from the sun.

According to the more advanced theories regarding comets, they are thought to consist of solid matter, and rigorously to conform to the laws of gravitation, and strictly to follow out their orbits. When a comet is far away from the sun, it appears very much like ordinary stellar matter; but as it gradually approaches the sun, and as its motion increases, it becomes more brightly illuminated, and sends out short streaks of light sunwards. Shortly these streaks are forcibly driven back, as by some repellent force, and gather about the head of the comet in a bright halo. On a nearer approach this halo appears to be partly thrown off, and one or more tails formed on the side away from the sun. When the comet sweeps round the sun its tail wheels round along with it, always keeping away from the sun, and as it recedes its tail—which is now in front—gradually dwindles away, until it appears as ordinary stellar matter again.

As comets (at least those that we have most to do with at present) travel in infinitely long ellipses, and strike the plane of the Ecliptic at a considerable angle, they may be considered, for all practical purposes, not to participate in the general circular movement of the planetary system; and when crossing the plane of the Ecliptic they will therefore be nearly stationary, and under the same influences as the sun himself. Let us see if a cold dark body, thus thrown within the influence of the contending forces takes on the appearance of a sun, that is sends its surplus force planetwards.

When a comet first makes its appearance we see it through our telescopes as a faint, hazy, undefined body, which appearance very probably results from a deficiency of power in our instruments. As it approaches the sun, short streaks of light spring forth sunwards, or rather an electric discharge passes from it towards the sun, owing to its having been formerly the rubber, and consequently endowed with a different kind of electricity. As it gets further within the influence that (according to these speculations) forms a sun, a repulsive action takes place between it and the sun (see double stars) owing to their now being charged with the same kind of electricity; in fact, for the time being it becomes a sun, and emits light in the direction of the rubber, or outer planetary matter, in the same manner as the sun himself.

But our hypothetical machine wants regulating, and to attain a good, self-regulating dynamo, we must assume that gravitation itself—i.e., universal attraction—is but the product of the action of motion upon mass, in the same manner as we assumed that the manifestation of physical force is but the outcome of the action of motion upon attraction. If we do this, it is at once evident we are dealing with balancing powers, and that any acceleration of planetary motion must result in increased attraction, which attraction would, of course, retard motion, and restore things to their normal condition.

In the foregoing speculations we have been working with natural powers, and assumed nothing but what is capable of proof or denial, some way or another. But when we attempt to formulate a working hypothesis on the creation of such structures, we have at the very outset to enter upon assumptions beyond the remotest chance of experimental or even intellectual inquiry. We have, as a matter of fact, to assume a Creator giving the initial push to primordial matter; and we have to see in primordial matter a trace, however small, imparted or inherent, of its usual attractive properties, for, unlike mass, it is inconceivable that matter itself (that is, non-attractive matter) could in any way be acted upon by motion however energetic. With these assumptions as a start, and our speculations to carry us through, a possible theory can be built up somewhat as follows:—

In the beginning "the earth was without form and void," or, in other words, there was matter, but no motion. To this inert matter motion was given, when it immediately became as it were a thing of life; atom whirled around atom, and as the outcome of the action of motion upon such matter is attraction, atom clung to atom, and molecule rushed towards molecule, to form the nuclei of future worlds. Everywhere these nuclei went spinning round, forming vast whirlpools (see Spiral Nebula in Canes Venatici) in their efforts to gather up as much matter as their fellows; but, owing to difference of speed and proximity of material, all were not alike successful. Among the less successful were some tiny masses furiously whirling away in their vain endeavours to overtake their more bulky companions, who had already swept up everything within their reach, and were now striving to draw their little friends within their grasp, but, owing to these smaller masses being endowed with a rotary motion round their own axis, the only effect which the attraction of the larger masses had on them was to convert part of their rotary motion into centrifugal force, which conversion had not only the effect of balancing the attraction, but also of swinging the satellites into the same plane as their primaries.

While this was going on among the comparatively smaller bodies, in our own system there was one huge mass (the sun) which had already sucked all the surrounding matter within its mighty vortex, and was now seeking to bring these rival systems within its powerful influence; but as satellite was rolling round planet, and planet was spinning round on its axis, it had no longer to deal with the infinitely small particles of which it had just been

built up, but with masses composed of the same material, and endowed with the same motion as the sun himself. He tried to draw them in: but as his attraction diminished with distance, and as the bodies on which he was exerting his attractive power possessed considerable magnitude, the attraction was greater on the near than on the further side of each individual planet; the effect of this, combined with their rotation, being to cause them to fly off at right angles to the attracting power, but still held by the attractive influence they were swung to the same plane, and rolled round the sun as a centre.

If the whole had ended here, and the planets been destitute of the power to increase or diminish the sun's attraction, the retarding influence of such attraction would have gradually overcome centrifugal force, and the planets would have been gently swept on to his surface, the whole matter of the universe thus ultimately coalescing into one monster mass, which, being no longer acted on by external matter, would have eventually returned to that void from which it sprang. But such was not the case; each planet, as it was added to our system, increased the sun's attraction, enabling him to stretch his influence still further out, and bring within his sway the more distant worlds. Attraction was increased, but so was motion; the fight between attraction and centrifugal force began, the core of our huge dynamo-machine became covered with a brilliant shroud, and the sun shone out in all his splendour, radiating his light in every direction, as it were in payment of the force expended to maintain him in his glory.

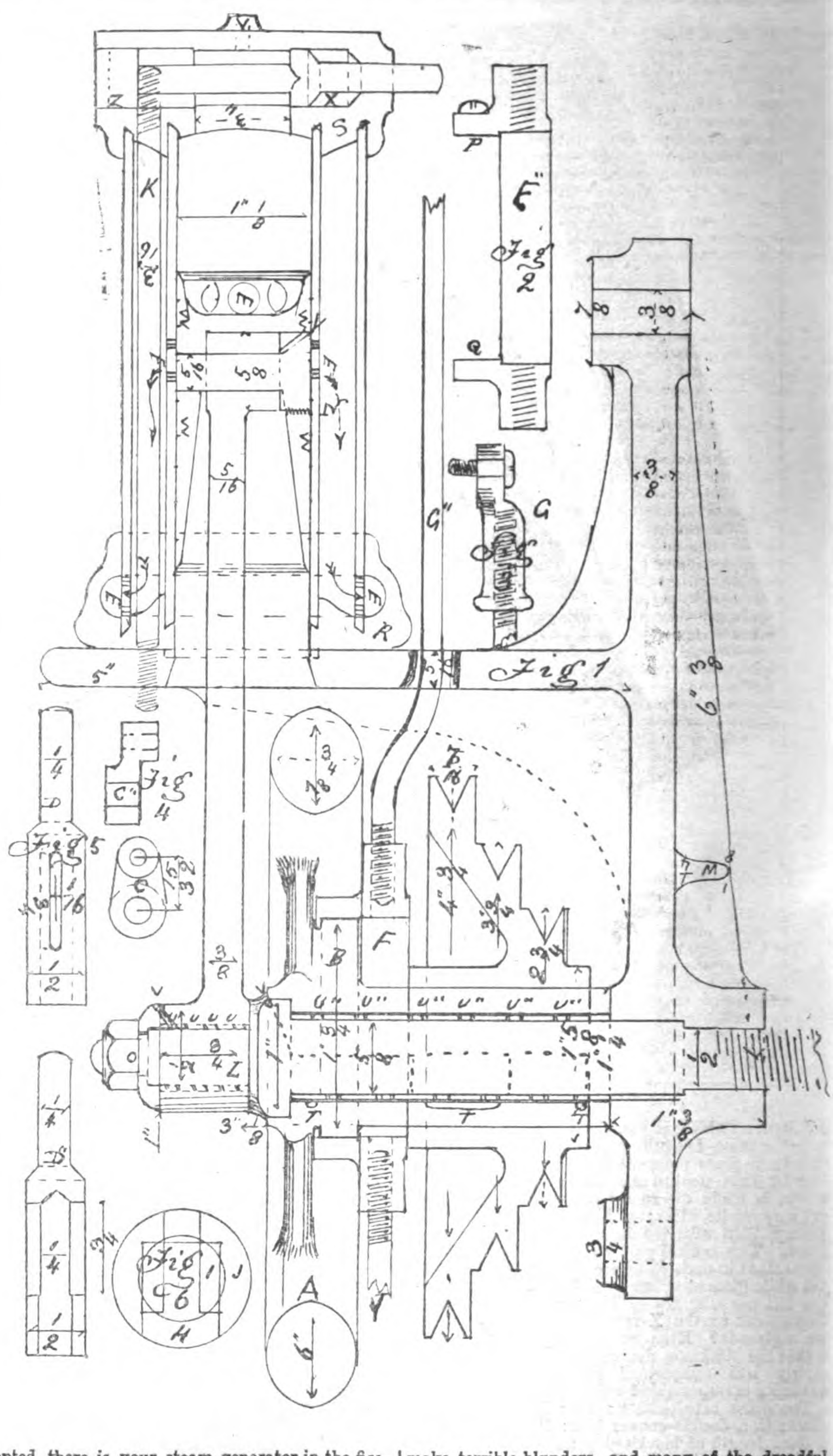
Along with these formations and arrangements of new worlds, there were at the same time small bodies (comets), which at the balancing of the more important masses, were situated midway between two contending powers, one of which for a time got them within its influence. Their speed, at first slow, gradually went on increasing as they got nearer to the attracting body; and as they were almost destitute of centrifugal force, owing to their having two centres of revolution, they appeared to be driving right on to the surface of the sun. Faster and faster they rushed along, until it almost seemed as if these puny masses were destined to overturn the equipoise of our system. But a sudden change took place; the comets had reached the region of contending forces, attraction was immediately changed into repulsion, and they swept round their huge relation uninjured by his power. Out into space they went, throwing off their bright trappings as they neared their starting-points, there to set out on a new pilgrimage, through other systems and round other suns;—their chief use in celestial mechanism being to hold system unchangeably separate from system, so that the motion of the one shall not in any way interfere with the correct working of the other.

And thus, in unchanging constancy, all shall remain, each unit fulfilling the part it was destined to play, satellite rolling round planet, and planet round sun without reduction of speed or diminution of force, until this great strucsure has accomplished the object for which it was created, when it will return to the void form whence it came. Not, however, by the clashing of worlds or the cooling down of our resplendent orb, but by the command of Him who gave it birth, that all be still, when the whole fabric will immediately return to its inert pristine condition without even the power to fall asunder.

R. L.

HOW TO BUILD A LIGHT ENGINE FOR VARIOUS PURPOSES.—IV.

[43240.]—ABOUT the early "fifties" I paid a visit to an engineer's shop, and was put out a bit as to the arrangement of machinery—i.e., tools and some engines—and was rather mystified; but upon arriving at the shop end and looking round again, I became somewhat enlightened. There, on the ground, were a couple of stout cast-iron I-girders let into the wall across the angle of the shop. These were no more nor less than parallel pieces. Upon these was a very large cylinder undergoing the process of boring out; above that was the motor part of the mill mounted upon a couple more girders, and below was a good deep pit. I had no idea that so large work was done in so small a shop. This, of course, accounted for what I see—i.e., machines bracketed to the walls—and therefore all was clear below for getting the cylinders and other large castings in position to work on. I thought then what an excellent arrangement it was: engine for boring cylinders, or kept going until they got through. Well, fancy a nice little engine bracketed to the wall for such a purpose, up out of harm's way, and ready to do duty any time; very little or any attention. What could be better! Now, when you have a small engine, the question is, What will you do with it? Where will you put it? If I might suggest a place, I should say: Build it with an entablature, and caulk it into the chimney-breast over the mantelpiece—i.e., make wallflowers of them. Other things could be served the same, or they could be mounted upon an inch floor-board, and put up against the wall, only, if the first plan is



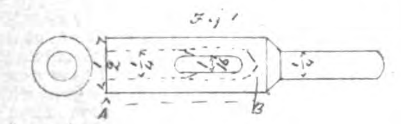
adopted, there is your steam generator in the fireplace, your water-tank upon the mantel-shelf, and, directly under, your engine with the feed-pump in it, and driven by the same motor that drives your valve. The following sketch is an engine for such a place. I have only shown it there with a 6in. flywheel; that you can augment by making the connecting-rod longer, and having a greater distance from the under-side of the bracket of the entablature, will be longer in proportion. I could have given a longer sketch, only I am restricted as regards paper and board on one side, and space upon the other, and it is easy enough to make any additional length if required; and I should advise anyone who goes in for these to make provision for more power if required, which can be easily done by making the bed an inch wider, and distance from under-side to stud for wheel longer. A larger cylinder could be built and put upon bed, and valve arrangement and other things remain the same; and the discarded cylinder, I have a notion, will fetch its price, so you will see how economically you can augment your power. You smile, I daresay, some of you, and say: "H'm, that sounds all right." Yes; and it is there I have stated a few blunders that have come under my notice. I merely do this to show you that so-called engineers make terrible blunders, and many of the dreadful so-called accidents, if you could trace them (and it is easy to trace them when you know your way about), are more generally gross neglect, and we will say nothing about the blunders that I know of. Now for the sketch. Dimensions are given as it stands. Fig. 1 is, taking it all round, an elevated section; Fig. 2 is the gate that carries the rubbing pieces for conveying the motion of the eccentric to the valve-gear, this acting very similar to an elliptic chuck for a lathe. Fig. 3 is the joint end that continues G" to work the bell crank. Fig. 4, C", being section, and C' face of same. Fig. 5 is the outside of valve, and the one underneath is transverse section of same; steam is taken up the centre, and then through the port. Fig. 6 is cross section of piston through pin and joint of connecting-rod. A is the flywheel; B the eccentric; C" and C ball-crank for valve-gear; D' D" steam-valve; E E exhaust holes into jacket; F gate for eccentric; G" C" valve-rod and connections for bell-crank; H, Fig. 6, pin; I joint of connecting-rod; J trunk piston; K one of the long $\frac{3}{16}$in. bolts, *not large ones*; P and Q where the rubbing pieces are to be put; F the frame or gate, cast all in one piece; L big end of connecting-rod on the pin. *Re* crank-pin, you will see a tube full of holes

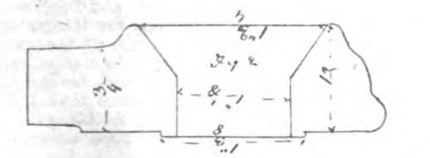
staggered all over it, *u u u u*; the same upon the main stud *u u u u u u*, and this is full of holes; T T T recesses for oil; V a place for a milled-headed screw, that is for the introduction of the lubricant; X and Z packing rings; S the steam-chest and cap, and R the base ring carrying the belt for the exhaust and tube for outlet, E E E E, showing the passage of the exhaust S R. Figs. 2, 3, 4, 5, and 6 may be made of any of the bronzes; the rod for driving of malleable iron, wrought iron, or mild steel; the loose bushes of solid drawn steel tube; pins of steel. N is a piece of brass wire screwed between the joint of pin and piston to keep it in its place; entablature of cast iron will do.

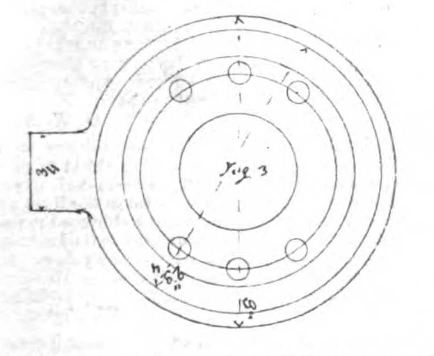
Jack of All Trades.

HOW TO BUILD LIGHT ENGINES.

[43241.]—IN answer to "Bonchurch" (43175), no. I am aware that the sketches (Figs. 2 and 3) are not mentioned in the text, because I had an idea that they would explain themselves without any great stretch of imagination. If you refer to the sketches mentioned you will see cylinder-end (Fig. 1) directly under it, which is the same only another view, or rather two views of the same, giving an idea for the pattern-making, which is simple enough. You ask where the brass triblet tube comes in, and for what purpose. Have you







read the text, and referred to F F F F, where the holes are in the steel tube for the exhaust? It exhausts through these holes into and between both tubes, makes its way down to F F, on through the triblet-tube into a belt at D, and makes its exit at the right-hand side at or just above D. This can, of course, be put in any situation to accommodate other affairs—i.e., it is not bound to be in that position; but it must be shown, as, if there is no opening for the exhaust, *it will not go.* I mention this because you may be warned; but you will not be the first who has sealed things up and expected them to act. And dimensions are given which must be looked after—for instance, a connecting-rod too long or the throw of the crank longer than your cylinder. I was called in to see an engine once that about forty men had been eight months trying to start. I stated what was the matter with it, and the next time I was that way I found a 1½in. lead collar put between the top cylinder cover and cylinder, and I have been told recently that the engine is still working like that. That was over 40 years ago. This plant was laid down by a well-known firm of engineers in London. In article 2, Jan. 5, 1900, I see I have given the port for the admission of steam as $\frac{3}{32}$. That was guesswork, and is wrong. The proper dimensions are given with diagram above, upon the same page, where it is shown how to get the position of eccentric. If this is not toothed, too, you cannot expect to get other things to act, as it will not take steam or cut off properly at the desired spot for expansion. With this I have forwarded the bottom of No. 1, on p. 428, Dec. 22, 1899. This shows you how to make the pattern, and gives dimensions, and it can be bored, turned, and fitted to the tubes as shown. Fig. 1 is the valve; the hole may be extended up as far as A B, which will make it much easier to get out the port, which might be cut out with a small circular saw. Fig. 2 is showing you a section of the pattern for the bottom D, and Fig. 3 dimension for moulding out side and position of holes. But do not mark them off or drill for them until you have decided where you want to turn your exhaust. The section to work to being given before in the cylinder elevation. There are only two holes shown in the triblet tube into the belt in D. Make as many or more as there are in the steel tube. The exhaust will keep the cylinder well drained, and it will be steam-jacketed by the exhaust.

Jack of All Trades.

TWENTIETH CENTURY.

[43242.]—MAY I take your valuable space to reply? Whether Anno Domini dates from the birth of Christ or from the time He was one year old can make no difference now, except that it would strike one that all dates of 1900 would be conveniently placed in the century. I think it is admitted that all other creatures except Christ had a first year, and that when they were any number of years old those years would have passed, so also in the exceptional cases of 100 years their century would be complete. I think a note should be made that the Emperor William's opinion, that the century was complete in 1900, is only the general consensus of scientific opinion in Germany.

W. F. Stanley.

AN OLD CRIMINAL TRIAL.

[43243.]—IN looking over reports of some old criminal trials, I met with one which may interest your readers. The date is 1787. In that year John Elliot was tried for firing at Miss Mary Boydell with intent to kill. The shot (or shots) was fired so close as to set her dress on fire, and there were two contusions on her body, said to correspond with the two pistol-barrels. But why was she not seriously hurt, or why did not the bullets enter her body? A surgeon who was examined, but whose name is not given, supplied the following explanation:—"It was certain that a pistol put quite close home to any resisting body, and discharged so as not to have the assistance of the air, lost much of its force."

The unintelligent jury, however, interrupted the Recorder in his charge by stating that it was clear to them that the pistol was not loaded with ball. But this was not the defence. It was insanity; and a Dr. Symonds was called to prove this. He had formed this opinion from a letter written to him by the prisoner in the preceding January, "the purport of which was a philosophical hypothesis that the sun was not specifically a ball of fire, but that his heat proceeded from the quality of the atmosphere that surrounded his body." The *Annual Register* adds: "Some part of this paper was read, and, so far from betraying symptoms of insanity, it had all the marks of quick and cultured parts. The hypothesis, however false, was ably argued."

Was John Elliot the first to maintain that the light and heat of the sun came from what is now known as the Photosphere? The jury acquitted him.

W. H. S. Monck.

USEFUL AND SCIENTIFIC NOTES.

THE stain of banana juice is almost indelible. It does not proceed from the stalk or plant, but exists in the green fruit as well, from which, when cut or bruised, it exudes in the shape of viscid milk or cream-like drops.

A NEW roller-boat is being built in Canada. This vessel is a cigar-shaped craft about 30ft. in length. The screw consists of a cylinder about one-half the length of the boat, situated in the centre and passing entirely around the hull proper. This cylinder is supplied with fins or wings running diagonally around from one end to the other, and their rotation gives motion to the hull. The keel, connected at both ends to the hull proper, hangs below the revolving cylinder.

THE largest single owner of blast furnaces in the world is said to be the Austrian Alpine Montan Gesellschaft, which owns 32 furnaces. These are mostly of small size, however, and run on charcoal iron. William Baird and Co., Glasgow, own 29 furnaces, including the works at Gartsherrie, Eglington, Lugar, and Muirkirk, Scotland. In the United States the Carnegie Steel Company owns 17 furnaces, the total annual capacity of which is 2,200,000 tons. The National Steel Company owns 12 furnaces, the total annual capacity of which is about 1,205,000 tons.

AN Admiralty order has been received at Pembroke Dockyard directing that the armoured cruiser *Drake* must be hurried on so as to be launched, if possible, in October next. The *Drake* was laid down on April 24 last. In the ordinary course her launch would not have taken place until the summer of 1901. She is 500ft. long, and will have a displacement of 14,100 tons. The engines will be of 23,000 H.P., and the maximum speed with natural draught 23 knots. These cruisers, when completed, will be the most powerful of their class in the world.

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96878.]—**Trigonometrical (U.Q.)**—Suppose the angles B P C, C P A, A P B are called u, v, w, and the side of the triangle is called x, then, of course—

$$\cos. u = \frac{b^2 + c^2 - x^2}{2bc} = l, \text{ say}$$

$$\cos. v = \frac{c^2 + a^2 - x^2}{2ca} = m$$

$$\cos. w = \frac{a^2 + b^2 - x^2}{2ab} = n$$

and since $u + v + w$ is zero, or four right angles, there is a relation between the cosines, namely—

$$l^2 + m^2 + n^2 - 2lmn - 1 = 0,$$

which leads to—

$$x^2 [x^4 - (a^2 + b^2 + c^2)\, x^2 + a^4 + b^4 + c^4 - b^2 c^2 - c^2 a^2 - a^3 b^2] = 0.$$

The required solutions are x_1 and x_2 where x_1^2 and x_2^2 are the roots of the equation—

$$z^2 - z(a^2 + b^2 + c^2) + a^4 + b^4 + c^4 - b^2 c^2 - c^2 a^2 - a^2 b^2 = 0.$$

And, consequently—

$$x_1^2 + x_2^2 = a^2 + b^2 + c^2$$

$$2 x_1^2 x_2^2 = (b^2 - c^2)^2 + (c^2 - a^2)^2 + (a^2 - b^2)^2.$$

I do not at present understand the point of the apparent solution $x^2 = 0$. The greater root corresponds to the case of P inside the triangle, and the lesser root to that of P outside.

QUIVIS.

[96919.]—**Floating Body in the Air (U.Q.)**—Mr. Maskelyne wisely keeps his secrets well guarded, so most of us can only state our opinions. It is certain that without actual contact no arrangement of magnets or other electric apparatus can keep a body suspended at rest in a fluid (like air) less dense than the body itself, and likewise at rest. Such a state of equilibrium, though conceivable, is unstable, as can be shown mathematically. As far as I can see, the only alternatives are either (1) the human body is held up by wires or other supports—i.e., it is not "floating"—or (2) it is buoyed up by gas, balloon fashion. The amount of space required for the second idea puts it out of court altogether, and I vote for wires, in spite of all the stick-waving.

QUIVIS.

[96969.]—**Oscillations of Pendulum (U.Q.)**—The times of oscillation of the pendulums are as the square roots of their lengths. Hence, the number of oscillations made by each per second is as the inverse square root of its length. It follows that the numbers of oscillations the two make in a second are respectively—

$$\left(\frac{l + c}{e}\right)^{-\frac{1}{2}} \text{ and } \left(\frac{l - c}{e}\right)^{-\frac{1}{2}}$$

i.e.,
$$\left(1 + \frac{c}{l}\right)^{-\frac{1}{2}} \text{ and } \left(1 - \frac{c}{l}\right)^{-\frac{1}{2}}$$

i.e., expanding by binomial theorem—

$$1 - \tfrac{1}{2}\frac{c}{l} + \frac{1\cdot 3}{2\cdot 4}\frac{c^2}{e^2} - \ldots.$$

$$\text{and } \quad 1 + \tfrac{1}{2}\frac{c}{l} + \frac{1\cdot 3}{2\cdot 4}\frac{c^2}{l^2} + \ldots.$$

The sum of these numbers is approximately—

$$2\left(1 + \tfrac{3}{8}\frac{c^2}{l^2}\right)$$

Hence, the combined number of oscillations made in a day is—

$$24 \times 60 \times 60 \times 2\left(1 + \tfrac{3}{8}\frac{c^2}{l^2}\right).$$

QUIVIS.

[96987.]—**Series (U.Q.)**—The given series may be written—

$$J = 1 + x + \frac{x^2}{2!\,2!} + \frac{x^3}{3!\,3!} + \ldots.$$

whence we get at once—

$$\frac{dJ}{dx} = 1 + \frac{x}{2!\,1!} + \frac{x^2}{3!\,2!} + \ldots.$$

and—
$$\frac{d}{dx}\, x\, \frac{dJ}{dx} = 1 + \frac{x}{1!\,1!} + \frac{x^2}{2!\,2!} + \ldots.$$

or—
$$\frac{d}{dx}\, x\, \frac{dJ}{dx} = J.$$

Change x into $-\frac{u^2}{4}$

and the equation becomes—

$$\frac{d^2 J}{du^2} + \frac{1}{u}\frac{dJ}{du} + u = o$$

which is known as Bessel's equation of zero order. Hence the given function must be of the form $A J_o(u) + B y_o(u)$, where J_o and y_o are the standard

solutions of this well-known equation. It happens in this case that A is unity and B zero, so that the given function is—

$$J_o [2(-x)^{\frac{1}{2}}]$$

It is impossible to express this in finite series form in terms of any of the simpler functions, such as log. x or e^x, but it is clear that it is the same as the constant term in the expansion of $e^x\left(t + \frac{1}{t}\right)$, where t is regarded as the variable. I fear none of us can do more summing for you than this.

QUIVIS.

[97162.]—**Dynamo as Motor (U.Q.)**—The reason your 300-volt dynamo will not give any power as a motor on a 100-volt circuit, is because it is not supplied by sufficient pressure at terminals. The resistance of the field coils is, of course, too high to allow sufficient current to pass to magnetise the field-magnets. Put your F.M. coils in parallel, and then see what power it will give.

Dudley. WEBSTER MICHELSON AND CO.

[97174.]—**Water Power.**—I am much obliged to "Metope" for noticing my question regarding power to be obtained from 6in. water supply pipe, and would be glad to know where the tables could be obtained. The 6in. pipe is about 14in. under the level of a practically inexhaustible supply, and can deliver the water to a tail race 4½ft. below the top level of the aforesaid supply, so I conclude the pipe ought to be filled, unless friction of water reduces the quantity, the length of pipe from supply being 40 yards.

J. S. S.

[97180.]—**Marine Navigation.**—No, "G.S.N.," the statement is not "rot," but the actual truth. The feat of getting something out of nothing has nothing to do with the question. In a big liner the exhaust steam from the numerous auxiliaries amounts to a large quantity, and it is led, as a rule, into the low-pressure cylinder receiver. After the engines have been started and a good vacuum established, this auxiliary engine exhaust steam is sufficient, in conjunction with the vacuum, to keep the big engines turning, and so drive the ship slowly. In the Navy this exhaust steam is now used for evaporating fresh water for the boilers, and answers very well.

J. H. H.

[97191.—**Disinfectant.**—Nitrate of lead is a well-known disinfectant, and has been mentioned in back volumes years ago. I think it is recommended by the medical officers of health to hang up a sheet soaked in a solution of nitrate of lead in front of the doorway of a sick-room in which there is an infectious case. The "disinfectant" mentioned by "Rotos" may be something special, as common salt is to be added to the water used as solvent; but if chlorine is given off by the reaction, I should prefer to be in the vicinity of the "infectant" rather than in that of the disinfectant.

S. R.

[97193.]—**Lantern Slides.**—Some of the best articles on lantern slides that ever appeared were published in the ENGLISH MECHANIC about 1871 or thereabouts; but, naturally, the numbers are out of print. I think Mr. Hughes, of Kingsland, published them in separate form. As to the special subject of the query, aniline colours can be used anywhere, provided they are mixed in suitable media. Some of them will not stand light for long. There is abundance of information on the subject in back volumes, and nowadays there are manuals which help the amateur which did not exist when this paper supplied so much useful information.

ESSAR.

[97221.]—**Telectroscope.**—I know nothing about this apparatus—therefore am I competent to answer the query. That is, I have hunted up every likely source of information, and can't find anything definite. All that has appeared seems to be mere newspaper "twaddle," which, however, should be published, because it sets "brains" thinking. To those who know something of "fundamentals" it is amusing to read newspaper reports. When we "see by wire," where will the wire be—in the eye or outside? There is nothing impossible; but will anyone be able to see round a corner—or more important, perhaps, be able to shoot round a corner?

T. P.

[97225.]—**Acetylene Burners.**—If the querist cannot make suitable burners for his lantern from the many descriptive articles given in your pages, he should consult those who advertise, and tell them exactly what he wants to do. His query is about as vague as possible—especially as to the "relative positions."

T. L.

[97230.]—**The Blue Eye.**—I suppose that Tyndall was referring to what Helmholtz had said in his lectures, collected under the title of "Recent Progress of the Theory of Vision," translated by Dr. Pye-Smith, and published by Longmans in "Popular Lectures on Scientific Subjects," 1873. As to a "blue eye" being simply a "turbid medium," that may be true enough; but it is also true of any colour eye—if true at all. See Helmholtz on "Light." He was "called over the coals" for saying that the human eye was not exactly a perfect optical instrument; but it did not matter—he was master of the coals.

S. R.

[97232.]—**Maxim Guns.**—The query should be put to the source of publication. All sorts of statements about guns are made nowadays; but where is the authority?

M. L.

[97263.]—**Organ Building.**—I notice in this query that there is to be a stop of 56 pipes called Piccolo of 2ft. pitch. What size will be the pipes of the upper octave, &c. Surely there must be some mistake about "56 pipes" of 2ft. pitch. I have seen some small pipes, but not a full row of 2ft. I suppose that what is meant is a half-row of Piccolo 2ft. pitch, but I should like to know whether a complete set of Piccolo (2ft. pitch) has been made.

W. A. J.

[97283.]—**Motor Tricycle.**—Let the shaft be a light driving fit, with two keys at 90° to each other, also well fitted, and there will be little trouble. Has "Jack" ever tried to assemble the shaft he describes, when both pins fit tightly? Finally, the method indicated by the writer of the articles is by far the best for the purpose, and "Monty's" method of machining quite reliable; but the disc should be properly lined out before chucking.

TURNER.

[97284.]—**Geometrical Progression.**—Concerning Mr. Burgess's remarks on p. 498, top of column 3, the introduction to my solution on p. 189 does not involve the use of any formulæ which would be unfamiliar to a beginner. The phrase, "it is easily shown, &c.," is a common form of abbreviation by omitting easy steps. I gave "Ontario" credit for seeing that

$$\frac{S^2}{\Sigma} = \frac{\dfrac{a^2(r^n - 1)^2}{(r-1)^2}}{\dfrac{a^2(r^{2n} - 1)}{r^2 - 1}} = \frac{(r+1)(r^n - 1)}{(r-1)(r^n + 1)}$$

C. P.

[97284.]—**Geometrical Progression.**—An occasional controversy helps to keep us lively. I thank Mr. Burgess for the way in which he has stuck to his guns without raising any new point; but I really do not think he has understood my friendly criticisms. To begin with, I cannot agree with his first statement about meaning of my words, for to say that a biquadratic can be broken up into (real) quadratic factors certainly does not commit one to any statement about how to solve a biquadratic. To what I said about $r = x$ I have nothing to add. As to "C. P." (excuse liberties, "C. P."), I mentioned the form of his solution, not his formula. The word "practically" is to be noticed; frankly I do not think much is gained by the use of so many different symbols as "C. P." had in 96725, p. 189, and I prefer my own style, but that is purely a matter of taste; the argument used in a problem is not. Again, passing over the suggestion of some sort of unfairness, of which I can make nothing, I should like to say that I have in no way accepted the assumption of "A. O. S." that a and r are integers as you may see from the careful qualifying words "on his lines," nor have I later on ridiculed the same suggestion that x and r should be integers, unjustified though it be. On the contrary, I have been at some pains to point out, by a *reductio ad absurdum*, that the particular conclusion, "r is necessarily 2," could not be soundly based upon that assumption, as premised, inasmuch as the fact of x and r being integers would not exclude the values—

$$r = -1 \qquad x = \text{infinity}$$
$$r = 0 \qquad x = 315$$
$$r = 4 \qquad x = -57$$

where I have chosen one new example which may suit Mr. Burgess better than the others, as those seem to give offence by making the *reductio ad absurdum* too obvious. By the way, I do not at all scout the result $r = -1$, which is a possible algebraic solution of the problem, though arithmetically it is meaningless. What I do object to is that an equation, $r = \frac{315 - x}{150 + x}$, having more than one solution in integers, should be described as having one only. Finally (I have never had the chance to do so much contradiction before), I did not state or imply that a quintic can be expressed by quadratic factors, but merely that some quintics can be reduced to quadratics; the meaning of which is obvious in face of the fact that "Ontario" asks for a solution in quadratics, and Mr. Burgess implies that such a thing is impossible. May I at the same time point out to Mr. James Paris, without desiring to raise any further storm, that there is a flaw in his argument on this same point, namely, where he says, in reply 97284, p. 476, "It is certain that the algebraical division cannot produce a different quotient than the arithmetical one." If the falsity of this statement is not sufficiently shown by what I have written above, perhaps another example will make it clear? Suppose x stands for 7, then we shall find that $x^2 - 11x + 10$ divided algebraically by $x + 1$ gives us the quotient $x - 12$, and remainder 22; that is -5 and 22; but the arithmetical division gives -2 and -2. I cannot understand the end of the letter, though I should like to know what it means. Even if the Editor is long-suffering enough to print this rather personal communication, I shall probably not have time to tackle Mr. Burgess again, as I shall by Jan. 26 be teaching algebra to small boys, who will, most of them, never know nearly so much about it as Mr. Burgess does. If "H. T. B." wants something to criticise, let him look at the stuff at end of p. 477.

QUIVIS.

[97308.]—**Salicylate of Soda and Uric Acid.**—Permit me to thank "M. B." and "Glatton" for their replies. I am convinced, however, that the opinion expressed by "M. B." that gout is probably the only disease caused by uric acid is erroneous. For 31 years—i.e., between the ages of 21 and 52—I had suffered with severe frontal headaches, or migraine, arising from liver and dyspeptic troubles. They increased in duration and intensity as the years went by, until latterly the worst of them would last 18 hours, and during the last few hours of the attack the pain was almost unsupportable. About a year ago I learned from Dr. Haig's work on "Uric Acid as a Factor in the Causation of Disease" that salicylate of soda would cure these attacks by dissolving out the uric acid; and I may add parenthetically that I am indebted to one of Mrs. Hunter's letters (to whom "M. B." refers) in the "E. M." for my knowledge of the book, and I have since that time nipped every attack in the bud by a timely dose of 10 or 20 grains, sometimes repeated, of this drug. Occasionally a slight gastric upset has supervened, and I have wondered if any alkalies in my food had interfered with the action of the drug. My wife has also suffered with headaches from causes pertaining to her sex, and has cured them in the same way, and I feel very grateful to Dr. Haig for publishing for the general benefit this method of alleviating one of the many ills that flesh is heir to. In reply to "Glatton," our medical adviser put me on a diet for chronic rheumatism, which I found so ascetic that I am trying other methods before finally adopting it. I have read somewhere that continued treatment with salicylate of soda is injurious to the bony structure of the body and to the teeth, but no proof was given. I have also read that the "natural salicylate of soda," which is very much more expensive (ordinary salicylate being very cheap), is free from these deleterious effects. Authoritative information seems very difficult to obtain.

D. W. A.

[97319.]—**Belts.**—The reason an ordinary belt only lasts a short time is because the strain or pull is all on the outside edge of the belt—in fact, when the belt is laid on the ground, it takes the form of a semicircle, owing to one side being stretched more than the other. We have had two belts in four months, and the laces break nearly every day. If the laces don't give, the belt itself breaks. We are now trying a raw-hide belt, and it seems to be doing better, as it is more flexible.

W. MOORE.

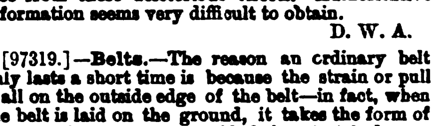
[97350.]—**Thermodynamics.**—To supplement the query under this heading, might I be permitted to add the following, which seems likely to amplify the original question raised by "T. B."? (1) It is said that "entropy" is the capacity factor, while temp. is the intensity factor of heat, and that—

$$\int \frac{dQ}{\tau} = \phi.$$

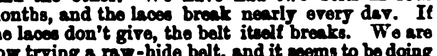
(2) Thermal capacity is quantity of heat expressed in heat-units required to raise temp. of any mass 1° C., while (3) specific heat is thermal capacity of unit mass. These definitions are all from standard books—e.g., W. Ostwald's "Lehrbuch d. Allg. Chem.," &c. Therefore, sp. heat × units of mass in body = thermal capacity. Now, suppose that dQ be expressed in units of heat, and unit mass of substance be taken, and suppose that $\tau = 1°$, then would the quotient in above formula = entropy = thermal capacity = sp. heat of that body? If not, why?

J. W. MELLOR.

[97355.]—**Mercury Interrupter.**—Take a piece of glass tubing (preferably combustion-tubing, it



A



B

being stronger) of the required diameter. Hold over a gas or spirit-lamp flame, as in Fig. A. If using a Bunsen burner, shut airholes, or the flame will be too hot. Turn tube round until it begins to soften, then draw it out, as in Fig. B. Break at d,

and select the best piece. Observe where the internal diameter seems to be a very little larger than the platinum wire. Break at this point, insert wire, and then fuse the glass round the wire by the blowpipe, so that the wire projects the right distance outside the end of tube, and also inside tube. Allow to cool carefully. Then it is ready for fixing in position. Before drawing out tube it must be bent to a right-angle, as advised in back numbers. Heat as above, where bend is required, and allow to bend into required shape by its own weight; allow to cool, then proceed as above. The co-efficient of expansion of glass and platinum being nearly the same, they are fixed immovably when cold. I have done the above often while testing in agricultural chemistry, to form convenient handles for holding wire for testing. A. DRYSDALE.

[97358.]—**Spherical Triangle.**—In the following I will use the symbols to which I am accustomed: Put C for P in your figure, A for Z, and B for S, and the sides opposite A, B, C, α, β, γ; these arcs of great circles corresponding to angles α, β, γ, at the centre of sphere. If we take any three points A, B, C, on a sphere, and suppose planes to pass through A B and the centre of sphere, and the same for B C and A C, and then suppose the sphere to disappear, leaving only the planes, we get a three-sided pyramid whose base forms a spherical triangle. Now if we open out this pyramid so that the three planes are in one plane, we get a fan-shaped figure M O N, such as I have drawn; and M O B, B O C, and C O N are the three planes or sectors having the angles γ, β, and α at their apices. Instead of using the capital Sigma to denote the sum of the arcs $\alpha, \beta \,.\, \gamma$, I will use the small Sigma σ to denote half the sum, then we have to prove that—

$$\cos. \frac{C}{2} = \sqrt{\frac{\sin. \sigma \,.\, \sin. (\sigma - \gamma)}{\sin. \alpha \,.\, \sin. \beta}}$$

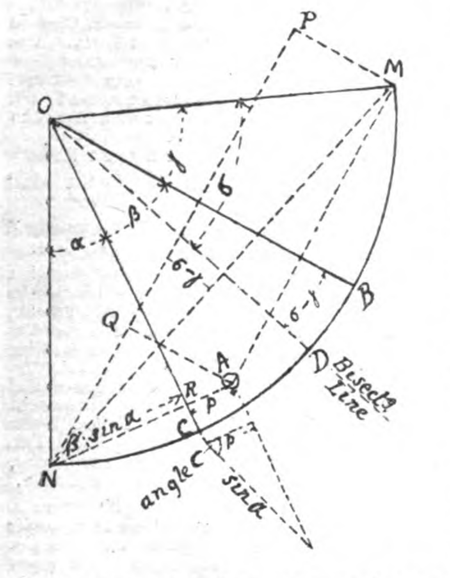
Square both sides, and remembering that—

$$\cos.^2 \frac{C}{2} = \frac{1 + \cos. C}{2}$$

we have to prove—

$$1 + \cos. C = \frac{2 \sin. \sigma \,.\, \sin. (\sigma - \gamma)}{\sin. \alpha \,.\, \sin. \beta}$$

Now if the two outer sectors were folded up into their former positions, the points M and N would meet at the point A, where the two perpendiculars on the turning lines meet, then (see small triangle) the



angle C will be seen. This small triangle is supposed to be an end view, and shows the angle between the two planes. It will be seen that $\cos. C = \frac{P}{\sin. \alpha}$ (R N = sin. α if radius = 1). Substitute this value of cos. C in the above equation, and after reducing we get—

$$\sin. \beta \,(\sin. \alpha + P) = 2 \sin. \sigma \,.\, \sin. (\sigma - \gamma).$$

Now, sin. α + P = N A, and angle Q N A = angle β, as the sides containing it are at right angles to those containing β; therefore sin. β (sin. α + P) = Q A. Again, B O D = $\sigma - \gamma$, and this = M N P for the same reason as in the last angle. N M, it will be seen, is 2 sin. σ, and therefore P M = 2 sin. σ sin. $(\sigma - \gamma)$. Now P M is evidently = Q A, so that the truth of the equation with which we started is proved.

Bath. M.I.C.E.

[97358.]—**Spherical Triangle.**—I suppose I may assume that "Fleur-de-Lys" is acquainted with the "fundamental formula" of spherical trigonometry. If not, its proof was given very fully and clearly by D. J. Carnegie, in "E.M." of June 23 last, which, I have no doubt, being so recent a number, could be easily procured. The fundamental formula is that in a spherical triangle A B C

$$\cos. A = \frac{\cos. a - \cos. b \cos. c}{\sin. b \sin. c}$$

But, by a formula of plane trigonometry—

$$2 \cos.^2 \tfrac{1}{2} A = 1 + \cos. A$$

$$= 1 + \frac{\cos. a - \cos. b \cos. c}{\sin. b \sin. c}$$

$$= \frac{\cos. a - (\cos. b \cos. c - \sin. b \sin. c)}{\sin. b \sin. c}$$

$$= \frac{\cos. a - \cos. (b + c)}{\sin. b \sin. c}$$

$$= \frac{2 \sin. \frac{1}{2} (a + b + c) \sin. \frac{1}{2} (b + c - a)}{\sin. b \sin. c}$$

$$= \frac{2 \sin. \frac{1}{2} \Sigma \sin. (\frac{1}{2} \Sigma - a)}{\sin. b \sin. c}$$

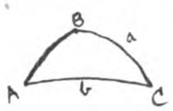
where $\Sigma = a + b + c$.

$$\therefore \cos. \tfrac{1}{2} A = \sqrt{\frac{\sin. \frac{1}{2} \Sigma \,.\, \sin. (\frac{1}{2} \Sigma - a)}{\sin. b \sin. c}}$$

Now apply this to our astronomical triangle Z P S, making P the angle A, and we have—

$$\cos. \tfrac{1}{2} P = \sqrt{\frac{\sin. \frac{1}{2} \Sigma \,.\, \sin. (\frac{1}{2} \Sigma - S Z)}{\sin. P Z \,.\, \sin. P S}}$$

which is the formula quoted by "Fleur-de-Lys." The reason of rejecting index 20 is to be found in the fact that the logs. of trigonometrical functions, as given in mathematical tables, are not the true



logs., but the logs. increased by 10, in order to avoid the use of negative integers. The tabular value of log. cos. $\frac{1}{2}$ P exceeds its true value by 10, which is doubled by the 2 in front, thus increasing that side of the equation by 20. The right-hand side of the equation contains four trigonometrical functions. Therefore it is increased by 40 above its true value. Hence, to preserve the equality between the two sides, 20 must be deducted on the right hand. The above proof of formula assumes a knowledge of the formula for the cosine of the sum of two angles, and of the formula for the difference of two cosines. These will be found, if necessary, in any book on plane trigonometry. If "Fleur-de-Lys" desires to pursue the study of these astronomical calculations, it might be worth his while to go systematically through a book of spherical trigonometry. Spherical trigonometry may not in itself be very interesting, but certainly becomes so when it is approached from the side of practical problems in astronomy. ARCTURUS.

[97359.]—**Flash Powder.**—Flash powders are necessarily explosive, and should at all times be used with great care. Keep all ingredients in separate stoppered bottles, and just before using weigh up each ingredient. Crush separately the chlorate, as this is apt to cake in lumps, and force has to be used to crush it, and when powdered thoroughly, incorporate with the other ingredients on a sheet of paper, using a bone or wood spatula, taking care to use no force whatever; and when mixed, lay it upon a sheet of tin-plate, and fire at arm's length, using either a piece of $\frac{1}{4}$in. or $\frac{5}{16}$in. iron rod made red-hot at one end, or a piece of touch-paper tied to a stick about a yard long. If you have to fire any quantity, lay it in a train, do not heap it up. The mixture named is rather a sensitive compound, and should not be kept ready mixed up, and, like all chlorate mixtures, becomes more sensitive to shock by keeping. If the querist will take care to always separately powder or crush each ingredient, and mix without contact with metals, and without force, mixing-up sufficient for immediate use only, the danger will be almost *nil*. He may also read paragraph on page 490 of your last issue with advantage. T. J. LENEY.

[97361.]—**Clock-Weight.**—Thanks to F. M. Mann. The pinions of my clock have twelve leaves, and I do not suppose that the other has more. Is it less expensive to plan the escapement for a large arc of swing of pendulum than for a small one? C. D.

[97371.]—**Prevention of Silver Oxidising.**—"If very clean" should read "if very black."

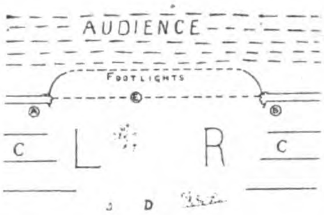
West Didsbury. M. COLE.

[97378.]—**Motor Tricycle.**—I do not know exactly the quantities and sizes of wires, &c., for making coil for tricycle motor, as I am not an electrician. Perhaps Mr. Bottone will oblige.

THE WRITER OF THE ARTICLES.

[97379.]—**Microscopic.**—To succeed in getting a clear picture of objects in each facet of a fly's eye the slide must be backed with black dull paper. Then the small flame of a petty powerful light—a 1in. paraffin burner will do—is arranged on one side of the stage, and the eye focussed until each individual image of the flame, on each individual facet of the eye, can be clearly distinguished. The photograph is taken whilst things are in this position. The exposure may vary, according to the power and proximity of the flame, from 8 to 60 seconds. To prepare a fly's tongue for mounting in Canada balsam, put the fly, when caught, bodily in good clean oil of turpentine. Let it remain there a week at least. It will then be found in good condition for mounting. Do not wash it too much, if you warm your Canada balsam. S. BOTTONE.

[97373.]—**Theatre.**—A is prompt entrance, where prompter sits, and where gas taps, &c., are situated; B is O.P. entrance—O.P., of course,



meaning opposite prompt; C are the scenery wings; D is back cloth; E is proscenium opening; R and L meaning right and left of stage facing audience. MAJOR.

[97380.]—**Manchester Dynamo.**—Mr. Joinson has omitted to state one very important item—i.e., the voltage the machine is required to give. The core discs are presumably of the plain drum type. If so, the bore of the pole-pieces should be $3\frac{1}{4}$in., and the winding for a shunt machine to give 50 volts 3 ampères at 2,600 revs. will be:—$1\frac{1}{2}$lb. No. 23 on armature, and 8lb. No. 21 on the fields.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97380.]—**Manchester Dynamo.**—Wind the armature with $\frac{1}{2}$lb. No. 24 silk-covered wire, and the field-magnets with 2lb. No. 24 d.c.c. This winding will enable the dynamo to give, when driven at about 2,500 revs. per minute, a current of 2 amps. at 15 to 20 volts pressure. Connect up in shunt. S. BOTTONE.

[97381.]—**Piston Speed.**—Generally multiply twice the length of stroke in feet by number of revolutions per minute of crank-shaft. High speeds give large expansion measures, smooth and uniform motion; require wider bearings and accurate balancing. REGENT'S PARK.

[97382.]—**Rats.**—I should not put poison down. I have heard that a good way to get rid of rats is to catch some and smear their coats with coal-tar (also the holes, if they can be found). Rats do not like that, and take their departure. It may be unkind to the caught rats, but returning to their haunts their friends quit, which I suppose will suit the object of the querist. A really good cat will soon clear any house of rats. They may go elsewhere, but they won't come where pussy is about. They fight shy of a good cat. I speak from some experience. S. R.

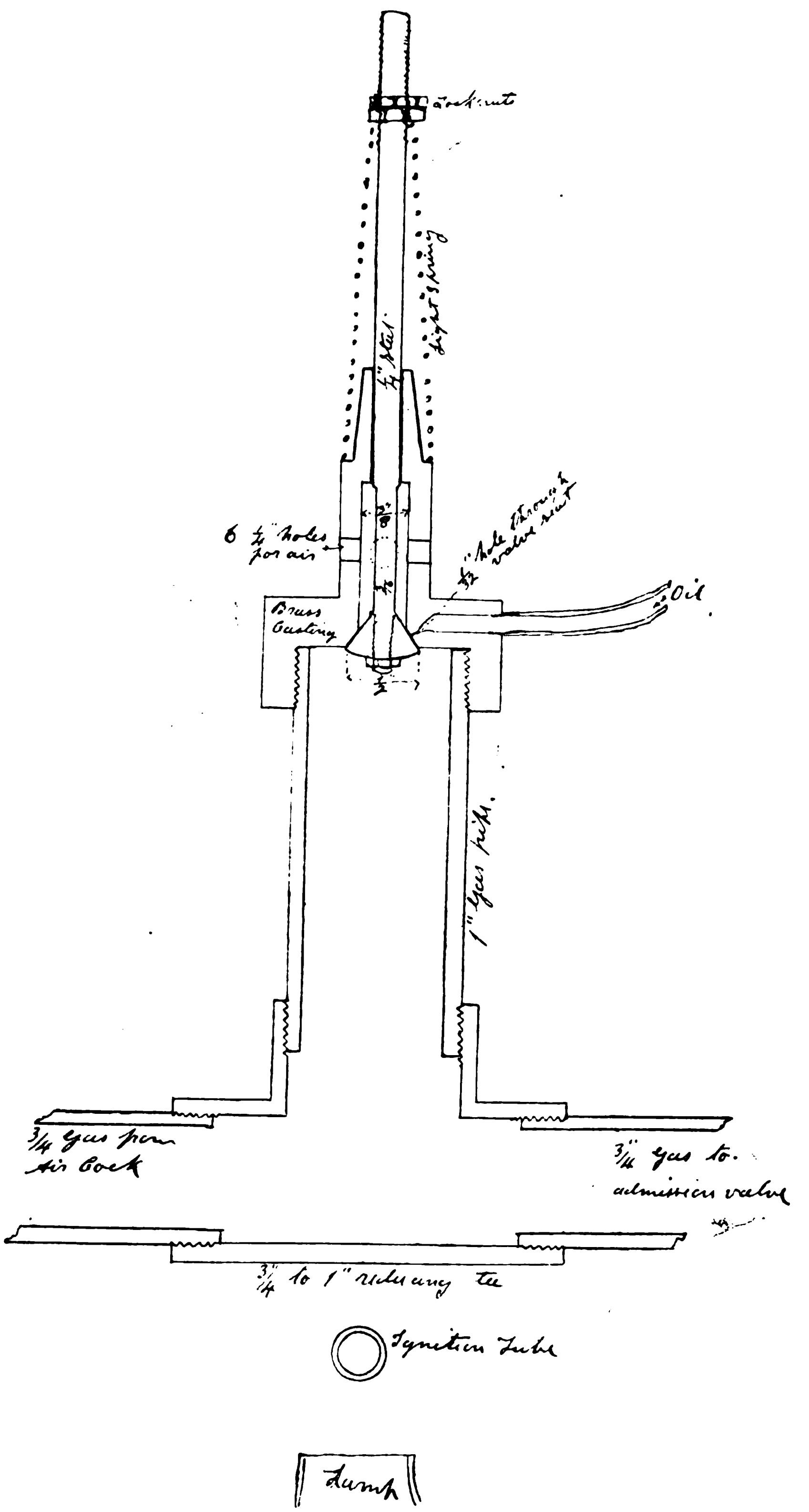
[97382.]—**Rats.**—A few drops of oil of rhodium on bait in trap entices them to their doom. Caustic potash, thin layers put into their holes, drives them away. Wafer corks cooked in grease in tracks, or sponge dipped in honey or molasses attracts them, gets in their fur, and tends to drive them away. Also, birdlime and oil of rhodium. Stiff mixture of common squill 2 parts, chopped bacon 3 parts, made into cakes and baked and placed in holes, will destroy them. REGENT'S PARK.

[97382.]—**Rats.**—A good dodge to clear a place of rats is to catch two or three in a trap, daub them well over with coal-tar, and let them loose near one of their holes, so that they shall make a bolt down the hole, leaving coal-tar wherever they run; stuff up the hole with broken glass, and you will have no more rats to trouble you. Don't tell your neighbours why they have so many more all at once. JACK TAR.

[97383.]—**Dynamo.**—To MR. BOTTONE.—In either case you will wind the armature with $\frac{1}{4}$lb. No. 22 d.c.c.; for shunt you will put 2lb. No. 22 on the two F.M.'s; for series only, you should use 2lb. No. 16 on the F.M.'s, while for compound you will lay on 1lb. No. 18 for the series coils, and over this wind 1lb. No. 24 silk-covered for the shunt coils. Speed about 3,000revs. per minute; output about 1 to $1\frac{1}{2}$ ampère, at 15 volts pressure.

S. BOTTONE.

[97384.]—**Storage Battery.**—To MR. AVERY.—I have not personally come across a similar case, but believe it to be a fault common to all cells of the Plante type. It is due to the plates gradually losing their "formation"; and charging in sulphuric acid solution alone is not sufficient to restore them. The cells would need special treatment in a solution the composition of which is the subject



of a patent owned by the firm in question. This self-same firm being, I believe, still in liquidation, it is a doubtful matter whether they are in a position to undertake the work of restoration.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97377.]—**Oil-Engine.**—If "A. C." will fit vaporiser as sketch to his gas-engine, it should work all right with oil. Vaporiser is easily made, mainly of iron gas-fittings. Sizes are right for 1H.P. engine. Should recommend separate lamp to heat ignition and vaporisers, as its oil-supply has to be under pressure. J. E. T.

[97386.] — **Drilling Gold Quartz.** — Harry Emanuel on "Precious Stones," alluding to drilling rock crystal (which may apply to gold quartz) gives: —Splinter of diamond is used with tool. In the case of cutting rock crystal, a copper wheel is used with emery, and, as he does not say otherwise, a copper drill is used. Fluoric acid also cuts rock crystal, and probably quartz. REGENT'S PARK.

[97387.]—**Frost on Windows.**—Thin coat of glycerine outside and inside of glass is said to check this. REGENT'S PARK.

[97389.] — **Series-Wound Motor.** — TO MR. BOTTONE OR MR. AVERY.—The following are the dimensions of one of my 3H.P. Lahmeyer-type motors, which will, to all intents and purposes, correspond to the type of carcase indicated in your sketch:—Armature, plain drum; core, 6⅝in. dia. by 7in. long, wound four layers deep with No. 20 S.W.G.; about 1,440 conductors; fields, 7in. bore; pole-pieces, 7in. deep by 5½in. wide by 3in. length of winding space; yokes, 2¾in. thick by 7in. long; series coils, about 300 turns No. 12 S.W.G., 150 turns on each bobbin; current required at full load, 12 ampères; speed, 1,800 revs.

A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97389.] — **Series-Wound Motor.** — TO MR. BOTTONE OR MR. AVERY. — Armature 6in. dia., 9in. long, wound with 9lb. No. 16 d.c.c., field magnet core of the shape figured by you, 12in. inside dia. 14in. outside dia., polepieces 5in. long, and embracing together ⅝ of the armature. Total length 9in., wound with 40lb. No. 10 d.c.c.

S. BOTTONE.

[97390.]—**Electro-Deposition of Lead.**—Lead can be deposited as a good adherent deposit, from a half-saturated solution of lead tartrate. The E.M.F. must not exceed 2 volts. If the solution is too strong bubbles of hydrogen are given off, and the lead deposit is spongy. A sheet-lead anode must be employed. To make the tartrate, precipitate the hydrated oxide of lead from the nitrate or acetate, by cautious additions of caustic potash solution; decant off the supernatant fluid, and dissolve the precipitate by the cautious addition of tartaric acid until all is dissolved. Add water to double the bulk. S. BOTTONE.

[97391.]—**Spun Glass.**—If a mass of soft glass is touched with a piece of solid glass and this latter quickly withdrawn, the soft glass is pulled out to a very fine thread, and if this thread is connected to the circumference of a wheel, the whole of the soft mass may be wound as a fine thread, provided heat of mass is maintained. See "Glass-Blowing and Working," by T. Bolas. REGENT'S PARK.

[97391.] — **Spun Glass.** — The only apparatus required is a wheel mounted on trunnions with a handle to turn it; a hot flame (spirit lamp or gas) and a rod of soft glass of the desired colour. The operator holds one end of the rod over the flame until it softens, pulls it out sharp, and whips the thread thus formed over the edge of the wheel, which he keeps rotating while the rod is still held in the flame. By this means, a continuous thread is produced. S. BOTTONE.

[97391.]—**Spun Glass.**—This is easily done. Two gas-jets fixed so that they both play on a rod of glass and keep it soft. Another bit of glass pressed on this and drawn away carries with it a thread of glass, the thickness of which depends on the speed at which it is drawn away. In practice, it is usual to lap the thread on a revolving drum or wheel so as to get an even pull. Spun glass is very nasty stuff to handle, as it is difficult to prevent small quantities getting into the lungs and eyes, where they do much damage.

West Didsbury. M. COLE.

[97392.]—**Tarnished Silver.**—Most likely by the sulphuretted hydrogen in room, which it cannot resist. If you care to varnish with transparent mixture use copal 1 part, oil of rosemary 1 part, absolute alcohol 2 to 3 parts; digest. Warm metal. Apply with soft camel-hair brush. Cleaned by rubbing with boiling solution of borax. Also with fresh concentrated solution of hyposulphite of soda, and polished if necessary, with buckskin. Trade cleaner of plate: Carbonate ammonia 1 part, water 4 parts, Paris white, 16; mix well. Apply to surface by soft leather or sponge.

REGENT'S PARK.

[97392.]—**Tarnished Silver.**—See replies in last week's issue at 97371. S. BOTTONE.

[97392.]—**Tarnished Silver.**—This is answered in reply 97371, same page as inquiry. M. COLE.

[97393.]—**Telescope.**—"F. B." may receive a dozen answers to this question, all of which may be right. But all practical astronomers will, I think, now admit that, given a definite amount to spend as stated, the best value can be obtained by deciding on a reflector with plain equatorial mount. An instrument of this kind, with four eyepieces and mirror 6½in. diameter, could be obtained, the mount being made in such a manner that divided circles could be afterwards added when required. This instrument would far supersede a 3in. achromatic, and prove a most convenient instrument to handle.

Corporation-street, Bolton. W. BANKS.

[97393.]—**Telescope.**—"F. B." cannot do better than get one of Messrs. Thos. Cooke and Sons 3in. educational telescopes. There are, of course, many cheaper and excellent makes in the market; but the extra few pounds will be well laid out in the superior finish and superb defining power of these instruments, which are guaranteed to bear the theoretical limit of magnification—a quality that few of the so-called first-class refractors sold really possess. An equatorial mount is doubtless an advantage for astronomical purposes, provided the telescope can remain a fixture outside under cover; but it adds considerably to the cost, and is by no means as handy as an altazimuth for all-round purposes. NORMAN LATTEY.

[97395.]—**Propellers.**—There is much in D. W. Taylor's "Screw Propulsion," of Whittaker and Co., and in Tomkins's "Marine Engineering," the first 1893, and the second 1896. The Patent Office would be sure to have literature, &c., and models—numbers at South Kensington, and in lectures (3) at Royal Naval College, 1885, by S. W. Barnaby, of Spons. REGENT'S PARK.

[97395.]—**Propellers.** — The "slip" of a propeller is the difference between the distance the propeller would advance in a certain time if the water formed an unyielding "nut," and the distance it does actually advance. Of course, if the

water were unyielding, the propeller would advance a distance equal to its pitch at each revolution; but in practice, the propeller always displaces the surrounding water backwards at a certain speed, and thus is said to "slip." The blades should revolve uniformly, and there is no "stroke" about them, much less an "intermittent" one.

R. H. PARSONS.

[97396.]—**Gassner Cell.**—See reply No. 97410 in this number. If the cell is a very large one and in good condition as far as regards zinc and terminals, it might be worth while, after having soaked the cell in water, as directed in the above-named reply, to squirt in the holes an ounce of saturated solution of permanganate of potash. A small glass syringe will do this well. When this has soaked in, the holes in the pitch must be sealed up again with a hot iron. S. BOTTONE.

[97398.]—**Climate of China.**—Is cold when compared to others in the same latitude. Pekin is as far south as Naples, yet the average temperature is 9° lower. The summers are hotter, and the winters colder, than in Western Europe in the same parallels. From November to February the weather is usually intensely dry and cold; March and April bring fogs and a milder temperature; in May rains are abundant; from July to September the weather is intensely hot, while hurricanes and typhoons may be expected; in October there is the gradual autumnal preparation for winter. S. BOTTONE.

[97399.]—**Wireless Telegraphy.**—Any large mass of metal lying between the transmitter and the receiver seriously interferes with the inductive influence of the electric wave. Even a tea-tray held in front of the receiver will in most cases prevent its acting. Induction can only take place through insulators or dielectrics: hence the disturbing effect of a metalliferous mountain.

S. BOTTONE.

[97399.]—**Wireless Telegraphy.**—Because the iron in the strata of the mountain absorbs the electrical waves which are propagated by the transmitting instrument. Thus the iron mountain is acting as a shield to the receiver. If querist has an apparatus of his own. I should advise him to put a large sheet of metal between the transmitter and receiver, and observe the results.

A. STAMMWITZ.

[97401.] — **White Brass.** — The special alloy mentioned by the querist is definite—it is a trade name for a very good bearing "brass." It must be understood that the "linings" of bearings are invariably called "brasses" in shop technology, and they may be Babbit metal or "white brass," or any other name. So far from there being "only one kind of brass," there are several—the proportions of copper and zinc are different, and the more zinc, the whiter the "brass." It is certainly a "composition" whatever it is; but I think the answer to the query is that all "linings" are called "brasses," and the alloys vary. M. T.

[97401.]—**White Brass.**—Magnolia metal said by Dean to be: Lead, 78; antimony, 21; iron, 1. White brass: Alloys of copper and zinc, with less than 45 per cent. of copper, cease to have yellow colour. Alloys from 40 down to 30 per cent. of copper are silver white. These are rather brittle, and fail generally under rolling, wire drawing, and pressure. White metal: Copper, 3; tin, 90; antimony, 7. Copper, 5; tin, 85; antimony, 10. See "Mixed Metals," A. H. Hiorns (Macmillan and Co., 1890). REGENT'S PARK.

[97400.]—**Dynamos in Parallel.**—Certainly.

S. BOTTONE.

[97400.] — **Dynamos in Parallel.** — Yes, certainly, provided the voltage of each machine is kept exactly alike. Instructions for coupling together have been given many times in back numbers. A. H. AVERY, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97400.]—**Dynamos in Parallel.**—It is possible to work your two dynamos in parallel, but you must take care that the voltage of both is kept equal and constant.

Dudley. WEBSTER MICHELSON AND CO.

[97401.] — **White Brass.** — The brass-finisher who had not heard of white brass must be a curiosity. Its trade name is Parson's white brass, and it is composed of tin 68, zinc 30·5, copper 1, and lead 0·5. It is, except in colour, very similar to ordinary yellow brass, and is machined with the same sort of tools. Magnolia metal is patented, and must be bought in ingot form from the Magnolia Company. It is claimed for it that it is to some extent self-lubricating. J. H. H.

[97401.]—**White Brass.**—The brass-finisher is right, as far as his knowledge of his own trade takes him; but what is often called "white brass" in an engineer's shop is more properly Babbit metal or some similar alloy. It is doubtless called "brass" because we always speak of bearings as "brasses," although they may be made of gunmetal, phosphor-bronze, or anti-friction metal, like magnolia or Babbit metal. HYDE PARK.

[97404.] — **Wilson's Four-Cylinder Locomotive.**—Robert Wilson and Co., of Newcastle, built the engine named Stockton for the Stockton and Darlington Railway Company, being No. 5 in the official list of that line, and it commenced work on March 15, 1826. This engine ran upon two pairs of cast-iron wheels of 4ft. diameter, having a wheel-base of 5ft. 9in., the boiler being 13ft. long and 4ft. diameter, having one fire-flue running throughout. Each pair of wheels was perfectly independent, being actuated by a pair of cylinders, the crank-pins being at right angles to each other. Steam could be applied to either or both pairs of cylinders at pleasure, and the two sets of valve-gear could be reversed independently. The exhaust steam was discharged into the chimney by two blast-pipes, one for each pair of cylinders. This engine, having run for a few months, in October, 1826, came into collision at Stockton, when the four cylinders and all the overhead gear were smashed, and the official list, dated December 31, 1826, states, No. 5, "This engine is not now in use"; and so it remained until April, 1827, when Mr. Hackworth, the company's locomotive foreman, rebuilt this engine. He lengthened the frame, added a new pair of wheels, thus converting it to six wheels all coupled, and placed a return-flue tube, in the old boiler, removed the four broken cylinders, and adopted two new ones. The original engine had one blast-pipe for each pair of cylinders, and Mr. Hackworth retained the same arrangement for the new pair of cylinders. The engine thus altered and renamed Royal George, No. 5, was put to work in October, 1827. The original working drawing of the Stockton was shown at the Chicago Exhibition of 1893, and a copy of it either has been, or shortly will be, on view at the South Kensington Museum.

CLEMENT E. STRETTON, C.E.

Leicester, Jan. 13.

[97406.]—**Ulcer in Stomach.**—The cause is something wrong in the system, most likely decomposed matter taken in food. If it be ulcer only, it can be cured. I had a servant suffering from it, and took him to a very clever medical man at Birmingham, who said the way was to let nature cure it, and in the mean time support the patient with nothing but milk, which, he said, contained all the elements necessary to support life. The patient visited the doctor at intervals for some months, and at last the doctor allowed him to add a little of Polson's corn-flour to the milk. After another interval he allowed him a square inch of meat, and so on. The man got quite well. He did his work as usual all the time. From the description which "Tempus Fugit" gives, there seems a probability that it may be something worse than ulcer. Two or three drops to each ounce of hot water of the tincture of Hydrastis canadense, and of this take a teaspoonful, hot, frequently, would help; but it is too serious a case for amateur doctoring. It ought to be under the constant superintendence of an experienced medical man, or go into hospital.

W. A. A.

[97406.]—**Ulcer in Stomach.**—I am not a medical man, but some years ago, when about fifty years of age, I felt constantly a very disagreeable—not actually painful—sensation in the stomach, as if there was an open sore there. Without medical advice I took two or three times a day half a glass of limejuice with a little water in it, and gradually kicked off the complaint, whatever it was. After drinking the limejuice the mouth should be rinsed with water, so that the teeth may not be injured.

N.

[97409.]—**Axle to Motor Car.**—If querists would not be so sparing of information they would get better replies. How can one advise the size of axle without particulars as to weight axle is to carry? I have seen 4H.P. cars of 5cwt. and of 25cwt. Obviously the same size of axle will not do for both. The differential gear could be placed between spring and wheel hub, but will require to be specially designed, and would then be working under rather trying conditions.

THE WRITER OF THE ARTICLES.

[97410.]—**Dry Battery.**—No, it can *not*.

HYDE PARK.

[97410.]—**Dry Battery.**—The manner in which this question is put proves that the querist does not understand the conditions involved in joining a dry battery of comparative low resistance to a (I presume) public supply of electricity. If this is attempted, a considerable resistance in addition to the battery should be inserted, along with an ammeter to measure the current, and the resistance withdrawn until the current required is obtained. This should not exceed one ampère. Of course, except the supply is a continuous-current one, it is useless attempting anything.

11, Corporation-street, Bolton. W. BANKS.

[97410.] — **Dry Battery.** — These batteries generally fail in consequence of the drying-up of the moisture in the paste. The contacts also get corroded between carbon and terminals. If they are worth renovating, which is doubtful at their present price, the quickest way is to remove the terminals for cleaning up, to make two ¼in. holes through the pitch with a hot wire, and then stand the cells for 24 hours in a pailful of water. Remove, dry, seal up the pitch again with a hot iron, and replace the terminals. You can put a little charge in from a dynamo, if you connect + to +, but it is not much good. S. BOTTONE.

[97411.]—**Edison Lalande Battery.**—This consists in a plate of compressed black oxide of copper as one element, and a plate of zinc as the other. The exciting fluid is a solution of caustic potash in water, of which the usual strength is 1 to 5 by weight. To prevent this from absorbing carbonic acid from the atmosphere, the solution should be covered with a layer, about ½in. thick, of heavy petroleum oil (vaseline oil). To my mind, these cells are not worth the space they occupy.

S. BOTTONE.

[97412.]—**Meridian Passage of Stars Locally.**—I think quite differently to "W. B. D." respecting this matter. Surely anyone possessed of a transit or other instrument, and requiring this information, must know the difference between "mean time" and "local mean time." "Mean time," or "Greenwich Mean Time," are the terms used generally, local mean time never being referred to except in connection with the difference in longitude of places compared to Greenwich.

Corporation-street, Bolton. W. BANKS.

USEFUL AND SCIENTIFIC NOTES.

THE number of men employed in building locomotives in this country has increased 10 per cent. during the year just closed.

ACCORDING to the correspondent of the *Standard* at Hamburg, the Hamburg-American Steamship Line is about to introduce a new kind of fuel for its freight steamers now building for the Eastern Asia line. The fuel consists of semi-fluid petroleum, which is imported from Borneo in large quantities. It is not liable to spontaneous ignition at high temperature. The new method of firing will permit of considerable economy of space and labour.

IT is estimated that Great Britain, the United States, and Germany have from two-thirds to three-fourths of the world's business in metals, shipping, finance, imports, exports, &c. These countries produce 77 per cent. of the world's make of pig-iron; 80·8 per cent. of the steel; they take 75·2 per cent. of the world's consumption of lead; 73·1 per cent. of the copper; 67·5 per cent. of the spelter; and 67·2 per cent. of the tin.

IN the vicinity of Australian streams may be found large and beautiful dragon-flies, often of considerable size; while everywhere, during the warmer months of the year, the ceaseless hum of the cigale reminds the traveller of a similar insect experience in Italy. Native honey-bees are plentiful in many places, and are easily recognised by their small size, being little larger than the common house-fly. Mosquitoes are practically unknown in the dry interior, but their place is taken by the sandfly, an equally mischievous insect. There are spiders of all sizes, a few being poisonous, but their webs are generally of a most fanciful character.

AN electrical system for working water-tight bulkhead doors was described at the recent meeting of the American Society of Naval Architects and Marine Engineers. A bulkhead door sliding in frames is arranged with a brass rack on one face. A pinion which gears in this rack also gears with a second horizontal shaft which is driven by worm-gearing. An electric-motor of 1H.P. is direct coupled to the worm-shaft. The weight of the door complete with the operating apparatus is 1,383lb. The sliding-frame and the guide-frame of the door are arranged so that the last ½in. of the travel sets up a wedge action, which forces the door against its seat. The electric-motor is compound-wound with relatively weak shunt-coils. The circuits are so arranged that when raising the door the series-coils only are used, while when closing the door the shunt and series-coils are both in circuit.

Coal and Gold.—The output of coal throughout the world last year is computed at 662,820,000 tons. In these totals Great Britain figured for 202,054,516 tons; the United States for 196,405,953 tons; Germany for 130,928,490 tons; France for 32,439,786 tons; Belgium for 22,075,093 tons; Austria and Hungary for 35,039,417 tons; Russia for 12,862,033 tons; and all other countries for 30,960,712 tons. The production of gold throughout the world during the last ten years has been as follows:—1888, £22,039,200; 1889, £24,696,000; 1890, £23,769,740; 1891, £26,131,200; 1892, £29,330,300; 1893, £31,498,960; 1894, £36,235,120; 1895, 39,752,720; 1896, £40,336,460; 1897, £47,500,960; and 1898, £57,485,720. It will be seen that the production of gold has increased with gigantic strides during the past five years. This is largely attributable to the revival and progress of gold-mining industry in Australasia, and also to the astonishing advance made in the Transvaal.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Quivis" has replied to 96878, 96919, 96969, 96967; Webster Michelson and Co., 97162.

97008. Motor Cycle, p. 302.
97014. Sledge, 302.
97016. Electro-Gilding Solution, 302.
97018. Electric Bath, 302.
97025. Punts, 303.
97032. Ink for Recording Instruments, 303.
97033. Acetylene Container, 303.
97035. Paint for Baths, 303.
97039. Clark Cell Method of Measuring Volts, 303.
97042. Shoe Jobbing, 303.
97045. Imitation Watered Silk Paper, 303.
97051. Metalised Bearings for Dynamos, 303.
97052. Atmospheric Engine, 303.

97212. Molybdenite, p. 388.
97216. Grammaphone, 388.
97218. Potash Making, 388.
97224. Curb Chain, 388.
97226. Condenser, 388.
97229. Voltmeter, 388.
97231. Moving Hearthrug, 388.

QUERIES.

[97413.]—**Electrical.**—I shall be glad to know what sort and size accumulator to use with induction coil, having as primary 10oz. of No. 16 s.c., and as secondary 2¼lb. of No. 36 s.c., in two sections. Also, what length of spark should be expected, with suitable condenser?—X.

[97414.] — **Hand-Camera Construction.** — At what distance ought I to place the lens of a fixed-focus hand-camera from the diaphragm over which shutter works? Have seen hand-camera with lens as far back as 1½in., and bellows-camera with barely ⅝in. between.—A. H. H.

[97415.]—**Automatic Boiler Feed.**—Will R. Hudson kindly see if he has made a mistake, as I have searched through three volumes of Salomon's "Electric Lighting," and cannot find it?—J. A. C.

[97416.]—**Leclanche Cells.**—I should be grateful to "Sigma" for advice on the following:—I lately purchased a dozen of the above-named cells of the sealed agglomerate type. The zincs are rod-shape, about ⅜in. diameter, standing in porous pots. I am disappointed in their action. (1) Shall I get increased intensity of current by substituting sheet zinc bent in cylindrical form for the rod? (2) If so, will it be beneficial to amalgamate the plates? (3) What description of paint should be applied to the outer surface of sheets? (4) Should the agglomerate carbons be clothed in canvas to avoid rapid polarisation? Other cells in my possession with the latter arrangement give most excellent results.—C. R. O., Hants.

[97417.]—**Micro-Metallurgy.**—How can I prepare and mount specimens of iron, steel, brass, and other metals for microscopic examination? Also, what would be the best kind of microscope, eyepieces, &c., and probable cost of same?—MAX.

[97418.]—**Microscopical.**—Will someone please give a formula for finding magnification of the image formed by the object-glass at various distances from it? For instance, if the initial magnification of the o.g. on a 10in. tube is 40 diameters, what would be the magnification of an image formed by it on a screen at, say, 33in.? Of course, I mean without an eyepiece.—VERINDER.

[97419.]—**Moisture.**—Can I learn anyway how to drive moisture from coagulated blood and starch waste economically on the large scale, and similar substances containing about 70 per cent. water? Can an idea be had of cost by steam heat (which is preferable), and also from a flame heat like a kiln?—GEMINI.

[97420.]—**Swiftograph.**—Some years ago I saw a system of shorthand called "Swiftograph," invented, I believe, by a Mr. Faut. Abbot. Can any reader give me his address, or tell me where the *Teacher* may be purchased? I shall be glad of any information.—HAYDON BARRY.

[97421.]—**Boiler.**—I have got a ½H.P. steam-engine. Could any reader tell me how to make a boiler for same, one that would make steam fast? Please state size boiler should be for half-horse engine.—BLACKSMITH.

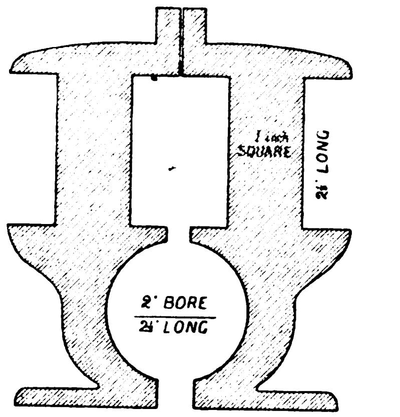
[97422.]—**Psoriasis.**—Would "Regent's Park," who suggested remedies in reply 97335, kindly say whether same would suit what I have been told is "psoriasis," as the effect seems to be the same in both cases—viz., quantities of scurf? I have tried many things, but none seem of any use, and hair is fast falling off.—A FELLOW SUFFERER.

[97423.]—**Mercury Contact-Breaker for 10in. Coil.**—Will some reader please help me out of the following difficulty? I have made a mercury interrupter, motor-driven, but am troubled with the mercury becoming one mass of small globules, and thus spoiling its efficiency. I put paraffin oil on the surface to prevent oxidation. Is this right? I have seen methylated spirit recommended. Is there no fear of its firing? Should something be mixed with the mercury? Shall be glad of any help. Will be quite ready to make another, if I know where the fault lies.—INTERRUPTER.

[97424.]—**Paralysed Hand.**—I wish for advice on what seems a sort of paralysis of the thumb. First, I should say that I have consulted a good doctor, who gives me little comfort and discourages my going to a specialist in nervous diseases. The thing has been coming on very gradually for a year or more, and now there seems no feeling in the end of thumb. Worse still, it seems to be creeping up the arm, and down to the forefinger. I have tried the ordinary galvanic machine, of which the doctor does not think much, and, of course, frequent and vigorous friction. Age 74, good general health, little beer, and no tobacco. Can anybody who has had a similar experience advise?—R. S.

[97425.]—**Eyepiece.**—Is there any objection to using a compound microscope as an eyepiece? If not, where should it be placed in the cone of rays from o.g.?—MICRO.

[97426.]—**Charging Dynamo.**—I have dynamo castings as per drawing inclosed, and I wish to make it



for a charging dynamo. Could Mr. Bottone or any other kind reader give me the full instructions as to wire in quantity, and the best armature, &c.? Field-magnets 1in. square, 2½in. long; armature tunnel 2in. bore, 2½in. long. What would be the voltage and the ampères?—G. B., Aston.

[97427.]—**Hard Composition.**—Can any reader inform me of a cheap composition which can be moulded, something like guttapercha, and, when hard set, nails can be hammered in, similar to timber?—BOLTER.

[97428.]—**Grease.**—I have a quantity of old hot-neck grease in which there is a quantity of gritty matter. Can any of our readers give me a recipe to refine this of all such matter?—BOLTER.

[97429.]—**Tin Scale.**—I should like to know the best means of bringing back to its metallic state a quantity of tin scale which I have? The scale is from tin scrap.—BOLTER.

[97430.]—**Power for Lathe.**—What would be the power required to drive a 5½in. screw-cutting lathe, and, say, an emery-buff as well?—B. M. S.

[97431.]—**Gas-Engine Valves.**—Can any reader of "Ours" tell me the best way to grind the valves of a gas-engine? They are iron valves on cast-iron seats, which are very hard and awkward to get at.—C. W.

[97432.]—**Double Star in Cetus.**—Can any reader inform me what is the name of the double star, which I find in position (estimated) R.A. 1h. 35m.. Decl. – 12°? I do not find this star in Webb, though it is just visible to the naked eye.—A. G. BATLEY.

[97433.]—**Dynamo.**—I have a dynamo, Manchester type. The fields are wound with 11½lb. of No. 22 wire on each, and 6¾lb. No. 18 on armature. I bought it as a failure, and rewound the armature, and got a fairly good light, but it nearly pulls a four-horse engine up. Are the proportions of wire right? And what candle-power should I get out of it if properly wound, and what horse-power should drive it?—W. S. LESLIE.

[97434.]—**Spherical Triangle with Side >90°.**—Will "F.R.A.S." or "Arcturus" kindly help me in the following question? In solving lunar distances, my method is to find from observed distance, and apparent zenith distances of moon and star or sun as data, the angle at Z (as also those at M and S), by the usual method—

$$2 \log. \cos. \tfrac{1}{2} Z = \log. \sin. \tfrac{1}{2} \Sigma + \log. \sin. (\tfrac{1}{2} \Sigma - M S)$$
$$+ \log. \operatorname{cosec.} Z M + \log. \operatorname{cosec.} Z S - 20.$$

Then, with angle at Z, and the two including sides got from true altitudes of moon and sun or star, to find the true distance by formula—

$$\tan. \tfrac{1}{2} M S = \sin. \tfrac{1}{2} (M + S)$$
$$\times \tan. \tfrac{1}{2} (M Z \sim S Z) \div \sin. \tfrac{1}{2} (M \sim S).$$

The method is cumbrous; but as my object is more that of practice in spherical trigonometry than actual determination of time, it has advantages over the versine method. My difficulty at present is, what happens when the triangle exceeds the limits of a quadrant?—e g., in the lunar given in Stebbing, the distance M S (obs.) is 98° 44′ 49″, and the quantity ½ sum of sides in Formula I. is 101° 14′ 3″. Is the log. sin. of its difference from 90° taken for log. sin. $\tfrac{1}{2}\Sigma$? If so, is the difference again used in log. sin. $(\tfrac{1}{2}\Sigma - M S)$?—FLEUR-DE-LYS.

[97435.]—**Electrical Power.**—I have a workshop situate 500 yards from a large lighting and power station, where the engines collectively are about 5,000H.P. The ground is broken gravel, with an underground stream about 20ft. from the surface. I have good reason to believe that a considerable amount of power is allowed to run to waste. Is it practicable to tap the ground and obtain, say, 40H.P. from the waste, and how can I ascertain if there is any electricity beneath my workshop? I am an engineer, and have not studied electricity; but if there is any probability of obtaining either light or power from this source, I will obtain it.—ECONOMY.

[97436.] — **Stamping Notepaper.** — Will some reader kindly tell me how to make the ink required for stamping notepaper by means of a die, and how to apply it to the die so as to adhere to the indented surface, as it is not, of course, applied to the raised letters, as would be the case with type? Any information will oblige.—R. A. R. BENNETT.

[97437.]—**Dew on Object-Glass.**—I should feel obliged if some of your correspondents would kindly inform me what is the best way to remove the dew from the object-glass of my telescope—whether wiping it off with a very soft cloth is harmful, or should it be allowed to dry off? The telescope is a 5in. refractor, and when in use I avoid the deposition of dew by using a dew-cap; but, as I have not a telescope-house, I have to take it indoors at night, and, although I put on the brass cap before removing the telescope, a deposit of dew occurs, owing to the warmer temperature of the house.—W. G. T.

[97438.]—**Gun-Cotton.**—What chemicals are employed, and what is the process of the manufacture of pyroxylin or gun-cotton? Information will greatly oblige.—H. M.

[97439.]—**Gauge Sticking.**—How can I alter my steam-gauge from sticking (Bourdon's patent)? It will move a few pounds at once with a jerk. Can it be put right, or shall I require a new one?—N.

[97440.]—**Governing Engine.**—I have an old-fashioned portable engine by Burrell, and our work is very irregular, and it is governed by the old-fashioned governor and throttle-valve. Can anything be added to it to make it more regular? One minute it has all it can do, and the next nothing. I have a small governor by Tangye. Could I add that or anything to valve-rod by link or so? Any information would be thankfully received.—ALABAMA.

[97441.] — **Enlarged Tonsils.** — Will Mr. Gerard Smith, M. B. (Galway), or any other medical reader give me a little advice respecting the following? One of my children was about two years ago suffering from enlarged tonsils. The doctor gave us some lotion with which to paint them, and this seems to have effected a cure; but on taking her to another doctor lately (having removed to another part of the country) he says she has a growth of some kind in her throat, which he wishes to take away, but he declined to say if this would be perfectly safe, or if it would be a permanent cure. The child (female) is eleven years old. She is getting very thin in body and limbs, takes her food badly, and takes cold very easily. What I should like is the opinion of the above-mentioned correspondents as to whether an operation is safe, and if it would be likely to result in a cure. Any advice as to suitable medicine or food would also be thankfully received.—QUI VIVE.

[97442.]—**To "F.R.A.S."**—Will "F.R.A.S." and other competent gentlemen kindly give me a little information on the subjects mentioned below:—(1) What does "the theoretical limit of power" for telescopic apertures mean? Why is 100 for each inch the theoretical limit? (2) I should like to know the exact formulæ for finding equiv. focal length of compound eyepieces. (3) When it is stated that the field of view decreases as the power increases, does it mean that the field of view itself actually decreases, or that objects are so magnified as to leave no room for anything else in the field? I thought the latter was limited by the stop. (4) How can I become a member of the B.A.A.? Is an introduction by a member necessary? What is the subscription, and what advantages accrue?—POLARIS.

[97443.]—**Face-Plate.**—Having made a model of a 24in. diam. face-plate for 6in. centre gap lathe, I got it cast, and find it weighs 150lb., or more than 1cwt. 1qr. My lathe is a heavy English screw-cutting one, by a first-class maker. When I come to turn this face-plate up true on the lathe, will it bend my mandrel? Must I discard it as too heavy? The makers' only weighs 40lb., but is only 20in. diam. Is it not safe to use a larger plate than 20in. on a 6in. lathe? Shall I bend my saddle if I turn up the large plate, as the saddle will project about 3in. over gap? I shall be very glad for a reply.—C. W., Hull.

[97444.]—**Tank Sinking.**—A rectangular iron tank, 80ft. by 20ft. by 9ft., floats at a draught of 4ft. A hole 1ft. square is made in the bottom. In what time will the tank sink? Take the coefficient of discharge as 0·6. Greenhill's "Hydrostatics," p. 463, gives 26min., which appears to be wrong.—NAVY.

[97445.]—**H.M.S. "Revenge."**—Where can the results of the rolling experiments on H.M.S. *Revenge* be read?—NAVY.

[97446.]—**Deflection of Oak Beam.**—An oak beam 16ft. long, 6in. broad, and 8in. deep is fixed down at its ends. A mass of 1,000lb. moving with a velocity of 3ft. per second impinges perpendicularly on the beam at its centre. What will be the amount of deflection caused?—NAVY.

[97447.]—**Cement.**—Wanted, cement for a mirror on china, to stand boiling-water. Can any of "ours" kindly tell me of a cement for above?—ALBERT SMITH.

[97448.] — **Galvanometer.** — Will some qualified reader give a short reply how to test Leclanché and other batteries with a galvanometer wound for quantity and intensity, and what the reading for a new one-pint Leclanché should be? Also, what is the proper definition or value of figures to which the needle is deflected? Anything of this sort would be more instructive and useful than a paper war as to 20th century and reasoning out the thinness of the that and the thusness of the why, or showing the difference between Tweedledee and tweedledum, Noah's Ark, ether, and destruction of Sodom.—NEW YEAR.

[97449.]—**Velocity of Sound.**—All the textbooks on Sound state that the velocity of sound in air (neglecting La Place's correction) may be calculated from the formula—

$$V = \sqrt{\frac{E}{D}}$$

where V = velocity, E = elasticity of air, D = density of air. Result is given as 920ft. per second. Will some reader perform this calculation?—ACOUSTICS.

[97450.]—**Drum Armature.**—I have a drum armature which gives 35 ampères 65 volts, the wires of which have got rubbed on the pole-pieces and worn thin. Can I rewind the faulty coils without undoing all the others? In Mr. Bottone's book on winding a drum armature,

it says the armature should be given a half-turn on the completion of every coil. Does this mean backward and forward, or continuously round?—D. A.

[97451.]—**Commutator.**—I wish to fix a new commutator on spindle. 32 sections, but cannot keep the sections straight. They twist round out of line when tightening the clamping-nut. How can I obviate this? Can the mica insulation be bought of a uniform thickness?—DRUM ARMATURE.

[97452.]—**Showcase.**—I have a showcase at street-door with flue electric lamps in. Can anyone tell me how to prevent the moisture coming on the glass? In damp weather it quite obscures the view. I have tried boring holes, but it makes the annoyance worse.—SHOWCASE.

[97453.]—**Motor-Car.**—I am making a small car for trade. Would "Country House" say if trade cars have to pay a license? If so, should I run any risk of running it to another shop to finish, thirty miles apart by road?—S. P.

[97454.]—**Overtype Dynamo.**—Will either Mr. Bottone or Messrs. Webster Michelson give me dimensions for overtype dynamo, compound wound, cog-ring armature, with cast-iron field-magnets, to light eighty 16c.p. 110-volt lamps? Also, the dimensions for a machine to light three 16c.p. 55-volt lamps?—LIDY.

[97455.]—**Alloy.**—Will some reader kindly tell me of a suitable alloy (aluminium) for making crank-cases, &c., for tricycle motors, with a few hints on casting, &c.? I am told pure aluminium is useless. Also, where can I obtain it, and what is the price about? I have a large brass furnace at my disposal.—LANKY.

[97456.]—**Launch.**—I have a fast rowing-boat for open sea work, 18ft. long by 4ft. 2in. beam, with a depth of 2ft. 4in., into which I wish to put an oil-engine, as fitting the screw in the usual way would mean rebuilding the stern of the boat. It has occurred to me that the screw-shaft may be brought out by the side of the stern-post. What is the minimum power of engine that should be put in her to do useful work? and also size and pitch of screw, which should not project below the keel, as the boat has to lie on the ground? Would a ½H.P. engine be of any use? One man sculling can send her along fast.—NAVIGATOR.

[97457.]—**Stopping Down Object-Glass.**—I would like to ask Mr. Norman Latey if his fine 4in. Cooke refractor has a stop near the object-glass, and its diameter. In my own 4in. there is a stop 12in. or 13in. down tube, contracted to an aperture of about 2½in., and one or two further down the tube. Now, I would like to ask any reader if my object-glass is more stopped down than it should be for one of the finest quality. I know the definition of the o.g. is very fine under high powers, and when I first saw the half-moon in the 4in., coming from a 3in., I was amazed at the difference. I may say the 4in. is a cemented o.g. of 6ft. focus, with the thick glass to the front.—O. G.

[97458.]—**Observatory.**—Will any reader inform me what is the smallest workable observatory with dome roof for a telescope of above dimensions—a 4in., of 6ft. focus. Most of the amateur observatories I have noticed in "Ours" have been of wood. Would not the ordinary frilled galvanised iron do at least for the square part? What size of dome would be necessary? Height of tripod 5ft. Could anyone inform me of probable cost of such a house?—OBSERVATORY.

[97459.]—**Deafness.**—I am a woman dependent on my own exertions, and am become excessively deaf. I have had the best of medical advice, but in vain. My occupation has been that of governess and housekeeper. I have read of an ear-telephone in *Pearson's Weekly*, but can obtain no information from the editor. An ear-trumpet fastens the hand. Is there such a thing as an ear-telephone? Is effectual aid possible for deaf workers—those who cannot afford to go in for a training? Do, please, help me if you can, by information or suggestion.—ANNE.

[97460.]—**Oil-Engines.**—Could any reader of the ENGLISH MECHANIC inform me, through the medium of that paper, how does the oil, after being vaporised, enter the cylinder in the Crossley and Blackwood oil-engines without being ignited in the vaporiser through which it first passes, for I noticed the lamp is underneath the vaporiser, and the vaporiser red-hot; and, also, where does the air mix with the vapour after entering or before entering the cylinder, and how does it ignite after entering cylinder, and not before, for the vaporiser is much hotter than the cylinder, and what prevents it? Kindly explain by means of a diagram?—CYMRO.

[97461.]—**Azimuth and Altitude.**—"F.R.A.S." would greatly oblige if he would apply a recent answer to the finding of the azimuth and altitude of a star of given R.A. and Decl., being also given the latitude of the place and hour of observation. *Whitaker's Almanack* available.—H. B.

[97462.]—**Vibration.**—The railway runs along at the bottom of my garden, and when heavy luggage trains are passing we are much annoyed with the vibrations. If I were to have a deep trench dug completely across, would it prevent the vibrations being felt? If you think it would, will you kindly say how deep the trench should be? My ground is 60ft. wide, and the house is about 135ft. from the metals. The house is an ordinary eight-roomed house, about 30ft. to ridge.—VIBRATIONS.

[97463.]—**Boiler.**—Would any reader versed in boiler experience say whether a $^3/_{16}$in. plate would be strong enough for a tube-plate, size 24in. by 15in., drilled with 100 1in. holes for tubes, the plate to be supported by six screwed tube-stays, in addition to the riveting all round the plate?—B.

A TELEGRAM from Cairo, dated Jan. 10, states that the first through train reached Khartoum on that day.

IT has been noted in connection with the prevailing epidemic of influenza that in the North of England, where the disease is common amongst artisans, the men who work in very high temperatures alone appear to have escaped the infection.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 17, and unacknowledged elsewhere:—

R. W. M.—G. E. O.—A. Stacey.—An Old Reader.—Mechanic.—G. A. Haig.—F. L. H.—W. S.—W. M.—Seeker.—Meteor.—NormanLattey.—Jack of All Trades.—H.—A Fellow of the Royal Astronomical Society.—Monty.

B. M. S.—We have inserted your first query, though it is put so vaguely that we fear you will get but poor replies. The second can be answered by nobody who has not seen the premises you propose to light. To ask at one and the same time "what power dynamo you will want" and "what the candle-power of lamps would be," is a little confusing! You had really better get an estimate from a decent electrical light contractor.

L. B. B.—Thanks; but drawing is not capable of reproduction.

W. M.—Methods of demagnetising watches have been given many times. The simplest seems to be to spin the watch round in the field of a magnet. The terms "burnt out" are misleading. See p. 297, May 14, 1897, No. 1677, and the indices generally.

B. P. MEHTA, Rangoon.—Full instructions for making a phonograph were given some years ago, and were subsequently published in book form by E. and F. N. Spon, 125, Strand, W.C. The numbers are all out of print. As to the optical lantern, such numbers as are still in stock will be sent.

NO SIRRAH.—Any bookseller can supply a work giving the Morse code of signals. Cassell and Co., Ltd., publish "The Telegraph Guide," price 1s., and Lockwood and Son publish works giving the usual code, but obviously not the "code" employed for signalling during war operations. Culley's work was mentioned on p. 433, because it is the standard; but it was expressly mentioned that "any of the small handbooks on the telegraph give the alphabet."

REX.—The subject has been frequently referred to in back volumes, and the action of light on selenium is well known. See pp. 56, 212, 338, Vol. XXVII., and the *Proceedings* of the Royal Society.

J. R., Penrith.—We do not see our way to issue another set of "Best Books" just yet, at the same low price. For one thing, paper alone is twenty per cent. higher in price than it was two months ago. We have not many sets of the present series left, and if your friend wants a bargain he will secure one before they all go off. He will not have a chance like it again just yet, we fancy. We send the set of 25 Best Books and Bookcase, complete for 30s., free delivery in London, or packed for rail in substantial wooden case free of extra charge.

P. ERNEST OLD.—It is not easy to guess which coil you mean, as so many have been given. Probably it is that described and illustrated on p. 241, May 1, 1896, which is the nearest to the "early part of '96."

WALTER SCUTT.—Thanks for the cuttings.

W. M. WORSSELL.—Many thanks; but letter and sketch of mock sun seen by you at Arundel on Jan. 11 reach us too late for this week, and will be out of date or crowded out by next week. It is desirable to send us notes of this kind *at once*, so as to give us a chance of publishing with next issue.

W. E. NICOLL.—The same remarks must apply to your otherwise interesting note on the meteor seen on the 9th instant in daylight at Woolwich, which you think is probably the same as that referred to in letter 43195.

THE strength of the German navy this year will be 152 ships, comprising 17 battleships, 8 ironclads, 11 large cruisers, 27 small cruisers, 5 gunboats, 84 torpedo boats. In sixteen years' time it is stated that the navy will be increased to 222 vessels.

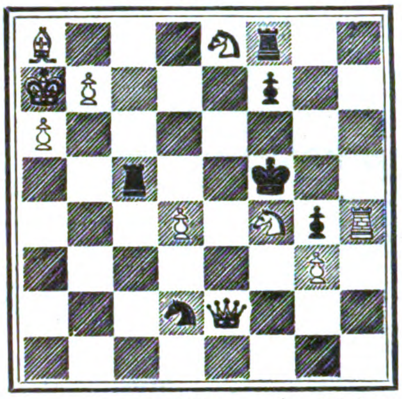
IN modern wind machines it is calculated that a 14ft. wheel will yield ¼H.P. with a 10-mile wind, ½H.P. with a 12-mile wind, 1H.P. with a 16-mile wind, and 2½H.P. with a 25-mile wind. A 20ft. wheel will give 1¼H.P. at 10 miles, increasing to 5½H.P. at 25 miles. A wheel 30ft. diameter is estimated to produce from 3H.P. at 10 miles to 9H.P. at 25 miles velocity; a 40ft. wheel ought to give from 5 to 12H.P.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1710.—By T. TAVERNER.

Black. [6 pieces.



White. [10 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Jan. 29, 1900.*)

Solution of PROBLEM No. 1708.—By G. B. VALLE.

Key-move, Kt-K B 5.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1708.—Correct solution has been received from A. Tupman, Whin-Hurst ("Appears ingenious, but not a very difficult one"), J. E. Gore ("Very pretty"), Rev. Dr. Quilter ("An admirable and clever problem"), Richard Inwards, F. B. (Oldham), Quizco, N. M. Munro, W. Masters, H. Hall, A. H. W. (reply sent by post).

H. B. F., TOM TIT, J. M. C., W-H.—Only solution as above.

SPECIAL OFFER.—CHEAP VOLUMES.

In the course of the next few months we are compelled, owing to the making of the new street from Holborn to the Strand by the London County Council, to remove our Offices and Printing Works. Due notice of our removal will be given shortly. In the mean time, to reduce stock and save trouble of removal, we offer readers desirous of making up sets of back volumes *any volume* in the list below at HALF PRICE, or post free for 4s. 1d.

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The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

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The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, JANUARY 26, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—IV.

HAVING the cylinder finished, we will next consider the cylinder cover, Fig. 10. This also is of cast iron, and its pattern will be the same as its casting, with the addition of shrinkage. Machining is also to be allowed for where it fits on to the cylinder end, on the edge, and on each of the 1in. bosses for the nuts holding it in place. The six ribs not only add very greatly to the strength, but also help to keep it cool. The six $^7/_{16}$in. holes for the studs are best drilled from the solid. To turn this casting I should grip it by the edge in a jaw-chuck and face the part which goes next to the cylinder. There is no need to face right over the projecting part marked 4in. diameter. Having faced one side, reverse it in the chuck, gripping it by the $^3/_{16}$in. rim and using the back centre to steady it. The edge can now be turned and a cut taken over the tops of the six small bosses, which will insure their being all of the same height and true with the cylinder joint. A circle $5^3/_{16}$in. diameter is next to be lightly scribed, on which to pitch out the centres of the $^7/_{16}$in. stud-holes. When these are drilled, the cover can be placed in position on the end of the cylinder, and the holes marked off for the studs. These should next be drilled and tapped, and studs screwed tightly in, as shown in Fig. 9. Fig. 11 is a vertical section of the valve-box on the line A B of Fig. 12, which is an end view showing the facing for the inlet valve. Fig. 13 is a horizontal section on the line C D of Fig. 12. The box is to be cast in iron, and should be of the same metal from which the cylinder is cast, so that the expansion and contraction may be the same for each.

This may be considered a theoretical detail; but it is by attention to very small matters that the best results are obtained. The pattern and core-box work on this part of the engine requires to be done with care; otherwise we shall have the cores showing through where not desired, or the metal left too thin to be of use. The pattern will be made solid, and a print put on the side which goes next to the cylinder. This print will include the print for the water-jacket, and also for the port leading to the valves. The shape of the print will be rectangular, with semicircular recesses taken out at each corner. Two core-boxes will be necessary —one for the water-jacket, the other for the valve-box and exhaust-branch. The guide for the exhaust-valve stem is to be cast solid and drilled out afterwards, as are also the four holes for the studs which hold the valve-box to the cylinder. In Fig. 11 will be seen a dotted line, A; this indicates the shape of the facing which corresponds with and goes against that on the side of the cylinder (Fig. 4). At D (Fig. 12) is the boss for the ignition-plug, seen also in section in Fig. 13. It is to be cast solid and drilled out. The shape of the facing on to which the oval flange of the exhaust-pipe goes is seen dotted in Fig. 13, the depth of the tapped holes for the studs showing in Fig. 11. In this figure the tapped holes for the inlet-valve cover-studs show also.

The first part to machine will be the flat face which goes next the cylinder. The casting must be lined out first, of course, and care taken to insure the centre line of the exhaust-valve guide and seating, and the centre of the hole for inlet-valve seating being at the correct distance ($1\frac{1}{4}$in.) from the cylinder-joint face. Having this face planed, the casting should be secured to an angle-bracket on the face-plate of the lathe, with the facing for the inlet-valve seating outwards. To reduce overhang, the exhaust-valve stem-guide may project into the lathe mandrel into the coned hole made for the centre. The oval facing can now be faced off, and the hole for inlet valve-seating bored out $1\frac{3}{8}$in. diameter. At the same setting the exhaust-valve seat can be machined, the actual seating being coned out at 45° to the bore, and made a bare $^1/_{16}$in. wide. Every precaution should be taken in drilling the $\frac{3}{8}$in. hole for the exhaust-valve stem. It

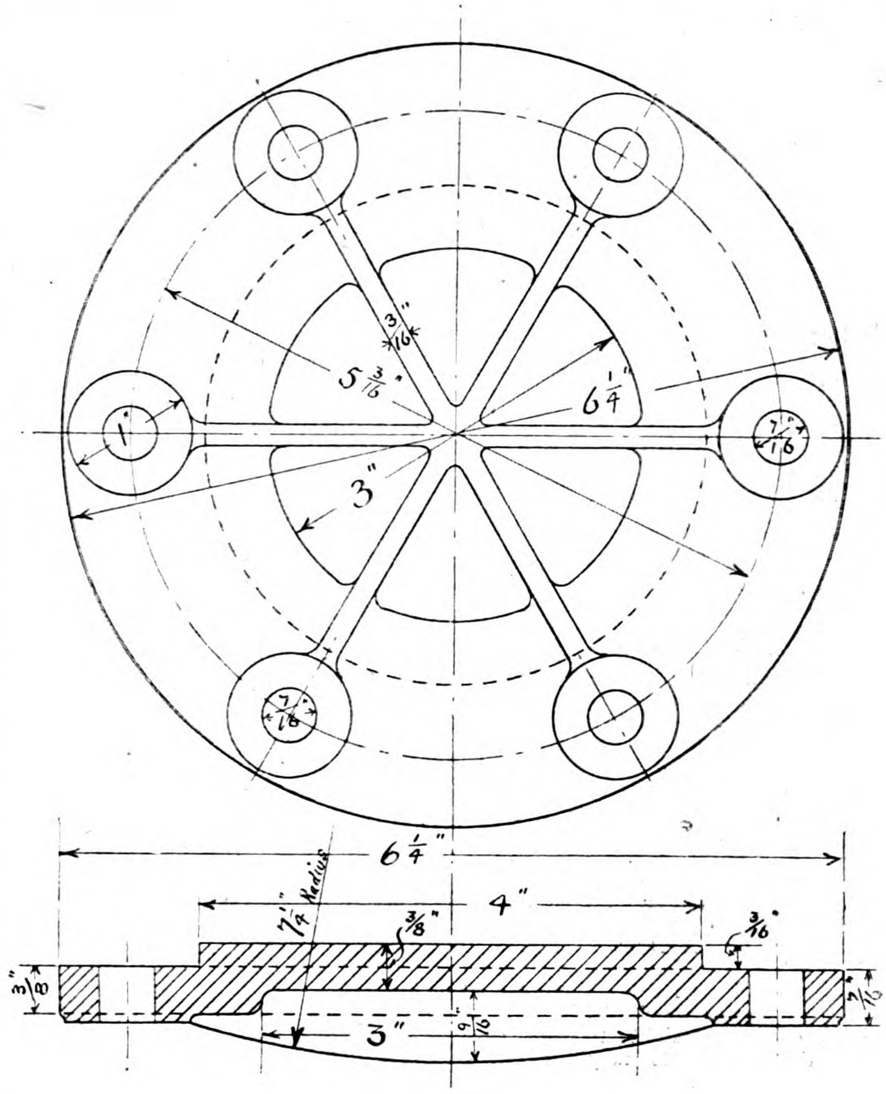


FIG. 10.

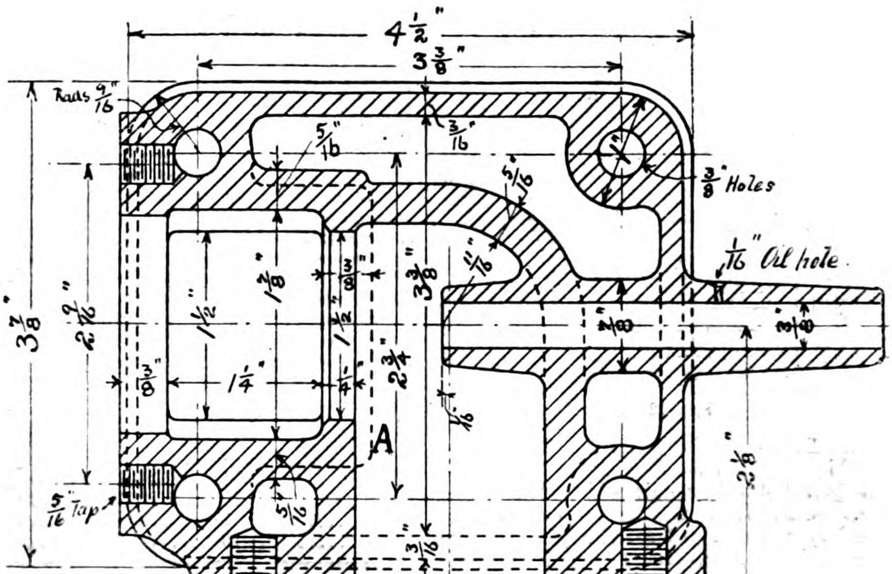


FIG. 11.

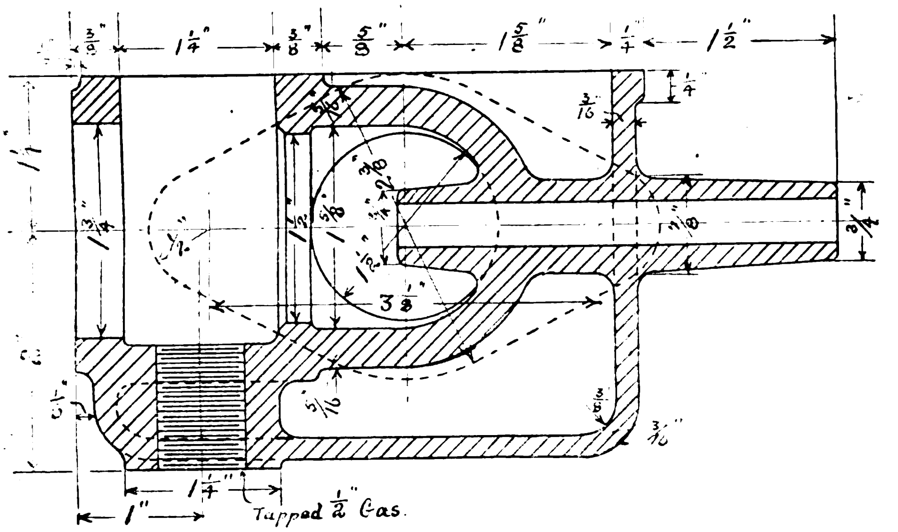


FIG. 13.

must be truly concentric with the valve-seat. The way I should adopt would be to run a ⅛in. or ¼in. twist-drill through first as truly as possible, feeding the drill up to its work by the back centre of lathe. Having drilled the hole clear through, take a straight piece of iron, steel, or brass rod, which is a fit in the hole drilled, push it through the hole, when, if the face-plate be rotated, the projecting end of the rod will indicate if the hole is true or not. If really true, the hole may be finished with a ⅝in. twist-drill. If, however, the hole runs out, other means must be adopted. With a small boring-tool bore up the hole to ⅝in. diameter for about ½in. or ⅝in. deep. A Dee bit will now be required with which to bore the hole through; the part bored up insures the Dee bit starting true, after which it will continue to cut its way straight through, even though the small hole may be out of

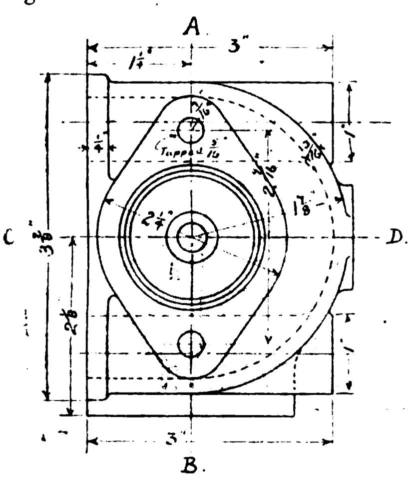


FIG. 12.

truth. To secure the casting to the angle-plate it would be as well to drill the four ⅜in. holes (through which the studs pass, which hold the valve-box to the cylinder) next in order after planing the cylinder-joint face. Bolts passed through these holes and the angle-plate will hold all secure during the facing and boring operations. The tops of the bosses on which the ⅜in. nuts bear are to be faced off with an arbor cutter. The holes in the valve-box facing on the cylinder can now be marked off, drilled and tapped, using the valve-box itself as a template. See that the studs are really tightly screwed into the cylinder. Dimensions can be obtained from Fig. 8. The studs for the exhaust branch facing should stand up 1in. above the facing, and those for the inlet-valve seating should project ¾in. from the surface of the facing.

Note that a 1/16in. oil-hole, countersunk, is to be drilled in the guide of the exhaust-valve stem, where mentioned in Fig. 11. The bosses for the four ⅜in. studs run right through the casting, as shown in Fig. 12. When the casting has been bored and turned, remove it from the lathe, and plane over the facing for the exhaust-pipe flange. Drill the boss for the ignition plug, and face it off with an arbor cutter, after which it may be tapped ¼in. gas thread.

ASTRONOMICAL NOTES FOR FEBRUARY, 1900.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon. Right Ascension.	Declination. South.	Sidereal Time.
	h. m. s.	h. m. s.	° ′ ″	h. m. s.
1	0 13 46·93 P.M.	20 58 44	17 8 32	20 44 56·78
6	0 14 17·38 ,,	21 18 57	15 39 42	21 4 39 54
11	0 14 27·24 ,,	21 38 50	14 4 15	21 24 22·34
16	0 14 17·64 ,,	21 58 23	12 23 0	21 44 5·10
21	0 13 50·31 ,,	22 17 38	10 36 47	22 3 47·85
26	0 13 7·24 ,,	22 36 38	8 46 26	22 23 30 64

The method of finding the Sidereal Time at Local Mean Noon at any other station is explained on p. 438.

Having arrived at a period of Sunspot Minimum, we can hardly expect the Great Centre of our System to exhibit much, if any, superficial detail of interest to the ordinary observer; still the Sun may be examined from time to time as occasion offers.

During, and especially towards the end of the month, the Zodiacal Light may be looked for after sunset in the West.

The Moon.

First Quarter..	Feb. 6	4h. 23·1m.	p.m.
Full Moon....	,, 14	1h. 50·3m.	,,
Last Quarter..	,, 22	4h. 44·2m.	,,
Perigee	,, 1	12h. 12m.	a.m.
Apogee	,, 16	1h. 0m.	,,

Day of Month.	Moon's Age at Noon.	Souths.	Longitude of Terminator at Transit.	Sun.
	Days.	h. m.	°	
1	1·44	1 29·8 p.m.	69·2 W.	R.
6	6·44	5 54·8 ,,	6·2 W.	R.
11	11·44	10 13·9 ,,	56·7 E.	R.
16	16·44	1 7·1 a.m.	73·1 E.	S.
21	21·44	4 43·3 ,,	10·4 W.	S.
26	26·44	9 18·0 ,,	52·7 E.	S.

E, East Longitude; W, West Longitude; R, Sun Rising; S, Sun Setting.

The Moon will be in Conjunction with

—	Day of Month.	Hour.	Planet.
			° ′
Venus	2	2 p.m.	6 52 S.
Jupiter	23	4 a.m.	1 31 N.
Saturn	24	10 p.m.	0 26 S.
Mars	28	11 ,,	6 21 ,,

When our Notes begin the Moon is in Aquarius. She enters—

—	Day of Month.	Hour.
		h.
Pisces	2	7 a.m.
Aries	5	8 a.m.
Taurus	7	2 a.m.
Gemini	9	10 p.m
Cancer	12	3 a.m.
Leo	13	10 p.m.
Sextans	14	11 p.m.
Leo	15	10 p.m.
Virgo	17	2 a.m.
Libra	20	Noon.
Scorpio	22	9 a.m.
Ophiuchus	22	10 p.m.
Sagittarius	24	10 a.m.
Capricornus	26	6 p.m.
Aquarius	27	9 a.m.

Mercury

is a Morning Star at the beginning of February, but comes into superior conjunction with the Sun at 9 p.m. on the 9th, after which, of course, he sets after the sun. He is somewhat indifferently placed for the observer, though his position improves towards the end of the month, and he will be easily observable in the succeeding one. His angular diameter increases from 4·8″ early in February to 6·0″ by the 28th.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	20 36 6	20 39·8	11 51·7 a.m.
6	21 18·6	17 52·3	0 6·9 p.m.
11	21 46·6	15 30·9	0 22·2 ,,
16	22 21·5	12 1·7	0 37·3 ,,
21	22 55·9	8 1·3	0 51·9 ,,
26	23 28·4	3 41·9	1 4·7 ,,

Starting thus in Sagittarius, Mercury will cross Capricornus and Aquarius, and be found at the end of the month in the confines of the last-named constellation and Pisces. He travels through a region of the sky curiously destitute of any but small stars.

Venus

is an evening star throughout the month, and is becoming a brilliant and conspicuous object in the West after sunset. Her now perceptibly gibbous disc subtends an angle of 12·9″ at the beginning of February, increasing to one of 14·6″ by the end of the month.

Day of Month.	Right Ascension.	Declination.	Souths.
	h. m.	° ′	h. m.
1	23 8·2	6 55·3 S.	2 22·9 p.m.
6	23 30·5	4 21·6 ,,	2 25·5 ,,
11	23 52·5	1 45·2 ,,	2 27·8 ,,
16	0 14·4	0 52·4 N.	2 29·9 ,,
21	0 36 1	3 29·7 ,,	2 31·9 ,,
26	0 57·8	6 5·2 ,,	2 33 8 ,,

It will be seen from the above ephemeris that Venus will travel from a point where Aquarius and Pisces are conterminous over the greater part of the last-named constellation. As in the case of Mercury, her path is quite void of any conspicuous stars.

Mars

is invisible.

Occultations of (and near approaches to) Fixed Stars by the Moon, visible at Greenwich.

Day of Month.	Star's Name.	Magnitude.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	κ Piscium	5 0	6 56 p.m.	Dark	101	65	7 43 p.m.	Bright	210	172
6	δ Arietis	4·5	8 36 ,,	Dark	127	93	9 24 ,,	Bright	214	175
7	A² Tauri	6 5	7 3 ,,	Dark	39	35	8 0 ,,	Bright	306	285
8	51 Tauri	5·4	†1 57 a.m.	S.	181	143				
8	56 Tauri	5·4	2 3 ,,	Dark	118	81	2 49 a.m.	Bright	243	209
9	κ Tauri	5·2	3 50 ,,	Dark	133	99	‡4 29 ,,	Bright	237	207
12	B.A.C. 2649	6·3	5 11 ,,	Dark	120	82	*6 4 ,,	Bright	276	241
16	55 Leonis	6·0	1 20 ,,	Bright	111	109	2 40 ,,	Dark	312	294
16	p² Leonis	6·2	†7 7 ,,	N.N.E.	23	344				
16	e Leonis	5·1	†7 51 p.m.	S.S.W.	203	242				
18	B.A.C. 4201	6·3	†4 35 a.m.	N.N.E.	26	6				

† Near approaches. ‡ Moon has set. * Moon setting. A description of the above table will be found on pp. 438 and 439.

Jupiter

does not rise until between 3h. and 4h. a.m. at the beginning of February, nor until 2h. a.m. or so, at the end of it, and

Saturn and Uranus

are in a worse position still; but

Neptune

continues visible during practically the whole of the ordinary amateur's observing night, and his considerable height at transit places him in a most favourable position for observation.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 36·2	22 3·4	8 49·8 p.m.
6	5 35·9	22 3·4	8 29·8 ,,
11	5 35·6	22 3·4	8 9·9 ,,
16	5 35·4	22 3·5	7 50·1 ,,
21	5 35·2	22 3·7	7 30·2 ,,
26	5 35·1	23 3·9	7 10·4 ,,

The tiny retrograde arc indicated above is described about 59′ to the north and 1° 13′ to the east of the 3rd magnitude star, ζ Tauri.

Shooting Stars

Are neither very numerous nor conspicuous in February. They may be looked for from the 5th to the 10th inclusive, as also on the nights of the 15th and 20th inst.

Greenwich Mean Time of Southing of Twenty-three of the Principal Fixed Stars on the Night of February 1st, 1900.

Star.	Magnitude.	Souths.
		h. m. s.
α Ceti	2·7	6 11 6·80 p.m.
Algol	2·2 to 3·7	6 15 42·98 ,,
α Persei	1·9	6 31 12·05 ,,
η Tauri	3 0	6 55 29·26 ,,
γ¹ Eridani	3·0	7 7 16·43 ,,
Aldebaran	1·0	7 44 0·04 ,,
ι Aurigæ	2·7	8 4 15·08 ,,
Capella	0 2	8 23 1·73 ,,
Rigel..........	0·3	8 23 26·48 ,,
β Tauri........	1·9	8 33 39·68 ,,
α Leporis	2·7	8 41 58·71 ,,
ζ Tauri........	3·0	8 45 19·52 ,,
α Orionis	1·0 to 1·4	9 3 21·83 ,,
γ Geminorum ..	2·0	9 45 25·83 ,,
Sirius..........	−1·4	9 54 12·48 ,,
δ Canis Majoris.	1·9	10 17 43·69 ,,
Castor	2·0	10 41 34·22 ,,
Procyon	0 5	10 47 29·67 ,,
Pollux	1·1	10 52 30·96 ,,
β Cancri	3·8	11 24 19 08 ,,
ι Ursæ Majoris..	3·2	*12 5 29·58 a.m.
α Hydræ	2·0	*12 35 42·09 ,,
ε Leonis	3·1	*12 53 9·64 ,,

* Early morning of the 2nd.

The method of ascertaining the Greenwich Mean Time of Southing of either of the stars in the above list, as also that of determining the local instant of the transit will be found to be described on p. 439.

Minima of the Variable Star Algol.

Day of Month.	——
	h. m.
2	11 44 p.m.
5	8 33 ,,
8	5 22 ,,
20	4 38 a.m.
23	1 26 ,,
25	10 15 p.m.
28	7 4 ,,

And on other occasions when daylight will render the phenomenon invisible.

THROUGH A SMALL TELESCOPE.—VI.

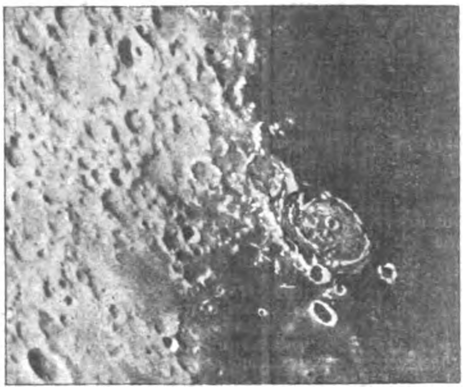
By NORMAN LATTEY.

METEOROLOGICAL conditions having been somewhat more favourable than during the previous week, the moon will occupy our entire attention in this paper. A reference to Fig. 1, giving a fine view of the "terminator" at first quarter—i.e., when daylight has advanced exactly half-way across the lunar disc—and Fig. 2 the key map thereto, will enable the student to easily locate all the features which we are about to deal with.

Turning our telescope on to the upper or southern portion of the illuminated area, one of the principal depressions we notice in this much pitted region is Maurolycus, ranking among the grandest walled plains on the moon. It extends fully 150 miles from east to west, and even more from north to south, covering an area equal to about that of Switzerland. This vast inclosure really consists of several crater rings crowded together and encroaching on each other; the whole bounded by a massive and deeply-terraced irregular wall towering nearly 14,000ft. above the interior. The central mountain is of great altitude; its lofty summit catching the rays of the rising sun long before the rugged peaks of the elevated ramparts begin to be illuminated.

Hard by on the right is a similar and even more extensive formation, Stofler, a magnificent spectacle when the morning terminator lies rather east of the western wall. Its surrounding rim is very uneven, varying from 3,000 to 12,000ft. in height. There are several conspicuous craters on the east and south walls. The floor is smooth and steely-grey; altogether, it well repays half an hour's careful study.

Immediately below Stofler lie two almost similar ring-plains, Aliacensis and Werner, 53 and 45 miles in diameter respectively. Both are surrounded by terraced borders of tremendous height—among the loftiest on the moon. On the eastern wall of Aliacensis the peaks rise to over 16,000ft., and around Werner they are hardly inferior. The latter contains a splendid central mountain 4,500ft. high, and at the foot of the north-east wall lies a bright little area suspected to be a comparatively new feature, possibly of recent deposits. To the north-west of this pair stretches a chain of dusky ring-mountains, Apianus, Playfair, Azophi, Abenezra, Geber, and Almanon. The last named is an interesting object about 36 miles across, surrounded by an irregular border of polygonal shape perforated on the south by a deep crater. Below and slightly to the east stands its more massive and rugged companion Abulfeda, some 40 miles in diameter. The encircling wall is much broken by narrow transverse valleys but finely terraced on the east and west. On the south-east originates the curious string of craterlets running in a straight line to the north-west wall of Almanon—a pretty sight under a low sun. Tacitus, still further to the west, has a lofty wall 11,000ft. above the floor

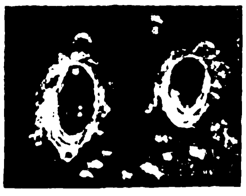


Sunrise on Posidonius.

and a conspicuous crater on the south-west rampart.

In Albategnius, one of the most prominent features near the terminator at this phase, we have a superb walled plain surrounded by a massive complex border rich in terraces, depressions, and winding clefts. The ridges are surmounted by lofty crests, one of which on the north-east, rears itself up to a height of 15,000ft. On the eastern side intrudes a fine circular crater Albategnius A, its towering peaks rivalling those of the larger formation. The central mountain of Albategnius exceeds 4,000ft., and is almost the only elevation on the crater-studded floor.

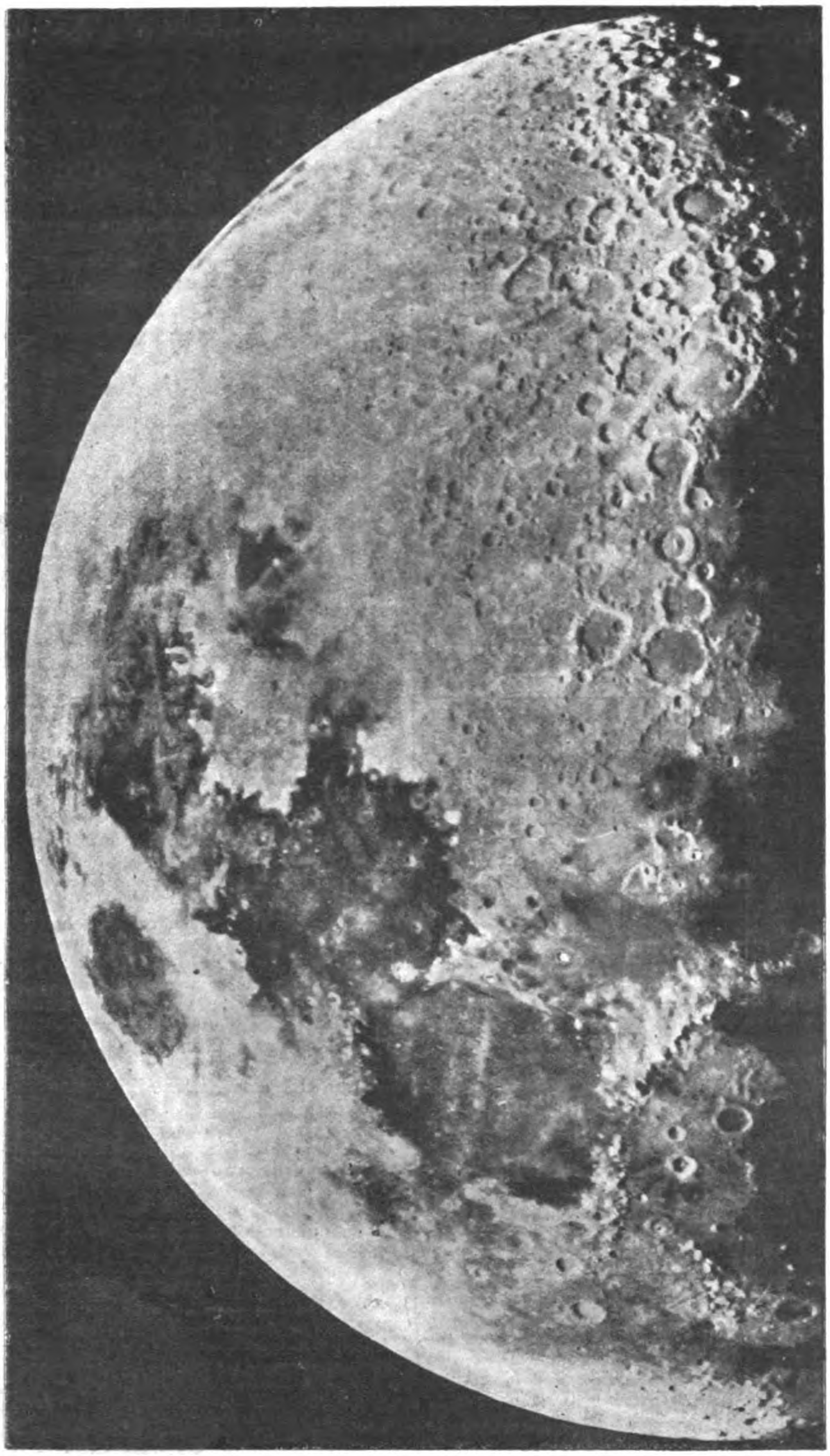
Immediately beneath Albategnius lies the ruined inclosure Hipparchus, an extensive ring-plain, whose broken walls bear unmistakable signs of physical decay. Its imperfect outline marked by the two deep craters Halley and Horrocks, can be barely detected in the photograph, but shows up in better relief under more oblique illumination. The interior of Hipparchus is crossed by many ridges and valleys, and near



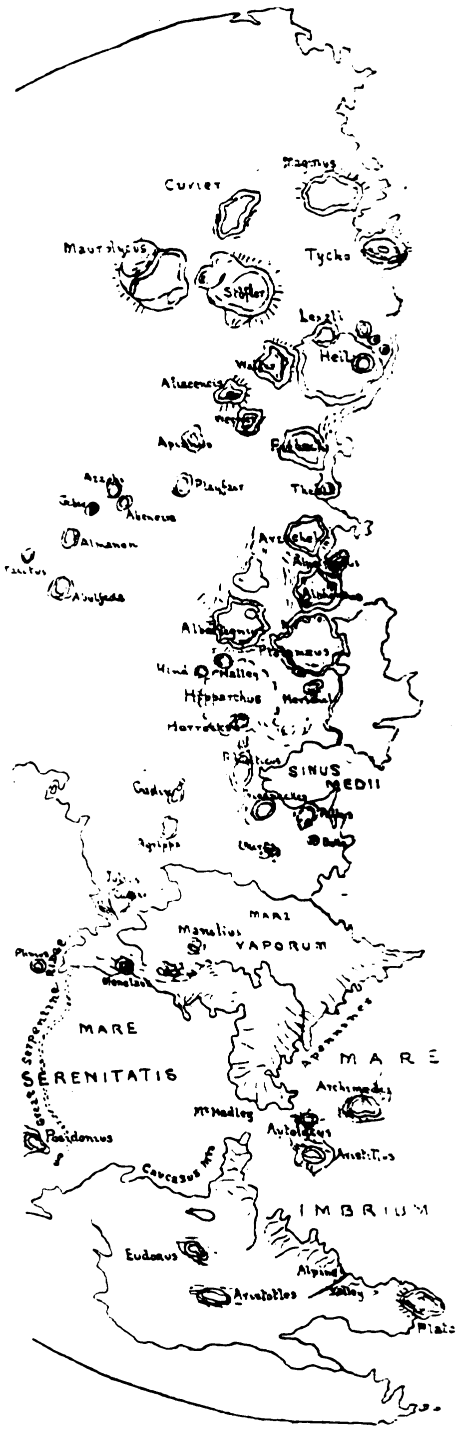
Eudoxus and Aristoteles. (Moon's Age, 6 l. 6h.)

the centre can be discerned the remains of what was evidently once a well defined ring. This region is specially interesting, and affords a pretty study under a low sun.

Crossing the head of the Sinus Medii, we soon reach Triesnecker, the centre of one of the most remarkable rill-systems on the moon. Although only fourteen miles in diameter, this famous object affords almost unlimited scope for examination under various phases. The north-west section of the wall is considerably higher than the rest, and exhibits many spurs and buttresses on the outside, with elaborate terracings within. The rill system—which needs a good night and high power to see really well in all its intricacies—consists of a complicated lacing of dark and light streaks which appear to grow wider and deeper as they approach higher ground. For this reason, the cause of which remains unexplained, they have been likened to an "inverted river system." To the westward are the twin formations Godin and Agrippa. Both have lofty borders deeply terraced. Still further in this direc-



Photograph of the Moon at First Quarter, as seen through a 3in. Telescope.



Key Map to Objects near the Lunar Terminator at First Quarter.

-tion, but some distance north on the promontory dividing the Mare Vaporum from the Mare Tranquillitatis lies the great irregular formation Julius Cæsar, remarkable for the duskiness of its vast floor, especially at the northern end. On its western flanks will be noticed a number of narrow valleys and low banks, besides three large swellings on the uneven interior.

Along the narrow southern "shores" of the Mare Serenitatis will be found three important objects all in a row: Manilius, Menelaus, and Plinius, the centre one, Menelaus, being almost immediately beneath Julius Cæsar. In Manilius we have one of the most brilliant objects on the moon, though only 25 miles in diameter. To the east will be noticed a small isolated mountain standing alone on the plains of the Mare Vaporum. Menelaus almost as conspicuous as Manilius, though slightly smaller, has a brilliant central hill, and is completely traversed by the bright streak crossing the Mare Serenitatis from north to south. The secret of these bright streaks, their nature, origin, and connection with the formations with which they seem to be associated, remains one of the yet inexplicable mysteries of the strange globe on which they occur. Plinius, the most westerly of the trio, to use the words of the late Gwyn Elger, "reminds one at sunrise of a great fortress or redoubt erected to command the passage between the Mare Tranquillitatis and the Mare Serenitatis." This magnificent circumvallation, somewhat triangular in shape, boasts exceedingly massive ramparts sloping much on the outside and incised deeply by wide and tortuous valleys. The interior is considerably brighter than the surrounding Mare, and several little craters occur on the summits and slopes of the walls. Here again we meet with an elaborate and delicate rill system seen tolerably well with a good 3in., and even better with a 4in.

Following the course of the western coast line of the Mare Serenitatis until we skirt the northern "shores," we eventually meet Posidonius, admittedly the finest telescopic object in the first quadrant. The figure gives a view of it under a low sun between five and six days after new moon. Its massive ring—within which, on the south-western quarter, can be seen the remains of a second concentric ridge—is about 62 miles in diameter, but not of specially high altitude. The most conspicuous object on the floor is the well-defined bright crater visible slightly to the east of the middle. The western wall is broad and regular, and perforated by several bright crater-rings. The floor, which shines with a silvery lustre, is scattered with craterlets, and scored by clefts and rill-valleys. A day or so later the Great Serpentine Ridge starts out of the darkness on the east, and extends for nearly 200 miles towards Plinius, like some colossal serpent wriggling across the smooth stretches of the *mare*.

Space now compels me to conclude with the two well-defined crater cups situated near the northern pole, Eudoxus and Aristoteles. Under a power of 200, when the moon was 6 days 6 hours old, this pair defied all attempts to adequately portray their rugged and lofty borders beautifully terraced within, and supported by complex buttresses and spurs without. Eudoxus, the smaller of the twain, is some 40 miles in diameter, with a border much broken by passes and clefts, particularly on its eastern wall, which contains two very deep fissures. Aristoteles, the companion to Eudoxus, is nearly half as large again, but similar in construction. Its ramparts are exceedingly lofty, one peak at the western end (stand-

ing out as a brilliant spec of light in the figure), rises 11,000ft. above the shadow-steeped floor. On the crest of the eastern wall stands a little crater, with its interior still unlit. The whole of the surrounding country is covered with a multitude of hillocks and craterlets, every eminence and depression standing out with stereoscopic sharpness and relief. No words can convey an adequate idea of the weird beauty of the scene as it appeared through the writer's 4in. Cooke refractor, even when stopped down to 3in. aperture.

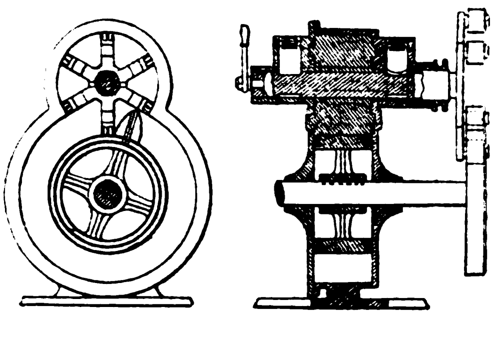
Next week we shall investigate the principal and most interesting features which at this phase lie on the edge of the terminator, some of them as yet hardly revealed in all their completeness. Copies of photographs, with much of the finer detail filled in at the telescope, will be again reproduced. But even these, striking as they are, will give the student but a poor idea of what his 2½in. or 3in., however indifferent, will show him.

DREAMS.

THERE are those who declare that they never dream at all; but in order to understand what they mean by this, it is necessary to understand what dreaming itself actually means, says H. G. Hutchinson, in *Longman's Magazine*. Dreaming does not merely mean, in the current sense of the term, that the mind is carrying on some kind of operations during sleep, but also that on awaking it should retain a consciousness of what it was thinking about during sleep. And in this regard it is to be observed, that when we are suddenly awakened it always seems to most of us as if we had been awakened out of a dream that is exceedingly vivid for the immediate moment. It is one of the most notable features of dreams that they vanish very quickly from our recollections a few minutes after we have thus been awakened, and we strive in vain to regain our grasp of what our mind had been doing while we were asleep. On the other hand, if the awakening has been gradual, it is probable that, in the leisurely process of the mind's reviving interest to the things of waking life, it unconsciously loses its grasp of what it had been doing in the sleeping state. From this it would seem likely that those who declare that they never dream do not really differ from the great majority of us who are dreamers by any difference of the operations of the mind while they are asleep, but rather that they are either slow in awaking, so that the mind loses remembrance of what it had been doing while they slept, or else that they lose their remembrance more quickly than most, owing to some difference of mental constitution. It would perhaps be curious to observe whether those who say they do not dream have any special characteristics in common, which would serve to explain this. The entire subject thus raised of the mind's remembrance of its experiences is a curious and interesting one. The common case of temporarily forgetting a name, which we painfully search for in vain, until it suddenly flashes across us while we are thinking of something quite different, is familiar enough, and yet more singular is the ultimate success in recalling a melody, of which all or part has escaped us and evaded us for a long while. It all goes to show that the mind has stored up within it, recollections of various kinds which the will is not always potent enough to summon into consciousness, but which something (probably some, often unsuspected, association of ideas) accidentally recalls. . . . It is essential, however, to realise that dreams have, properly speaking, no being unless they can be remembered when we awake. Without this a dream cannot be said to have occurred in any sense that is humanly speaking intelligible, any more than there can be deemed to be any continuity of the ego, or of the individual existence, except on the assumption that in the future life we are to have remembrance of our being in this.

ROTARY ENGINE.

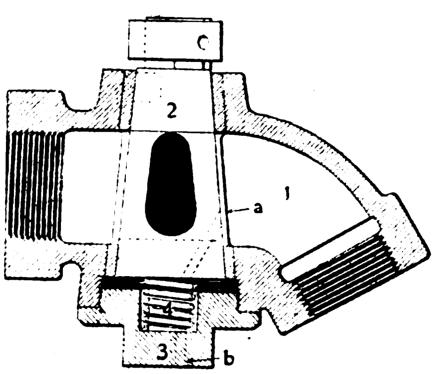
THE rotary engine shown in the annexed engravings differs from the usual designs in that it has an annular steam-space, and a central shaft on which is mounted a radial piston. The valve consists of a sleeve provided with ports, and free to rotate on a stationary shaft in which the admission and exhaust passages are formed. On the main shaft is a drum fitting steam-tight against the ends of the cylinder, and carrying the piston which fits steam-tight against the sides thereof. The fixed shaft and sleeve are contained in a cylindrical valve chest parallel to, and communicating with, the engine cylinder; and the sleeve is furnished with a number of radial partitions fitting steam-tight in the valve-chest, and one of them against the drum on the main shaft, six such partitions being shown on the drawings. Ports are formed in the sleeve



between each pair of partitions; and the fixed valve shaft has in it one admission and two exhaust passages in the form of tapering slots, the latter passages being on either side of the former. The piston gears with the partitions and rotates the valve, one side of it being thus opened to steam, and the other to exhaust. By a partial revolution to the valve-shaft (one-sixth revolution in the example shown), the position of steam and exhaust passages with respect to the piston may be interchanged, and the direction of rotation reversed. A cam device, by means of which the valve may be rotated continuously, instead of intermittently, is shown and described.

A SAFETY ANGLE-COCK.

SOME years ago, writes C. B. Conger, the angle-cock had a small hole drilled through the side, and also into the cavity inside the plug, so that when the angle-cock was shut, the air in the hose would bleed out through this hole, and allow the hose to



be easily uncoupled. In addition to this feature, it also acted as a safety feature; for this opening would let the air out of the hose fast enough to set the brakes on the train in case an angle-cock towards the engine was closed. If the other one, next the rear end of train, was closed, the leak would be enough to call the engineer's attention. But these cocks with the bleed-holes drilled in them soon began to leak so badly that the practice of drilling them was abandoned.

About two years ago, on the Illinois Central Railroad, they made a trial of drilling a ⅛in. hole obliquely down through the plug 2, to let the air from the hose down into the angle-cock cap or spring-box 3, when the cock was closed, another hole being drilled through the cap 3, as shown in the annexed cut, to let the air outdoors.

This plan has proved a success with a two years' trial; none of them leaking through this opening when the cock is open, as was the case when the bleed-hole was in the side of both plug and body of cock. They are used on engines and tenders only, and are not used on freight-cars. They are not patented, and can be used by anyone who wishes to do so.

The annexed cut shows the hole in the plug at *a*, and in the cap at *b*, connecting the hose with the atmosphere when the cock is closed.—*Locomotive Engineering*, N.Y.

ABOUT RIFLES: AND THEIR USES.

THE present war is an object-lesson in the use and effectiveness of the modern small-bore, smokeless powder, magazine rifle. It is, in fact, the first serious war in which white men have been opposed to one another, using this powerful weapon. . . . In war, where men can (theoretically, at all events) be killed every two seconds by one unseen rifleman further off sometimes than they can hear the report of this smokeless, death-dealing triumph of murderous modern gun-making science, it is obvious that marksmanship has not only a far higher scope for its skill, but, artillery and cavalry notwithstanding, there are circumstances where skilled individual rifle-shots are now of enormous practical value, out of all proportion to their other military qualities and to their numbers. This importance must, of course, vary a good deal with circumstances. In volley-firing, for example, preceding the final assault of a position, probably at several acres of enemy or trenches, fine shooting may not be so important. Possibly all that may be required in this sort of work is that the rifle should be fired at rapid intervals more or less in the required direction at elevations given by word of command. The other military qualities of courage, discipline, and determination then became relatively more valuable, and so on till the final bayonet charge carries the day. On the other hand, the entrenched rifleman repelling scattered troops in the open, the member of a surprise party waylaying an enemy's reconnaissance, the defender or "sniper" of an isolated post, is valuable exactly in proportion to his individual powers of marksmanship, every other military quality sinking comparatively into insignificance. . . .

As regards our regular Army, there is good reason to believe that until comparatively recently the opportunities given and time devoted to rifle practice were altogether inadequate. In the days of the Snider and Martini-Henry the average shooting of the British Army was not good. A story is told of a patent bullet-proof coat of mail being sent to Woolwich some years ago to be tested. A squad of soldiers fired ten rounds each at the coat of mail at 200 yards. On inspection, it was found that not a shot had hit the mark. At the Battle of Ulandi, British troops fired for twenty minutes at the thousands of yelling Zulus who attacked them in the open, and killed a certain number. It was subsequently calculated that only one British soldier in every fifteen killed a Zulu at all. In other words, fourteen out of every fifteen of our troops fired for twenty minutes at savages in the open without hitting any of them. There may be some exaggeration in this calculation; it is difficult to verify. But there seems to have been something wrong in a system which could produce results anything at all like this; and the faults, if any, must have been the faults of the system of training, and not of the men themselves. . . .

There are probably many really good marksmen scattered up and down the ranks of our regular, militia, and volunteer forces; and doubtless many of our officers (who till quite lately have never carried a rifle in war) are first-class shots, probably from game-shooting practice. But it is a serious question whether the general average standard of rifle-shooting is as high as it ought to be. It used to be said, and is even now held in some quarters, that it takes the expenditure of a man's weight in lead to kill him in war. If this is or was true, there is or must have been plenty of margin for improvement in the average shooting of troops, and the saying is also evidence of the very low standard of rifle-shooting accepted by some military authorities. No doubt the practical test of a standard of excellence is its comparison with others. On general principles the Transvaal burgher is bound to be a better rifle-shot than the British soldier. His opportunities have been infinitely greater. He was originally taught in the school of necessity, when sometimes his life, and usually his dinner, depended on his accuracy of aim. He lived in a wild, open country where he could practice rifle-shooting from his front door. He has thoroughly learned the lesson of the rifle in the process of killing natives and hunting big game, and may even now be said to be teaching this lesson to us in the sterner game of war. The Western American ranchman and settler, with whom I am intimately acquainted, is another instance of this skill evolved by circumstance. As an example, when the Union Pacific Railway was building through a country west of the Mississippi River swarming with antelope, many Western settlers made a living by supplying railway camps with meat. The skill these men often attained through constant practice was simply marvellous. . . . .

As regards our skilled material, I believe it exists in plenty already in a potential state among the 40,000,000 of population of these islands; but it requires cultivating and organising. It is not credible that a people who produce many rifle-range

shots of the first class (see the number of "highest possibles" recorded every year at Bisley in all the various competitions), whose healthy boast it is to excel in all athletic sports and games of skill in hand and eye, who produce by far the largest number of successful big-game hunters and crack gun-shots of any country in the world, could not also produce a reasonable proportion of mounted military riflemen second in skill of shooting to none in the world. But it is quite possible that our military authorities have not even yet realised the real effectiveness of the modern rifle in a master-hand, and how important it is to enlist and pay and cultivate that skill and effectiveness, and have it ready to hand as and when required.

For the immediate purposes of this war, and so far as our volunteers and yeomanry are concerned, a special sharpshooters' corps would, it is suggested, be a first step towards the desired end. Instead of your crack shots being scattered up and down the ranks of a battalion, let them be detailed as a special company for the battalion, and drawn from the special sharpshooters' corps. The commanding officer could then appoint them for their special work, as opportunity arose, without difficulty or disturbance of the ordinary rank and file. They should be specially equipped in various important details. First, each rifle should be as well fitted as time will allow in length and bend of stock to each individual sharpshooter. Then the pull of the trigger must be carefully considered. The regulation 7lb. pull may be all very well for the ordinary rank and file, to whom the handling of a rifle has not become second nature; but for your crack shot, possessed of special aptitude and skill, this regulation should be amended. The pull is far too heavy. A 4lb. or 5lb. pull is quite compatible with safety. As a matter of fact, I believe the regulation pull is often over 7lb. Each man should also be supplied with the best possible pair of field-glasses, invaluable for scouting purposes; and possibly with a telescope sight. These sights were, I believe, used with great effect in the American Civil War.

Lastly, the standard of markmanship for such a corps should be as high as possible. The power of shooting quickly, as well as accurately, and at unknown ranges, should be fully taken into account. This sharpshooters' corps might be mounted, and the nucleus of it taken from the present Imperial Yeomanry now being formed, of which movement it would form a part. . . . Some system of Saturday afternoon competitions, with prizes, that would appeal to the regular rank and file, might be made more common and popular. The regular course of practice should also include more quick shooting at moving objects and at unmeasured ranges. Special marks of distinction for really first-class shots might also be awarded. It looks as if the Army rifle is now about as good a weapon as science can contrive. It remains for the man whose business it is to use that rifle to be fully educated up to it.—H. SETON-KARR, M.P., in the *Pall Mall Gazette.*

COMBUSTION IN LIQUID AIR.

WHEN air is liquefied, nitrogen and oxygen condense simultaneously, so that the liquid has the composition of the gas mixture in the air. As soon, however, as evaporation recommences, the composition begins to change. At first the escaping gas is essentially nitrogen. After a while the vapours again contain the two gases in the proportions in which they are found in the atmosphere. That point occurs when about 70 per cent. of the liquid has evaporated, and 81 per cent. of the original nitrogen, and 35 per cent. of the oxygen have escaped; the remaining liquid contains the two bodies in equal proportions; afterwards oxygen begins to predominate in the vapours. These numbers concern evaporation at atmospheric pressure. In vacuo, the evaporation of the two gases proceeds more rapidly; at increased pressure, more slowly. The changes may be observed with the help of a glowing chip of wood. At first the wood will be extinguished when held over the liquid, then it will brighten up, and when dipped into the liquid burn intensely. Powdered carbon, soaked with liquid air, puffs away like gunpowder on ignition, and explodes when a detonator cap is employed. This seems very strange when we think of the exceedingly low temperature of the liquid. −180° Cent.; and in a paper brought before the Bavarian Academy of Science, Carl Linde expresses the opinion that we may have to modify our views on the nature of explosions. Petroleum, absorbed by kieselguhr or powdered cork coal, can be saturated with liquid oxygen. Such a mixture explodes even when not confined. Cartridges filled with it cause others, placed at a distance of 25 centimètres (10in.) from them to explode, whilst with the highest explosive so far known, blasting gelatine, cartridges 15 centimètres away from the detonating cartridge remain inactive. Linde has tested this preparation at Schlebusch. Within a steel bomb of 20 litres capacity blasting agents are exploded by means of fulminate of mercury. The gas pressure is registered by a piston on a drum which has a circumferential velocity of 330 centimètres (10ft.) per second. The petroleum-liquid air preparation gives a curve which demonstrates that the maximum pressure surpasses that obtained with blasting gelatine, and is reached in a shorter period of time. The preparation was simply wrapped in paper. It is singular that such a mixture should burn more rapidly, in spite of its low temperature, than any solid or liquid compound we know at ordinary temperatures.—*Engineering.*

LORD RAYLEIGH ON FLIGHT.

THE discourse delivered by Lord Rayleigh, F.R.S., last Friday at the Royal Institution attracted much attention, for the subject was "Flight." In the course of his remarks Lord Rayleigh said that the main problem of the flying machine was the problem of the aëroplane. What were the forces that acted on a plane exposed to the wind? This was also the vital problem of kites, of which he mentioned some of the practical applications by Franklin, Archibald, Baden-Powell, and others; but kites were always anchored to the ground, and as soon as we cast ourselves adrift from the ground the problem became difficult, for it was then necessary to consider how maintenance in the air could be managed. The Malay kite [see No. 1542] was, he thought, one of the simplest, but the best was that invented by Hargrave in Australia—a curious-looking affair, more resembling a skeleton box partially covered with calico than an ordinary kite. It was a very stable machine in the air, however, depending on side vanes which, when the kite got a little out of the wind, tended to bring it back again. [For illustrations see p. 238, No. 1493.] Messrs. Roche and Marvin, in America, had, he said, flown kites to very great heights, as demonstrated by self-recording instruments. The essential question in connection with the kite was the action of the wind on the aëroplane, but it was different with the flying machine, which, unlike the kite, was free and unattached to the ground. Some birds maintained themselves in the air by a vigorous flapping of the wings. Others seemed to maintain themselves in the air with little effort. What was the nature of the "soaring" or "sailing flight" by which a big bird maintained itself with but little flapping of wings? There had been much discussion about this point, often foolish because of misunderstanding between the disputants. However, the science of mechanics enabled it to be laid down with certainty that a bird could no more maintain itself without motion of the wings in a uniform wind moving horizontally than in air at perfect rest. It was entirely a question of relative motion. If, then, a bird was seen to be maintaining itself without flapping it was certain the air was not moving horizontally and uniformly. But there might be rising currents of air upon which it was supported, and these were much more common than was often supposed. In other cases where it was difficult to imagine the existence of such currents an explanation might be sought in the non-uniformity of the wind, for it was mechanically possible for a bird just at the point of transition between two different *strata* of wind to maintain its position by taking advantage of the different velocities. The albatross, he believed, did so. Langley had pointed out how the bird could turn to account the internal work of the wind by taking advantage of its gustiness.

Referring to aëroplanes, Lord Rayleigh said that if a man raised himself in the air, and he was not to fall, something must fall instead of him—that was to say, there must be a downward current of air caused by a screw, and the question was what must be the size of the screw and the work to be done in order that the man might be supported. Mr. Wenham had considered the matter carefully, and had decided that it was impossible for a man, by his own muscular power, to support himself by means of a screw. A bird had an advantage over a man in point of size, and the wings a man would require, if he were to fly with them, would have to be absurdly large. In the same way, the size of a screw would have to be out of proportion to anything that could be managed. Mr. Maxim had said the difficulty was to be got over—that it was only a question of money, and he (Lord Rayleigh) was inclined to agree with him. But even when the problem of flight was solved, flight would not be a safe form of locomotion for a lady going to London for a day's shopping. It was difficult to see how alighting could be made safe, there being always a danger of getting into gusts of wind near the ground.

MESSRS. ROBERT BOYLE AND SON, Ltd., of Holborn Viaduct and Glasgow, the well-known ventilating engineers, have issued a most elaborate catalogue descriptive of their devices as applied to buildings of all kinds, accompanied by the opinions of experts and extracts from the Press. Boyle's system has been in use now for many years, and has practically no competitor. The illustrations show all sorts of buildings, with the various methods of applying the system.

ARTIFICIAL COAL IN GERMANY.

THE United States Vice-Consul at Mannheim states that he has recently assisted at a trial to demonstrate the combustible properties of an artificial coal invented in Germany, and has observed its ready inflammability and its apparently considerable heating qualities. The inventor claims that all sorts of earth may be used for his substitute, with the exception of sand and gravel; but it is thought that only those whose component parts are vegetable or ligneous, as moor peats and turf lands, would be available. The inventor also enumerated, among suitable substances, various kinds of clay; but, in the opinion of the vice-consul, these would probably have to be used as an admixture with the vegetable soil for graduating the heating qualities of the coal. Certain ingredients are mixed with the earth and worked into a homogeneous mass for the purpose of making it inflammable. These ingredients are the inventor's secret; but, since his preparation is intended to have the properties of pit-coal, their nature can be easily guessed. They are to take the place and produce the effect of the bitumen of the mineral article, and must be substances of quick ignition and combustibility, such as pitch, resin, naphtha, or similar products. One hundred kilogrammes (220lb.) of such articles may be bought at Mannheim for about 8s. 4d.; but only 6 to 8 per cent. are required for 50 kilogrammes (110lb.) of the artificial coal. Including labour and general expenses, the cost for the quantity would be, say, 3½d. A tract of land bought lately by the inventor furnishes 50 kilogrammes (110lb.) of earth especially suited for the purpose, for about one farthing; so that 50 kilogrammes (110lb.) of the artificial coal will cost not more than 3¾d. to produce. This calculation is taken from the notes of the inventor. The cheapness will be best illustrated by comparing the prices of the various grades of pit coal, which have run in the last year from 8½d. to 1s. 1½d. per 110lb., at Mannheim. The artificial coal, of a greyish black, is pressed in blocks (briquettes) of three sizes—viz.: No. 1, 7¼in. long, 2¼in. broad, 1½in. thick; No. 2, 6¼in. long, 4in. broad, 1¼in. thick; No. 3, 3¾in. long, 3in. broad, 1¼in. thick. The blocks are hard and brittle, and when thrown into the furnace whole or in pieces, they ignite readily, and burn briskly. The suggestion that for technical establishments blocks of larger size would be desirable was answered with the statement that forms for making 10lb. pieces were already in preparation. The result of an examination of this coal by the technical assayers at Karlsruhe showed that it contained water 14·79 per cent., ashes 17·73, and combustible substance 67·48 per cent.

DIFFICULTIES IN SILVER PRINTING.

THAT much may be done to produce a good print from a faulty negative, by means of dodging in printing as well as submitting the negative to special preparation prior to its being placed out to print, is a fact well known to every photographer who is possessed of even a moderate amount of photographic experience, and it is also well known that, in the hands of an expert printer, many seemingly useless negatives can be so manipulated as to cause really serviceable prints being pulled from them.

The numerous dodges to which printers resort in dealing with faulty negatives are now and again trotted out in the different handbooks and other photographic literature, very much of which all run in the same groove, and too often savour of an amateurish nature, for professional printers know when to keep a good thing up their sleeve quite as well as anyone.

That a deal may be done to improve the printing quality of a negative by subjecting it to one or other of the common everyday dodges, such as the application of ground glass or mineral paper to certain parts of its surface, and also by reducing over-density by any of the well-known methods so generally practised, is a fact recognised by everyone; but, as a rule, all our handbooks and guides to photography stop here, leaving a student to worry over an indifferent-printing negative, and which, in his hands, is never capable of being made to yield anything like the results an expert printer can produce, simply by reason of the fact that the expert printer carries his treatment of a faulty negative a long way further than many might imagine.

During recent years the production of special photographs for reproduction by means of half-tone blocks has caused the utmost attention to be devoted to this branch of photography, and it is quite surprising what is now capable of being accomplished in the way of turning out high-class results from indifferent negatives.

Take, for instance, the case of a dimly-lighted interior, in which a stained-glass window forms a prominent object in the view, the details of which are required to be faithfully rendered as well as the architectural features of the building surrounding

the window, and we have a by no means easy subject to photograph without special means of lighting, only practised by a few expert architectural photographers. Even with their special knowledge of how best to photograph such a subject it is quite ten to one the negative they produce will be considerably improved by after-manipulation. But it is not only in the treatment to which such a negative is subjected that much of the final success in reproduction lies—there is what may be termed an intermediate stage of dodging not only the negative during its printing, but a very clever system of treating the actual print (during the time it may be said to be printing) in such a manner as completely stops the printing of those parts that are being overdone before the denser portions gain a sufficiency of depth. To many not experienced in printing difficult negatives this may appear almost an impossibility; but, as everything is easy when you know how to do it, so such a method of treating a faulty negative gives little thought or trouble to an expert printer.

When it is impossible to produce a fairly even print by means of ordinary printing, one of the most effectual means of gaining satisfactory prints from an uneven negative will be found to consist in subjecting those parts of the surface of the silver prints that are being over-done to a blocking-out operation, performed by applying a suitable water-colour pigment where it is desired to stop any further action of light. Many young printers, although quite appreciating the *rationale* of such a method, fail to understand how it is possible to obtain possession of a silver print so as to apply to its surface such a pigment in as careful a manner as is necessary without the removal of the print from the surface of the negative, and the consequent liability of being unable to register it in exactly the proper position, so as to avoid even the slightest semblance of what is termed movement in a printing frame.

In practice, however, there is no real difficulty in accomplishing such an operation, and, once a printer has ocular demonstration of this treatment of a print, he for all time coming would never think the operation a difficult one.

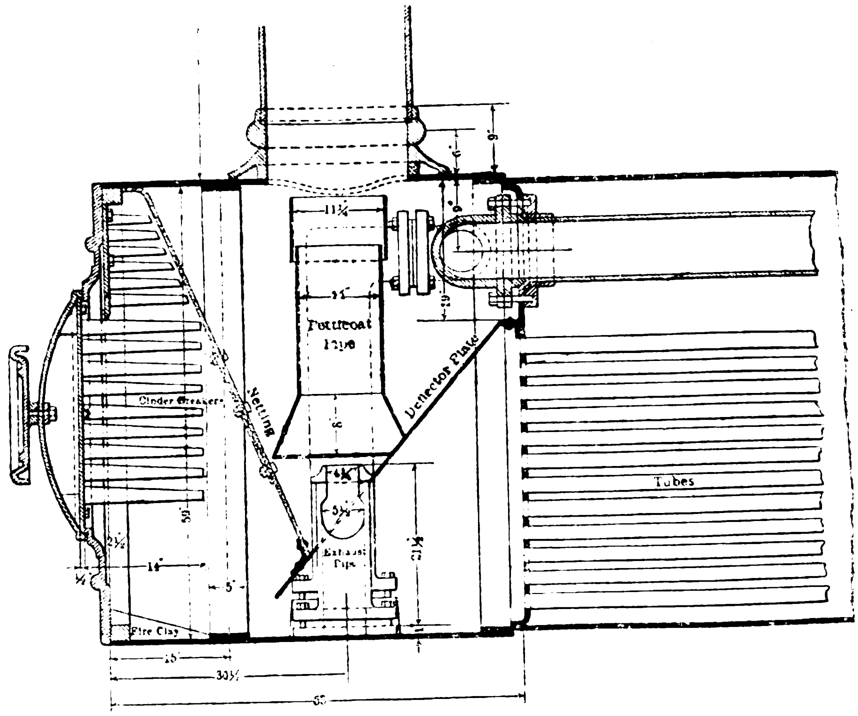
To carry out this seemingly difficult printing dodge, the negatives should be printed in frames a size or two larger than that of the negative itself. This is best accomplished by attaching the negative to the centre of a thick sheet of glass by means of strips of gummed paper, binding carefully round its edges, so that it will not move during the time it is in the printing frame. This done, the negative will be found firmly attached to a sheet of glass having a margin all round its sides. This margin is of service in the way of permitting a sheet of paper being used in printing that is larger in size that the negative, and will enable the side or one end of the printing paper being gummed or otherwise firmly attached to the glass support in such a manner as will permit of the negative and its glass support being removed from the printing frame as often as may be desired during the time of printing, so that the most careful examination of all portions of the surface of the print may be made.

The printing paper being of considerably larger size than the negative permits of the print being folded over. After the negative and its support are removed from the printing frame, when folded over, it enables any water-colour pigment, such as gamboge, or ivory, or lamp-black being carefully painted over the very finest part that may require to be stopped off from further printing, and, when the pigment is dry, the print is merely folded down in contact with the surface of the negative again, with the certainty of being in perfect registration. Of course, the application of the pigment is best conducted under a good lamp, such as a powerful paraffin table lamp would yield in a darkened room. This prevents any degradation of the paper during inspection and manipulation. The painting of an opaque pigment on the surface of a silver print will cause no evil effects to the print, for the pigment will wash off in the first washing water, and the toning operation proceed as usual, and there is also no difficulty in tracing over the minutest outline if merely an ordinary amount of care be taken, and a suitable brush employed.

By this means an expert printer is possessed of almost unlimited power in the production of single as well as even combination prints. Faulty backgrounds being blocked out in the negative will enable any portion of a picture being printed on one negative to any extent, and, this being blocked off on the surface of the print, may then be removed to another negative, and quite a different background printed in.

The secret of success lies in so attaching the print to the surface of the glass support that the entire surface of the printing-paper is capable of being got at without the possibility of the image showing any movement from the surface of the negative when readjusted.

To many this method of printing a negative may be considered difficult. In practice, however, it is quite easy of accomplishment, and, once practised, can be made to yield quite a number of particularly fine prints from negatives that would by many be discarded as unprintable.—T. N. ARMSTRONG, in *British Journal of Photography.*



COBURN'S SPARK BREAKER.

WE present herewith a cut of the arrangement applied to the front ends of the locomotives on the Chicago, Indianopolis, and Louisville Railway, the Monon route, to break up and pulverise the cinders, so that when they finally get to the ground after leaving the top of the stack, they will be too small to do much damage by setting fires. The front-end deflector plate, nozzle, and petticoat pipe are of the Master Mechanics type, with a low nozzle. It is shorter than usual. Between the netting and front door in this space are a series of fingers, cast on a plate, extending close to the netting. These fingers are 14in. long at the bottom and shorter near the top. The effect of the draught dashing the live cinders against the fingers is to break them up and kill them. Two years' trial has demonstrated the value of this device in reducing the fire claims of the road over 80 per cent. It is patented by W. P. Coburn, master mechanic.—*Locomotive Engineering*, N.Y.

THE LANCASHIRE PLATEWAY.

AT the Walker Engineering Laboratories, University College, Liverpool, Mr. Alfred Holt, M.I.C.E., read a paper last week on the proposed Lancashire Plateway—a scheme which has occupied the attention of the commercial community of Lancashire for some time. Prof. Hele-Shaw was in the chair, and Mr. Holt explained at the outset of his paper that though it referred to the "Lancashire" plateway, it was really a paper on the system, which seemed to carry with it nothing less than an entire revolution in inland carriage. Having glanced at the mercantile necessities which gave rise to the idea, and also originated the Manchester Ship Canal, he said the basis of the plateway was simply a railway suitable for a smooth-tired wheel. Ordinary railway traffic might traverse the plateway metals, which formed, in fact, as good a railway as any other; and that being so, it would be advisable that the new system, if ever introduced, should be on lines to escape some of the present railway disabilities, such as the cramped loading gauge. This should be a foot wider on each side, and 1½ft. or 2ft. higher overhead; some other countries had a great advantage over England in that respect. Also, everything should be suitable when used as a railway for much heavier loads than at present carried, 40 tons in the way of minerals, metals, corn, &c., being often carried in one waggon in the United States, and economy resulted. Having demonstrated (1) the identity of the rolling conditions of the plateway and the railway, and (2) the fact that the plateway is a railway, Mr. Holt said it would be apparent what an unfortunate name plateway was, for of plate there was not a vestige. A better name would be "Railway suitable for vehicles with both flat and flanged wheels," and the word "Barway" had been suggested, which was not bad. So long as the engine kept on the metals, which having flanged wheels would always be the case, it did not much matter if the lorries occasionally ran off. The vehicle was proposed to be the ordinary four-wheeled lorry. If suitability for moving goods was to be taken as a test, and surely there could be no better, it was a long way ahead of the railway waggon. The differences between them were in the main two: (1) In the lorry the fore wheels lock—that is to say, are attached to an under carriage—which supports the fore end of the load, and is capable of being turned to any angle with the vehicle. (2) All the wheels are loose on stationary axles. On railways the wheel is fixed on the axle, and both revolve together. As the system could not be considered to meet the necessities of the case unless trains as long as those on a railway could be made up, he explained that the proposed coupling method was not dissimilar to that adopted in coupling road trucks behind a traction engine. Having only proposed a speed of ten miles an hour, spring buffers were probably unnecessary. The practical mode of carrying goods by the plateway would be as follows: The lorry, being loaded at the ship's side or warehouse in Liverpool, would be horse-drawn, exactly as at present, to the nearest plateway lines, placed on them, if convenient, or, at any rate, near to them; the long horizontal shaft bolt would be withdrawn, and the horse would be driven off, carrying the shafts with him. The iron coupling frame would then be unhooked from under the fore body of the lorry, and one end of a rope made fast to it, the other end carried either to the hinder part of the engine or of the preceding lorry, or else taken to a live capstan, and by one of these means the lorry would be pulled into position, the short vertical coupling bolt would be dropped in, and the transformation would be completed. Mechanical traction by steam, or preferably by electricity, would then convey it as part of a long train, say, to Manchester, where horses, which would be standing waiting, having brought other lorries for Liverpool, would be led up, the coupling frame would be again hooked up under the fore body, the shafts attached, and the lorry again horse-drawn to destination at either mill or warehouse, its load never having been touched. Probably between Liverpool and Manchester, where there is an enormous traffic, the road would ultimately come to be paved the whole way. Horse-drawn traffic would then come on anywhere, run on the metals five or ten miles, and then drawn off. Lord Derby would dine at the Liverpool Town Hall, and go home to Knowsley in his carriage, using the plateway. The slow plateway claimed over moderate distances to deliver in less time than the speedy railway. Mr. Barcroft, of Newry, noticing his (Mr. Holt's) project, built a plateway of about three miles in length from Newry to Bessbrook some fifteen years ago. The line was, he believed, still at work. Regarding the public advantages of the system, it had been pointed out how it would affect the Lancashire trade; but there was a greater interest it would affect in a greater degree, and that was agriculture. Railways had never helped the farmer: the merest fringe of his requirements had been touched. Owing to the difficulty of carrying hay, for example, its price had been known to differ 20s. a ton in places 30 miles apart with a railway between them. Then why should great coal-yards like those at Crown-street exist? It was to be hoped that the plateway system would develop as a road trust, while lorry-hiring companies would come into existence with

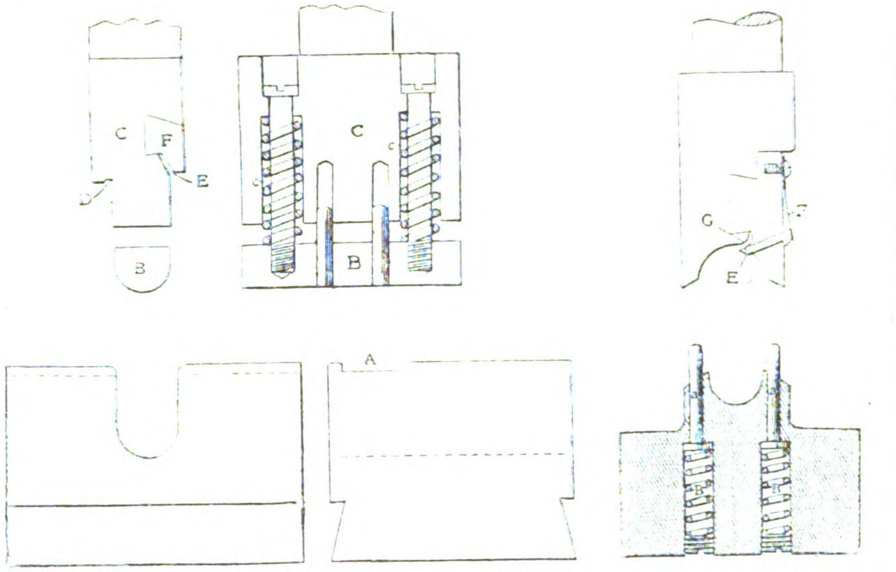


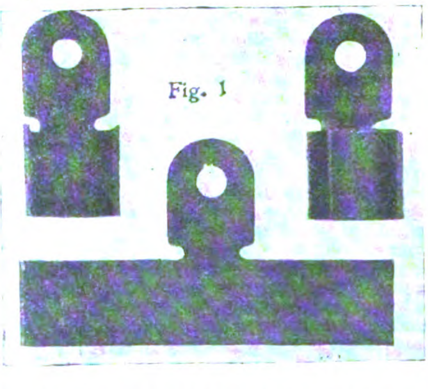
Fig. 2

Fig. 3

depots up and down the country at which they would keep standard lorries for different classes of traffic. He concluded by a short recapitulation of the points he wished to make. They were:—(1) That railways attained their remarkable success over previous methods of land carriage by the adoption of two novelties—(a) The metal pathway; (b) mechanical traction; and from their combination resulted almost the cheapest known method of moving goods. (2) That both are equally applicable to vehicles with flat as with flanged wheels. (3) That flat wheels can also traverse the ordinary roads, which flanged wheels cannot. (4) That, therefore, handling is saved, which has been demonstrated to be the largest component part of the cost. (5) That the plateway system which avails of these is in the present state of mechanical knowledge the *ne plus ultra* for cheap and undamaging conveyance.

SPECIAL BENDING-DIE.

OF the different classes of dies in use for the press working of sheet metal, probably there is none that taxes the skill and inventive powers of the mechanic more than those commonly known as bending-dies. There are rarely two alike; the one you are working on usually differs in some respects from all previous designs; each punch and die is a law unto itself, and after completion it is dismissed from one's mind, to be followed by something new.



The peculiar or special feature of each job, however, is generally recorded in the notebook of the up-to-date die-maker for future reference.

The accompanying sketches show two punches and dies that we have recently made, to bend a piece of flat copper 2¼in. long, ⅛in. wide, and ·025in. thick, into a circular form with an irregular contour and overlapping ends, the outside one being flared outward at the extremity. A sample blank and the two stages of the bending operation are shown in the half-tone, Fig. 1. On one side of the blank, almost in the middle, will be seen a projecting part, that, according to the specifications, must be flat, and unaffected by the bending operations, and also central with the loop.

Following the regular experiments to ascertain the size and shape of blank required, the piercing and cutting die is made, and requires no description here.

Fig. 2 is a sectional and front view of the punch and die for performing the first bending operation, which comprises the bending of the ends up, not unlike a letter U, with the highest end turned inwards, the bend being about $\frac{1}{16}$in. from the top. The blank is placed in the recess A, Fig. 2, which acts merely as a gauge for locating it sideways; stops for the ends are ⅛in. pins, not shown. The work is brought well forward, to allow the projecting part to stand out over the front of the die, to avoid bending when the other part passes down into the die. The downwardly-extending portion B of the punch is held stationary by the coil-springs, C C, until it comes in contact with the bottom of the die. As the ram of the press continues on the downward stroke the notch in the shoulder at D strikes the end of the work on that side, and forces it down to its proper height, thus securing uniformity. At the same time the opposite end of the blank is passing into the slot E, and bending inwardly. F is a dovetailed piece, to facilitate the making of the slot E in the punch.

It is a good plan in this case to locate in the bottom of the die, in rear of where the work comes, a strip of sheet metal or a rigid pin, the same height as the thickness of the stamping, to permit the punch to rest on. This will prevent a hard pressure on the work, and allow it to slide round under the punch and avoid buckling when the shoulder at D presses on that side to correct the height.

Fig. 3 shows the closing punch and die. Following the first bending operation, the work is located on the die between the two pins, A A, that hold it in its proper position for closing. The pins are supported by slender coil springs, B B, which are regulated by the headless screws below them. Screwed and dowelled onto the middle front of the die is a small block of cast iron, not shown, with two pins, one on each side, to guide the pivoting part on the work during the closing of the circle. On the descending movement of the punch the pin E gives a slight pressure on the work, and causes the end, that has been previously bent in at its extremity for this purpose, to pass on the inside. The pin is retained in position by the flat spring F. As one end of the stamping goes down on the inside, the opposite one follows along the punch until it comes in contact with the upper surface of the pin E, when it is forced to pass up into the groove G, and bent outwardly. The use of a round arbor is necessary in this operation to size the circle in the work.—DIE MAKER, Lynn, Mass., in *American Machinist.*

MESSRS. ROSS, Ltd., of New Bond-street, W., send some useful catalogues of their productions—telescopes, microscopes, and of binocular glasses. The latter are just now much talked about; but, as all students of the question are aware, there are no more powerful glasses of the kind than can be supplied by Ross, Ltd.

M. PICARD, Commissioner-General of the Paris 1900 Exhibition, has been informed by the president of the jewelry section that an enormous diamond from Kimberley will be exhibited in the jewelry pavilion. The stone was found shortly before the war. It has been insured for £400,000, and will be shown in a showcase guarded by four policemen. At night the showcase will sink into the ground in the same way as that in which the Regent is kept at the Louvre. The new diamond is said to be finer than the Regent, the Shah, the Grand Mogul, and the famous Koh-i-nor.

SCIENTIFIC SOCIETIES.

ROYAL METEOROLOGICAL SOCIETY.

THE annual meeting of the society was held on Wednesday evening, the 17th inst., at the Institution of Civil Engineers, Great George-street, Westminster, Mr. F. C. Bayard, LL.M., president, in the chair.

The secretary read the report of the council, which showed that the most noteworthy event in connection with this society had been the removal of the offices and library from 22, Great George-street to new rooms at 70, Victoria-street. This step was rendered necessary by the acquisition of the former premises by the Commissioners of Her Majesty's Works and Public Buildings for the erection of new Government Offices.

Mr. F. Campbell Bayard, in his presidential address, discussed the meteorological observations made at the Royal Observatory, Greenwich, during the fifty-one years, 1848-1898, and brought out in a novel way many interesting features in the variability of the different observations of the barometer, maximum and minimum temperatures, relative humidity, direction of the wind, and rainfall. These were shown in a diagrammatic form on the screen by means of a number of lantern slides. The address was also illustrated by various views of the Royal Observatory and of the instruments employed. Mr. G. J. Symons, F.R.S., was elected president for the ensuing year.

QUEKETT MICROSCOPICAL CLUB.

THE 374th ordinary meeting of this club was held on Friday, Jan. 19, at 20, Hanover-square, W., Dr. J. Tatham, president, in the chair. After the usual formal business, the list of nominations made by the committee was read as follows:—For president, Mr. George Massee, F.L.S.; for vice-presidents, Messrs. Tatham, Waller, Michael, Nelson; for treasurer, Mr. H. Morland; for editor, Mr. D. J. Scourfield; the other officers as before. Messrs. Allen and Chapman were elected as auditors. Members were nominated to fill six vacancies on the committee. The death of Mr. W. T. Suffolk, treasurer R.M.S., was referred to, he having been one of the earliest members of the club, and taking an active part in its proceedings for some years.

Mr. Nelson exhibited and described three so-called "compass" microscopes, fitted with Coddington lenses, and said to have been made for the late Mr. J. Newton Tomkins.

Mr. Rousselet read "Notes on some Australian Lacinulariæ."

A short paper "On the Minute Structure of some Diatomaceæ from Corica Bay, Melbourne," by Mr. A. A. Merlin, was, in the author's absence, read by the secretary.

Mr. Karop gave a brief account of some recent biological observations and other matters of scientific importance.

Votes of thanks were passed for these several communications, and the proceedings terminated.

The next meeting, which is the annual general meeting for the election of officers and other business, will be held on Friday, February 16.

Trees Struck by Lightning.—Under this title, Mr. Howard B. Little, in *Knowledge* for January, discusses some remarkable cases of trees shattered by the dread stroke, for particulars of which the original article should be consulted, but we may quote here a single passage:—"P. de Jersey Grut gave particulars of a case which is perhaps more interesting than any yet cited. In this instance the tree struck was encircled by a rope some 25ft. from the ground, and it so chanced that an end of the rope stood out from the bark of the tree, so that during the earlier part of a rainstorm the tree was damp from the top to the rope, while the lower portion of the trunk was kept comparatively dry. The tree in this condition was struck, the lower part only being damaged. And the damage followed, downwards, a path which the twist in the fibre of the wood made easiest."

THE effects of wire-drawing and annealing on the stress-strain diagram of steel wire have been studied by Mr. A. D. Keigwin, and the results given in the *Proceedings* of the Institute of Civil Engineers. The conclusions are:—(1) Steel when wire drawn has its breaking load increased. (2) When the wire is annealed, the breaking load is lowered to that of the billet from which the wire was drawn; in this case an average reduction of 39 per cent. (3) The ratio of yield point to breaking load—36·7 and 31·8 per cent. for unannealed and annealed wires respectively—is lowered. (4) The ratio of the extensions at yield point and at breaking load in unannealed wire—viz., 0·25 to 0·75 per cent., is increased by annealing to 0·25 to 5 per cent. (5) The reduction of area of break is increased 16 per cent. by annealing. (6) The mean stress-strain diagram for annealed wires is a parabolic curve.

SCIENTIFIC NEWS.

THE elements and ephemeris of the new minor planet known as 1899 E Y are given by Herr O. Knopf, of Jena, in *Ast. Nach.* as M 345° 32′ 15·3″, ω 3° 32′ 19·9′, ☊ 39° 46′ 43·3″, *i* 15° 22′ 20″, epoch 1900, Jan. 0·0, Berlin M.T. The ephemeris for Berlin M.T. 12h. is on Feb. 3 R A. 4h. 11m. 19s., N. Dec. 19° 1·9′.

The Spanish Government will make the best possible arrangements at the Madrid Observatory for the reception of foreign astronomers who will come to observe the eclipse of the sun on May 28. Nevertheless, says a Reuter's telegram, other places are better adapted for the purpose, as, for example, Naval-Moral, two hundred kilomètres from Madrid on the Caceres Line, because at that place the eclipse will be total for two minutes. Several foreign astronomers have expressed their intention of coming to Spain to witness the eclipse.

For the larger number of those who desire to observe, the convenience of getting to the best spots is the chief consideration, and probably nothing could be better than the arrangements made by the British Astronomical Association, the vessel calling at Cadiz, Alicante, and Algiers, the former place for those desiring to pay a visit to Central Spain. Hotel accommodation has to be considered, but vessels touching at Oporto would suit some observers, as the line of totality passes close (at Oveiro); but there are reasons why Oporto will not be chosen, except by those who may have business there at the time.

The 67th *Annuaire* de L'Observatoire Royal de Belgique (Brussels: Hayez) has been issued under the direction of MM. A. Lancaster and L. Niesten. It contains the usual calendars and tables, statistics of various kinds, and several articles which are of interest to astronomers.

M. Poincaré has been awarded the gold medal of the Royal Astronomical Society for his researches in celestial mechanics.

The following note may be of interest to those who study the effects of the sunspots and of the moon on the weather. Mr. T. F. Summerhayes writes from Dominion Bank Chambers, Toronto: "A letter appeared in the *Times* in December from Mr. Payne of the Meteorological Office, Toronto, to which you append the following:—'We gladly print Mr. Payne's letter to show that "Our Lady of the Snows" is a title that cannot be applied, at any rate to that part of the Dominion from which he writes.' By the same post I received a letter from the North-West Territories in which the writer says 'We have not even enough snow to be able to use the sleighs.' Apparently the title cannot be applied there either. It is an interesting addition to Mr. Payne's facts that the bushes surrounding Trinity College Buildings, Toronto, were in the middle of December budding again, and had lectures lasted another week I should probably have been able to say they were in leaf. Although a heavy snowstorm has blocked traffic in England (Dec. 11), we have had no snow worth the name. I may say, however, that the lack of snow is likely to seriously hamper the farmers and lumbermen. The former need snow to protect their fall (i.e., autumn-sown) wheat from the frost: the latter to haul their felled trees over the otherwise uneven ground to the river banks." It may be noted that it was only in parts of England the traffic was blocked.

The Geological Society will this year award its medals and funds as follows:—The Wollaston Medal to Prof. G. K. Gilbert, of Washington; the Murchison Medal to Baron A. E. Nordenskiöld, of Stockholm; the Lyell Medal to Mr. J. E. Marr, of Cambridge; the Wollaston Fund to Mr. G. T. Prior; the Murchison Fund to Mr. A. Vaughan Jennings; the Lyell Fund to Miss G. L. Elles; and the Barlow-Jameson Fund to Mr. G. C. Crick and Prof. T. T. Groom.

At the Royal Institution, to-day, the Hon. C. A. Parsons, M.A., F.R.S., is to deliver a discourse on "Motive Power—High Speed Navigation—Steam Turbines." On Friday, Feb. 2, Signor Marconi is to deliver a discourse on "Wireless Telegraphy."

At the Tuesday evening meeting of the Applied Art Section of the Society of Arts, Jan. 30, a paper on "Niello Work," by Mr. Cyril Davenport, will be read. The paper on the Wednesday evening meeting, Jan. 31, will be by Sir Martin Conway, M.A., on "The Undeveloped Resources of the Bolivian Andes."

Our readers will regret to hear of the death of Prof. David Edward Hughes, F.R.S., the famous inventor of the type-printing telegraph and of the microphone. He was born in London, May 16, 1831, but spent much of his earlier manhood as professor of music at Bardstown, Kentucky. In 1855 he patented the type-printing telegraph, and brought it to this country, where it met with a cold reception; but the French authorities saw its advantages, and honours soon began to be the reward of the inventor. In 1878 Prof. Hughes described to the Royal Society his invention of the microphone, and, as our readers may remember, a lively discussion was carried on in these pages by Mr. Edison, Mr. Preece, and Prof. Hughes. The deceased inventor was awarded the gold medal of the Royal Society and the Albert Medal of the Society of Arts.

The death is reported from Florence of Mr. John Bernard Stallo, of Cincinnati, in his seventy-sixth year. He was formerly Ambassador of the United States at Rome during President Cleveland's first term of office, but since his retirement has resided at Florence. He was well known as a philosopher, mathematician, and physicist.

News from Cracow states that M. Kostanecki, assistant doctor at the bacteriological institute there, has died with symptoms of plague. A later telegram states that an investigation has revealed the presence of a very infectious form of streptococcus.

Signor Manfredo Camperio died at Naples recently, in his seventy-fifth year. He was originally a Sardinian cavalry officer, but after his retirement he founded the Italian Society for the Commercial Exploration of Africa, and became well known as a geographer and traveller.

Prof. William Hauchecorne, principal of the Berlin Academy of Mineralogy and chief of the Prussian Geological Survey, died last week at the age of sixty-eight. He was the author of several works on metallurgy.

In a memoir presented to the Paris Academy of Sciences by Mme. Sklodowska Curie it is stated that there is a difference of a fundamental nature between those rays of radium which are deviated by the magnet and those which are not. The latter, it appears, are more easily absorbed the greater the thickness of the material they have passed through, while the deviable rays have a coefficient of absorption which either decreases or remains constant—a singular phenomenon in absorption different from other known radiations.

The Paris Academy of Sciences have elected M. Zeuthen, of Copenhagen, and M. Peron, of Auxerre, as correspondents in the room of the late M. Lie and M. Matheron.

Some very definite opinions were expressed last week before the Departmental Committee on Preservatives and Colouring Matters in Food. Prof. W. H. Corfield, consulting sanitary adviser to Her Majesty's Office of Works, said he had found salicylic acid in the lighter wines—British, for instance—and the lighter beers. It was a slightly acrid, irritating substance, which was used externally for the removal of corns and warts. He knew it did that. It was a most undesirable article to put in food. He advocated the prohibition of both boracic acid and salicylic acid, unless it was clearly shown that the drug was perfectly harmless in any quantity in which it was possible that it could be added. Mr. Walter Collingwood Williams, a public analyst for a number of Lancashire authorities, said he had found salicylic acid in a number of temperance, non-alcoholic drinks. In ginger wine there was from 49 to 113 grains per gallon, in raspberry wine from 87 to 133 grains per gallon, in orange wine from 94 to 106 grains per gallon, and in black-currant wine from 47 to 140 grains per gallon. He also found it in lemon-squash and lime-juice. The use of boracic acid in new milk is strongly objected to by many of the witnesses, as that kind of milk forms a large part of the food of invalids and children. The chairman of a firm of well-known jam manufacturers said they never used preservatives, but they did use cochineal as a colouring medium for jams.

It has been stated that Signor Marconi has satisfied himself that he can utilise his system of wireless telegraphy over the greatest distances, and now it is announced that Signor E. Guarini, of Puglia, can do the same. He is quite a young man, and has studied electricity with much ardour. According to such accounts as have been published, his invention is called a repeater, which receives the electric waves and is capable of transmitting them to other repeaters for continuous repetition. There need only be a repeater at every five-hundredth mile in order to establish communication with any given point of the surface of the earth. One of the many contemplated applications of Guarini's repeater is its use in future Polar expeditions, the commanders of which will, it is claimed, be able to maintain constant communication with home.

Similar statements are made in connection with the name of M. Nikola Tesla, who is reported to have completed his experiments, and to have satisfied himself that he will be able to communicate from New York with every city in the world. He hopes, it is reported, to "attain a speed of from 1,500 to 2,000 words a minute."

Experiments have been made with wireless telegraphy between Chamounix and Mont Blanc, and they have been recently described by MM. Léon and Louis Lecarme before the French Physical Society. As previously mentioned, there are great, if not insuperable, difficulties in achieving complete success, though the experiments gave satisfactory results. The brief account is published in the *Bulletin* of the Society, and the principal difficulties are—the difference in altitude between the two stations, the influence of cloud layers, the intense electric phenomena which occasionally occur at high altitudes, and the effects produced by the three-phase currents employed in the lighting installation at Chamounix. It is proposed to utilise those currents in future experiments.

According to a report coming from Sheffield, the corporation, after spending many thousands of pounds on their overhead electric tramways, are about to experiment with the invention of a Sheffield man to improve surface and contact system of electric traction, which, if successful, will abolish overhead wires and street standards. First and second-class car fares will be recommended for adoption shortly, on the ground that well-dressed people object to sit next to working men who are grimy after their day's toil.

Amongst the electrical railway schemes to come before Parliament in the session is one for the construction of an electric express line between Manchester and Liverpool. The proposed capital is two millions sterling.

The electric railway in the Isle of Man, between Douglas and Ramsay, has been fitted with hydraulic plant for working during the winter months, when there is comparatively little traffic. The works are at Laxey, where the famous water-wheel is a sight for tourists.

Mr. J. B. Carruthers, F.L.S., has been selected by the Colonial Secretary for the appointment of mycologist to the Government of Ceylon, and assistant-director of the famous botanical gardens at Peradeniya. The post has been created in order that the diseases of economic plants in the island (e.g., coffee and tea) may be thoroughly investigated.

At a meeting of the British Ornithologists' Club last week, Dr. R. Bowdler Sharpe exhibited some interesting views taken during a recent trip to Norway, one of the greatest interest being a brood of young woodcocks showing the striped down. Mr. Walter Rothschild, M.P., exhibited some views taken by one of his collectors in the island of Laysau. The first showed a number of albatrosses of a new species, which he has named *Diomedea immutatus*, from the fact that the plumage of the young, contrary to what is usual, resembles that of the adult. He also exhibited a picture representing the wholesale fashion in which the eggs of the albatross are collected—a number of railway waggons drawn up, and a band of men loading them with eggs, which are used as food.

Amongst the schemes for utilising fish is one for establishing a sturgeon fishery at the mouth of the Garonne, which is one of the rivers frequented by the sturgeon. The principal object is the production of caviare (the salted roe), but no doubt the flesh of the sturgeon will be prepared for the market in some way.

Australian papers give accounts of an unprecedented plague of cuttlefish that has been for a time entirely upsetting the fishing industry in North Australian waters. It is reported that the creatures are swarming in such numbers that hundreds are brought up in a single haul of the

nets. As the haul is drawn up they cling with their tentacles to the under side of the boat, and have to be disengaged with axes, so that large quantities of tackle have been destroyed and many boats injured. They range from 15lb. downwards in weight, and their appearance in such huge numbers has been as sudden as it has proved unpleasant.

A trial of the Laffas system of preventing railway accidents by applying the brakes automatically was made last week at Barry. The testing train consisted of an engine and nine coaches, weighing altogether about 160 tons, and the first tests were on the down slope of a slight incline. At a speed of 20 miles an hour the train, after contact with the Laffas block, stopped in 146 yards, at 30 miles in 200 yards, at 35 miles in 210 yards, and in a fourth test at 30 miles speed, steam being kept up, the train stopped in its own length. On the flat at a lower speed the train stopped in less than its length. The apparatus may be briefly described as a block placed in the 4ft. way, and set by the signalman. It has a curved surface, which, when the signal is standing at danger, is so raised that a rod with a little wheel makes contact and actuates the valve of the air brake placed either on the engine or on one of the coaches. Further experiments are to be made.

USEFUL AND SCIENTIFIC NOTES.

THE gold yield of Victoria for the year 1899, amounted to 854,500oz., being an increase of 17,242oz. as compared with the preceding year.

Magnesium Paper.—The following method of making magnesium paper may be useful to some, as it is easily carried about, and the intensity of the illumination may be regulated by the quantity of paper burnt. Two sheets of paper should be coated with starch paste, and then dusted with powdered magnesium, and the two surfaces pressed into contact. Two sheets are also prepared in a similar manner with powdered chlorate of potash, and then pressed on the outside of the magnesium sheets.

THE aggregate rainfall during the year just closed was deficient over the whole of England, the deficiency amounting to 6in. in the Channel Islands, 5in. in the south of England, and 4in. in the east and south-west of England. There was a slight excess in most parts of Scotland and Ireland. The mean temperature for the year was in excess of the average over the whole area of the British Islands, the excess being greatest over the southern portion of the kingdom, although it was also very large in the north of Scotland. There was an excess of sunshine over the entire country, amounting to about 350 hours in the south of England, and exceeding 200 hours over the whole of England, except in the north-eastern district. In Ireland the excess was about 150 hours, but in parts of Scotland it was not so large.

Polyphase Electric Generators.—The polyphase alternating current system is specially adapted to the distribution of light and power from central stations, and polyphase generators are being largely introduced for this purpose. The Westinghouse Company is bringing out some improved belted generators of this type, with high efficiency and close regulation of potential. They are wound to deliver either two-phase or three-phase currents. The lower half of the field and the supports of the bearings constitute a single casting. The pole-pieces are of soft laminated steel, cast into the field yoke or frame. A special grade of soft steel is used in the armature coil, and the construction is such as not to injure the steel, which would increase the losses due to magnetisation. The armature coils are held in slots by wedges of hard fibre, driven parallel with the shaft. No band wires are used, and the field and armature coils are wound upon moulds or formers. In the machines of 220 and 440 volts the armature conductors are copper bars, held in place by the overhanging tips of the armature teeth. The bars are united into a common winding by suitable end connections. The armature winding is of the closed circuit type. In the two-phase generators connection is made to the winding at four points, an insulated conductor conveying the current from each of these points to one of the four collector rings. In the three-phase generators there are three points of connection and three rings. On all sizes smaller than 180 kilowatts the fields are composite wound. The current which passes through the auxiliary field winding is not the high potential current generated in the armature. It is a low potential current derived from the secondary of a series transformer, consisting of primary and secondary coils wound upon the arms or spokes of the armature coil. The small commutator used to rectify the derived secondary current which excites the auxiliary field coils is carried upon the armature shaft.—*The Engineer.*

LETTERS TO THE EDITOR

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

THE CIVIL AND ASTRONOMICAL DAY —CALCULATOR OF EPHEMERIDES— THE LUNAR RAYS: A NEW THEORY —JANUARY 0·0—FIELD ARMOUR— ANSWERING WITH A PASTE-POT AND A PAIR OF SCISSORS—TELESCOPE—NEW MOON IN FEBRUARY— THE REPORT OF THE SUPERINTENDENT OF THE UNITED STATES NAVAL OBSERVATORY FOR 1899— THE YEAR 0—IS 31M. ANDROMEDÆ STELLAR?—THE MOON AND THE WEATHER—APERTURE AND FOCAL LENGTH—EVIDENCE OF INSANITY (P) —DOUBLE STAR IN CETUS—LUNAR DISTANCES — BE-DEWED OBJECT-GLASS — SEPARATING POWER: EQUIVALENT LENS AND DECREASE OF FIELD OF VIEW—THE BRITISH ASTRONOMICAL ASSOCIATION— ALTITUDE AND AZIMUTH.

[43244.]—THERE is surely some curious mistake in the first paragraph of your "Scientific News," on p. 490. I have just seen the latest volume of the *Connaissance des Temps*, in which, as in the *Nautical Almanac*, the day is reckoned—as it always has been—from noon to noon. An attempt which was made, unofficially, some few years since, to assimilate the astronomical and civil modes of reckoning (i.e., from midnight to midnight) fell through entirely.

In case "Ell Hay" does not reply to one query which "Neptune" puts in letter 43190 (on p. 493), I mean that concerning the calculation of the ephemerides of the Satellites of Jupiter, Saturn (Uranus), and Neptune, I should like to say that such ephemerides are computed, one and all, in the *Nautical Almanac* Office, those of Jupiter's Satellites from Damoiseau's tables (now 64 years old!), those of the Satellites of Saturn from Prof. Newcomb's MS. tables, and the elongations of the Satellites of Uranus and Neptune from Newcomb's "Uranian and Neptunian Systems." But "Neptune" must forgive me for pointing out that he is labouring under a slight mistake in his assumption that these ephemerides were calculated by the late Mr. Albert Marth. What that wonderful computer used to produce were ephemerides for physical observations of the planet Jupiter itself, of Mars, and of the Moon, &c., and in this he has a most worthy successor in the person of Mr. A. C. D. Crommelin, F.R.A.S., of the Royal Observatory, Greenwich.

When "Mark" (letter 43197, p. 494) was reading the account of the liquefaction of atmospheric air by intense cold, he somehow seems to have skipped that part of the description of the process which refers to the simultaneous stupendous *pressure* of 300 atmospheres, or so, being employed to produce the liquefaction. Now the mass of the moon is only $\frac{1}{81 \cdot 7}$ that of the earth, and one would be a little curious to know whence "Mark" gets his pressure?

Mr. Watson (letter 43199, p. 495) is quite right in his assumption that January 0 in *Nautical Almanac* (*loc. cit.*) does mean December 31, 1899, because January 1 does not begin astronomically until the Greenwich Mean Noon of that civil day, and for purposes of calculation it is simple and convenient, not to say absolutely necessary, to employ a zero, even if, as in this case, it is merely an artificial one. As for the use of the 0 on p. 592, it must be remembered again that the object of the table there given is to enable the number of *days* which have elapsed at mean noon at any given date since January 1, 4713 B.C., and for this purpose 1 B.C. followed by 1 A.D. would involve an obvious muddle by introducing one year, or 365 days, too many in reckoning from, say, January 1, 13 B.C., to January 1, 1802 A.D., which interval is really 1,814 and not 1,815 years, and so on. But I fail to see that the 1900·0 has any different meaning on pp. 1 and 290—*et seq.*; for, taking the first page as an illustration, we find that from 1900·0 to the noon of January 1, 1900, the precession in longitude = 0·69", which, assuming 1900·0 to be = 1900, January 1 noon, is absurd.

"W. B.'s" suggestion (in letter 43204), p. 496, is Delicious (with a capital D). Tommy Atkins is to be got up in greaves, and to have to toil up steep hills, with a shield, at the rate of three miles an hour! Moreover, he is to be attended by his rear-rank man, who is to carry his rifle—for all the world like a keeper who follows with one's second gun at a battue. Does it occur to "W. B.," *in limine*, that this would involve the doubling the numbers of our troops, and necessitate the despatch of, say, 100,000 men to do the work of 50,000. As in the case of Mr. Lawler, it is abundantly evident that your correspondent's military knowledge might almost be algebraically described as a − quantity.

I could not help laughing at letter 43225 (on p. 512), when I read that Mr. Lawler's shields were "actually receiving the practical attention of . . . a man who has had more to do with wholesale manufacture of armour-plates than"—anyone Mr. L. knows! "There is nothing like leather." I spoke merely from a practical point of view, and can assure Mr. Lawler that he is labouring under a very curious delusion when he imagines that "Shields would have taken us to Ladysmith and Kimberley long ago."

I hope, though I may be pardoned for doubting, that "Argentine" (queries 97352 and 97353, p. 479) may be edified by the replies of "Regent's Park" on p. 500. I wonder whether the gentleman who adopts that *nom de plume* ever made an observation to determine longitude in his life; or whether he has any practical acquaintance with the theodolite, the only instrument, apparently, that "Argentine" possesses. I rather failed to understand the exact nature of "Argentine's" difficulty set forth in query 97353; but assuredly reply 97353 (*loc. cit.*) will not help him. I should be very very sorry to say or do anything discouraging to anyone so obviously anxious to enlighten his brother-readers as is "Regent's Park," posing, as he does, as a perfect Admirable Crichton in these columns, prepared to answer questions on every single branch of human knowledge; but even he is not infallible. Why, yet another illustration of this occurs on the very same page, where (in reply 97348) he refers your querist to a perfectly ridiculous book, before spending any money upon which that querist should read No. 370 of the *Edinburgh Review*, for October, 1894. *Ne sutor ultra crepidam.*

I am afraid that "F. B." (query 97393, p. 501) will fail to obtain a new 3in. achromatic (worth anything), equatorially mounted, for £16, and I certainly know of no optician of repute from whom such an instrument, so mounted, whether it be called a "student's" telescope or not, could be obtained at that price. Your querist might pick such a thing up secondhand; but if he saw one advertised, it would be necessary to have it inspected and tested by some competent friend. Besides, instruments are bought by dealers at about the value of the brass and glass of which they are made, and reappear in their catalogues at most astonishingly advanced prices.

"New Moon" (query 97394, p. 501) will find that the last time there was no New Moon in February was in 1893. Your correspondent must employ a professional computer to ascertain in the February of what year this will recur. There was no Full Moon in February, 1889.

The report of the Superintendent of the United States Naval Observatory for 1899 is very interesting reading for all who are concerned in the use and adjustment of astronomical instruments, giving, as it does, a précis of what has been accomplished in this way at Washington with the 26in. and 12in. equatorial refractors, the 9·14in. and the 6·0in. (steel) transit circles, the prime vertical transit instrument, the 5in. (steel) altazimuth instrument, and the 40ft. heliograph, together with some account of the work performed, and a mass of miscellaneous information. The work done with the 26in. telescope has consisted chiefly of measures of the observed diameters of Mercury and Venus in all parts of their orbits, for the determination of the effect of irradiation upon such diameters. In the event, as might *à priori* have been expected, irradiation was diminished by the use of high powers, which, of course, reduced the brightness of the images. The results for unit distance, so far as Venus was concerned, were to make her mean diameter 17·38". It will probably be remembered that Prof. Barnard's determination of this quantity amounted to 17·307", a not very unsatisfactory agreement. Observations with this same telescope were also made of Saturn's satellites, of the famous planetoid Eros, of the *comes* to Sirius, and, by the aid of spectrum photography, of the motion of various stars in the line of sight. The 12in. telescope appears to have been used in the observation of certain planetoids and comets, and of occultations of stars by the moon. It would seem that the public are admitted every Thursday evening to view various celestial objects through this instru-

ment, under the direction of four of the official computers. The 9·14in. transit circle had to be dismounted for alterations and repairs during a portion of the twelve months covered by the report, and the whole observing force was transferred to the 6·0in. (steel) transit circle. Nevertheless, 3,138 observations were secured with the larger instrument. The prime vertical instrument in conjunction with the 5in. altazimuth has been used to determine variations of latitude and the constants of nutation and aberration. The method employed to ascertain the former quantity is as simple as it is ingenious. Using the altazimuth as a vertical circle to observe the declination of α Cygni at every possible culmination both by day and night (that star culminating 5° 59′ north of the zenith at Washington), and that of Vega (which souths 14′ south of the zenith), it is quite evident that the zenith lies between the two stars, and while the changes in the half sum of their declinations will be the variation in latitude, the differences of their declinations should be constant. It is believed that the declinations of stars are observable with distinctly greater accuracy with this 5·0in. (steel) altazimuth when used as a vertical circle than when a transit circle is employed. The 40ft. heliograph is employed to take a daily photograph of the sun whenever the sky is clear. From the part of the Report devoted to the American Ephemeris we learn that in the forthcoming volume for 1903, Newcomb's Tables of the Sun, Mercury, and Venus, and Dr. G. W. Hill's Tables of Jupiter and Saturn will be employed in lieu of those in use in former years. As a detail, I may mention that the apparent semi-diameter of the sun to be adopted will be 961·50″, that now in use being 960·78″. It is probably known to everyone who will read these lines that the value employed in our own *Nautical Almanac* is 961·18″. The gravitational astronomer, no less than the observer, will be glad to hear that the elements of the satellites of the outer planets of our system are undergoing a thorough—and much needed—revision at the hands of Prof. Harkness. I have only touched upon the leading points of interest in the report lying before me, but it will be found well worth reading in its entirety.

In connection with Mr. Bennett's interesting letter (43218) on p. 510, let me assure him that my sole claim was to be *historically* correct. For good or evil, the first year of the Christian Era was called 1 A.D., and, that being so, the century could not terminate until the expiration of the year A.D. 100. As your correspondent will see from my answer to Mr. Watson above, when we come to reckon the number of sequent days which have elapsed between two dates, one B.C. and the other A.D., we have to introduce an imaginary year 0.

I should hardly go as far as "Silverplume" (letter 43219, p. 510) in asserting categorically that 31 M. Andromedæ is stellar. It has a continuous spectrum, it is true; but if it be actually stellar in the ordinarily accepted sense of that word, it is very odd and remarkable that it has never shown any real signs of resolution in the gigantic telescopes now in use in America and in this country. Let us wait and see if the stupendous instrument which is to be a centre of attraction in the Grande Exposition, now so imminent in Paris, will resolve it into its component stars?

If "A. B. M." (letter 43221, p. 511) imagines that I could, or would, shut my eyes to anything in the shape of *evidence* of the influence of the moon on the weather, he seriously misjudges me; but so far we have been favoured with nothing whatever but assertion, pure and simple, of, I may perhaps add, a more or less blatant character. There lies before me the continuous record for 44 years of the weather at a single English station, and a series of the *Nautical Almanac* for 43 of them, containing, I need scarcely say, the fullest details as to the so-called "changes" of the Moon, her Right Ascension, and (what I believe the weather-mongers consider very important), her Declination for every single hour of the period covered, and I defy "A. B. M.," or anybody else, Frenchman, Swede, or American, honestly to trace the slightest connection between them and the heat, drought, lightning, rain, snow, cold, or any single meteorological phenomenon observed during the period to which they jointly refer. It is not difficult to see how a very slender case can be made out for lunar influence on the weather. Varied as it is, there is bound to be *some* place on the surface of the earth in which correspondence takes place between a given position of the moon and the local weather, and this is triumphantly pointed to; while, on the next recurrence of the occupation by our satellite of a similar position, when no such correspondence whatever is traceable between it and the atmospheric conditions in the same locality, some totally different station is picked out, as an illustrative example of the prophet's acumen. This may be very clever, but it is suspiciously like Old Bailey advocacy. *If* the moon does influence the weather, *cæteris paribus*, and under similar conditions, that influence should produce approximately identical results in the same locality; and I say, unhesitatingly, that it does *not*.

I may perhaps say, in reply to the question with which "A. S. L." concludes letter 43222 on p. 511, that to eliminate aberration as far as may be, no achromatic refractor should have a focal length shorter than from 14 to 15 (say 14·5) times its aperture. Of course increase of focal length decreases aberration, but at the same time makes the instrument unwieldy; so that the proportion I have indicated will, I think, be found to be that adopted by our best makers.

The evidence given at the trial of John Elliot to prove his insanity, to which Mr. Monck refers (in letter 43243) on p. 517, reminds me that a dear friend of mine, now dead and gone, used to keep batrachia and reptiles as pets, and that a young lady who knew him, happening to meet the rector of a West of England parish of the same name, inquired of him if he was related to her (and my) friend; to which the response was: "Well, he is a cousin of mine, but"—touching his own forehead—"I do not think he is quite right in his head; he keeps toads and frogs!"

The star of which Mr. Batley speaks (in query 97432, p. 522) is 251 Ceti (Σ 147). The components are of the 5·5 and 7·5 magnitudes, and about 4″ apart. It is not easy to understand why Webb omitted this object.

Probably "Arcturus" will answer query 97434 (p. 522) in detail; but I may just say that, of course, the sine of an angle = the sine of its supplement—i.e., log. sin. 101° 14′ 3″ = log. sin. 78° 45′ 57″, and this is its value *passim*. "Fleur-de-Lys" might study pp. 393 to 420 of Chauvenet's "Spherical and Practical Astronomy" with advantage.

If "W. G. T." (query 97437, p. 522) does bring his telescope into the house, he can expose the object-glass to the fire, of course, at a safe distance, and the moisture will evaporate. The less an object-glass is wiped the better.

In answer to "Polaris" (query 97442, p. 522), I may say that (1) "theoretical limit of power" means *separating*, not magnifying, power, and is obtained by dividing 4·56″ by the aperture of the telescope—e.g., a telescope of 1in. aperture will just divide two stars of the sixth magnitude that are 4·56″ apart; or supposing that the telescope aperture were 2·5in., then would it divorce a pair 1·82″ from each other, while a 4in. object-glass would show as stars just separated a pair 1·14″ apart, and so on. The 100 to the inch refers to magnifying power, and is a practical and not a theoretical limit at all. In fact, though, it is but rarely that such a power can be used in England with advantage. (2) The focal length of a lens equivalent to a Huyghenian eyepiece is found by dividing twice the product of the focal lengths of its component lenses by their sum. Thus in the best form of Huyghenian eyepiece if the focus of the eye-lens be = 1, that of the field-lens will be 3. Call these inches. Then $\frac{2 \times 3 \times 1}{4} = 1\frac{1}{2}$in. (3) When it is stated that the field of view decreases as the power increases, it means that the angular subtense of the stop decreases. In other words, if with a power of 70 the sun *just* fills the field of view, with one of 140 only half his diameter would do so. (4) Look through the list of members of the B. A. A. and get some friend to nominate you. He will doubtless secure you a seconder. The entrance fee is five shillings, and the annual subscription half a guinea. For this you get some fifteen shillings' or a pound's worth of publications annually, can attend the very interesting meetings held at Sion College on the last Wednesday in every month, and can join one or more of the observing sections, whose competent directors prescribe a settled plan of work for the members. You will be puzzled to obtain such a ten-and-sixpenny-worth anywhere else. I have said nothing, moreover, of the excellent lending library, &c. Address Mr. T. Frid Maunder, 26, Martin's-lane, Cannon-street, London, E.C., for all particulars.

If "H. B." (query 97461, p. 523) will give me his latitude, the name of the star to be found in *Whitaker*, and its hour-angle from the meridian, I shall be very glad to repeat the calculation for him for which he asks.

A Fellow of the Royal Astronomical Society.

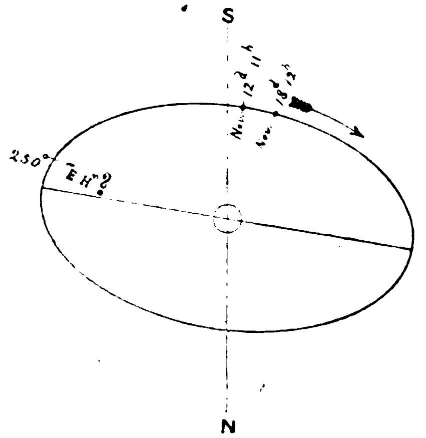
THE SATELLITE OF NEPTUNE.

[43245.]—"NEPTUNE" says in his letter in your last issue (43190): "Can any of your readers give the positions of the satellite of Neptune on the nights of Nov. 12 and Nov. 18 last, when 'Ell Hay' estimated the position-angle as 250°?" I give the graphic sketch shown above, accompanied by a few explanatory remarks.

The ellipse is copied, as accurately as circumstances permit, from the one given in the *Nautical Almanac* for last year, the proportions being preserved, not the size. Upon the curve I indicate the positions of the satellite as computed for the given dates, from data found in that ephemeris, and across the curve I draw a line from which "position-angle" is measured, which is done, as we all know, from N. in the direction reverse to the arrow. The arrow shows the direction of the satellite's motion, and the central circle indicates the planet. The degrees upon the curve were measured off to mark the two positions in question, in their elliptical equivalents, and the measurements were made from the western and eastern apsides.

The position given in (43168) viz., 250° of position-angle is also shown in its place as illustrating the alleged observation by "Ell Hay."

The satellite came to its greatest western elongation on Nov. 11, at 0·3h., and had made very nearly one quarter-revolution by the 12th at 11 p.m., having passed over 88·5°. By Nov. 18, at 12h., it had made one entire revolution and a small part



more, moving, as mentioned above, in the direction of the arrow. It would have come to its greatest eastern elongation on the 19th at 19.9h., and as 12h. on the 18th was short of this by 31·9 hours, its position was 81·4° short of the eastern apsis on Nov. 18 at midnight, which was the reputed time of "Ell Hay's" second observation. The positions of the satellite as measured in degrees from the apsides (the degrees being taken in values dependent upon the obliquity of its orbit as seen from the earth) are marked off upon the ellipse for both dates, but to neither of these positions does the observed one of "Ell Hay" at all correspond.

His position-angle (250°) was given, as he says, with "no great accuracy"; but I think no one can possibly associate it with the true position for either of the dates, for the difference amounts to about a whole quadrant.

I find, however, a small star somewhat near the possible place of his "satellite" when Neptune occupied the place it did at the mean of the dates mentioned, although even that star does not quite suit his observation.

H.

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15 CEPHEI—A DOUBLE STAR IN CETUS NOT IN WEBB—O Σ 24—63 CYGNI.

[43246.]—"A MEMBER OF THE B.A.A." (letter 42990) must kindly pardon the delay in answering his query; but an accident occurred to my dome, and I was unable to get the telescope on 15 Cephei till the other night. The angle should be 300° instead of 200°. The second query I could not answer, as I do not possess the work in question.

In answer to Mr. Batley (query 97432), the star is χ^1 Ceti. In Lord Lindsay's summary of Struve it is given as follows:—Σ 147 χ^1 Ceti. R.A. 1h. 33·5m. Dec. S − 11° 55′ (1875) P. 88·2°; D. 4″; mags. 5·3, 6·9. Later observations do not show any substantial change. The star has curiously escaped insertion in each edition of "Celestial Objects." I have made a note of it.

The star O Σ 24 R.A. 1h. 4·7m. N. 50° 28′ is described by O Σ as follows:—

A B	66·3°	60·6″	7·0, 8·8
B C	45·4	8·1	C. 11·2

Dembowski, in measuring, added another star: D, 287·9°, 43·8″, mag. 10·5. I found, on Nov. 23 last, a faint companion to this, which thus turns the group into a bright star, with two pairs in the field. The following give my results:—

A B (O Σ 2·4)	.. 65·9°	.. 60·5″	.. 7·5, 10·5
B C ,,	.. 48·7°	.. 8·6″	.. 10·5, 12·5
A D (Dembowski)	.. 286·1°	.. 43·8″	.. 7·5, 11
D E (Es)	.. 82·0°	.. 10·0″	.. 11, 13.

63 Cygni, R.A. 21h. 3·1m., Decl. 47° 15′.—On Dec. 1 I noticed a minute attendant to this star, which I have tried to measure, but have not, so far, been able to deal with it satisfactorily with my rough apparatus. I give below the results for what they are worth:—

Dec. 1	.. P 150·1°	.. D 15·7″	.. Mags. 4·5, 13·5
Dec. 27	.. ,, 153·9°	.. ,, 15·1″	

T. E. Espin.

Tow Law, R.S.O., Co. Durham, Jan. 19.

SCHAEBERLE ABERRATION.

[43247.]—The most complete mathematical exposition of this is to be found in a paper by Prof. C. L. Poor in the *Astrophysical Journal* for 1898, pp. 114-123, and as some of your readers may not commonly see this periodical, a short abstract may be of interest. Lack of space prevents me from giving more than the author's conclusions; for the proofs of these the original paper must be consulted.

Prof. Poor, examining the optical properties of a paraboloid mirror cut from any portion of the curve, shows first that the "field" is spherical, the diameter of the sphere being equal to the focal length of the mirror. This portion of his paper I omit.

In any portion of this spherical field, the aberration (= Schaeberle error) is given by the equation—

$$(14)\quad \tan.\,\gamma = \frac{\sin.\,\alpha\,\tan.\,\frac{1}{2}\theta\,\tan.\,\theta}{2\,(\cos.\,\alpha + \cos.\,[\alpha+\beta])\cos.^2\frac{1}{2}(\beta+\theta)}\,.\,P,$$

where γ = angle subtended by transverse linear aberration at centre of mirror,
α = angle of incident ray with axis of paraboloid,
θ = half angular aperture of mirror,
β = angular distance of centre of mirror from axis of paraboloid.

"If in this expression we put α equal to zero, then we have at once γ equal to zero—that is, the image of a star in the direction of the axis of figure is a point. And this is true for a mirror cut from any portion of the paraboloid: it is the well-known property of the parabola."

Considering the particular case where $\beta = 0$—that is, when the centre of the mirror is at the axis of the paraboloid, as is commonly the case, the equation (14) becomes—

$$\tan.\,\gamma = \tan.\,\alpha\,\tan.\,\theta\,\tan.\,\tfrac{1}{2}\theta\left[1+\frac{1}{2\cos.^2\frac{1}{2}\theta}\right]$$

"A very convenient and dual approximation" to this latter formula may be made by putting—

$$\cos.\,\theta = \cos.\,\tfrac{1}{2}\theta = 1,$$

and the equation becomes—

$$\gamma = \frac{3}{4}\cdot\frac{a^2}{f^2}\cdot(\alpha'')$$

a being the half-linear aperture of the mirror, and α' the angle of incident ray with the axis of the paraboloid expressed in seconds. "The size of the star disc is thus directly proportional to its angular distance from the centre of the field and to the square of the proportions of the telescope (aperture divided by focal length)."

Prof. Poor gives a table (i) showing the actual amount of this aberration for different mirrors, which may be summarised thus—

Aperture: Focal Length.	Aberration for 5′	30′	Star disc, 1° from centre.
$\frac{1}{5}$	2·16″	12·95′	33·3″
$\frac{1}{10}$	·55″	3·30′	9·8″
$\frac{1}{20}$	·14″	·84′	3·2″

The second and third columns giving the distance from the centre of the field in minutes: the fourth column combining the aberration with curvature of field. This we may at present neglect. He remarks: "As a result of this we see that in order to obtain satisfactory results the proportions of mirrors should be about the same as those of lenses: the ratio of aperture to focal length should be 1 to 15 or 20. Good results cannot be obtained with the mirrors now in use—i.e., those in which the ratio is 1 to 7 or 8."

Prof. Poor tested the accuracy of his results by measuring the star-discs in one of Dr. Roberts's photographs of the nebula in Orion, as follows:—

Distance from centre of field.	Measured increase in star image.	Computed aberration.
12′	6″	6″
27	9	12
34	13	15
42	19	19

which is a tolerably close approximation, all things considered.

This letter has already reached an inordinate length, but I hope I may be pardoned for this in view of the fact that papers like Prof. Poor's, where the figures are derived from mathematical calculation, and not from mere guesswork, are unfortunately, not common. **Alpha Ursae.**

MOON'S PATH—DETERIORATION OF ALMANACS.

[43248.]—With reference to the last paragraph of letter 43220, p. 511, I should like to point out that "M. O." is in error when he describes the moon's path in space as "a sort of elongate S, or slightly wavy from a straight line," and that his diagram, being, as he himself admits, greatly out of proportion, gives a totally wrong idea of the moon's path [illegible] to the sun. A reference to p. 233 of Godfray's "Treatise on Astronomy" will furnish "M. O." with a simple mathematical proof that the moon's path is concave to the sun at the very place where he has shown it on his diagram as convex—viz., at New Moon. Diagrams illustrating the concavity of the moon's path to the sun will be found in the work referred to, and also in Young's "General Astronomy," p. 161

Letter 43233 on p. 514 reminds me of a query inserted in the "E.M." for some date towards the end of Dec., 1896, and which seems, by the style of writing, to have been written by the same person. After deploring the deterioration of almanacs (from the querist's point of view), the writer went on to say that it seemed to him a pity there was now no diagrams of the moon's passage through the earth's shadow. In response to his query, I made a diagram of the lunar eclipse on Jan. 7, 1897, which the Editor kindly inserted, but I made no remark about the supposed deterioration. It will thus be seen that, assuming the writer of the letter and of the query were one and the same person, the deterioration of almanacs, from the writer's point of view, lies in their not containing diagrams of lunar eclipses and particulars of solar eclipses for "30 or 40 places in Great Britain, also for Paris." Now it seems to me, from the amateur's standpoint, these details are not very important. Moreover, the *Nautical Almanac* for the current year gives a diagram of the track of the moon's shadow during the solar eclipse on May 28, particulars of the eclipse for six representative places in the British Isles, and the data and formulæ for computing the circumstances of the eclipse for any place. **S. B. G.**

THE MOON'S ORBIT.

[43249.]—On p. 511 of your last issue is a diagram which is likely to mislead your readers. Your correspondent "M. O." may be surprised to learn that *the lunar orbit is everywhere concave to the sun.* His idea of an "elongated S or wavy line" is therefore quite fallacious. If he will plot out the orbits of earth and moon approximately to scale, he will easily see that the above statement is probably true; but a knowledge of gravitational lunar theory (*pace* Mr. Hugh Alexander) is necessary for its exact proof. **C. P.**

HUYGHENIAN EYEPIECE DIAPHRAGMS: RULES FOR—TO MR. E. P. CLARK.

[43250.]—In letter 43104, Dec. 8, your ingenious and persevering correspondent mentioned above made inquiries concerning this subject, complaining that he "can find no rule for the diaphragm," and appealing for directions to the numerous "competent authorities" to be found amongst your readers. To this request there appears to have come as yet no response. My own delay in answering has been largely from a wish on my part to allow the desired information to come from some of the "competents," although Mr. Clark's courtesy has led him to suggest that I also might be able to meet his wishes. But contributing also in no small degree to my delay was the fact that, without a considerable amount of technical circumlocution—call it attempted demonstration of principles—I could not see my way to give the desired information in the form of a "rule," although for fairly good practical indications I could possibly at once have sent short and easy directions for a special case. I felt that such a reply as men of Mr. Clark's stamp demand—i.e., one which embodies all the conditions necessary for any possible case, given in accurate form, and with at least some small amount of accompanying demonstration, that such a reply, even with the assistance of diagrams, might fill more space than should be desirable, and that at a time when we were beginning to have again many interesting communications on subjects which we all delight to see in prominent place—I mean the purely mechanical.

For those amateur opticians, however, who may merely wish to be able to fix up in a sort of good-enough kind of way the mechanical parts of a Huyghenian eyepiece of the most common type, and without any special adaptation to any particular kind or focus of telescope, the following preliminary pieces of information (scarcely to be called "rules") may be given before the general question is entered upon with any pretence to complete accuracy or to to reasonable explanation of the "why and the wherefore."

For this prefatory purpose, let the conditions be: the lens focal lengths as 3 to 1, the lens distance apart equal to half the sum of their focal distances, and the lens apertures of any size which experience has determined for them, or which may be found upon the lenses purchased by those who cannot make them. (Here, the expert will notice, there is no attempt to adjust the distance apart to principal focus of object-glass or speculum.) And, further, it is to be assumed (of course, quite gratuitously) that the actual width of the image formed by the object-glass is equal in width to the aperture of the field-lens, which means that the pencils of convergent rays passing to above image are comprised in a parallel beam, the latter circumstance being pretty nearly the case with telescopes of long focus, whether simple or compound. For example, in the compound reflector, and in the refractor with a "Barlow lens," the pencils of convergent rays about to enter the field-lens of the Huyghenian eyepiece are very nearly parallel, owing to the relatively long equivalent focus; the same, of course, with a very long-focus object-glass or mirror. As showing an approach to this easy assumption (parallelism of pencils, *not rays*, near the field-lens), the figure I gave for a Gregorian eyepiece at p. 578, August 11, and which the Editor has kindly had reprinted, will serve to show the reasons at least approximately for the following simple attempt at a "rule" for the diaphragm. But as the pencils to the right of the field-lens B in Fig. I, although nearly parallel, are not really so, the "rule" cannot be quite correct, and with shorter principal or equivalent focus of object-glass or speculum, the "rule" will be still further from strict accuracy, although possibly near enough for the practice of most amateurs.

In Fig. 1, while the lenses are of relative foci, $2\frac{1}{4}$ to 1, instead of 3 to 1, and of apertures very much greater than what is required for average refractor eyepieces; the geometrical foundation of the reasoning leading to the rule for the diaphragm, is the same in principle as if the present simple assumed conditions just given had existed. Were the beam of convergent rays entering B really parallel, the image at Y Y′ would equal the lens B in width. Now, the available width of B, the field-lens being a fixed quantity, i.e., by either experience of best aperture for given focus, or by "chance" let us say, and, from above assumption of parallelism, the known equal width of Y Y′ enables us at once to find Z Z′, which as the corresponding width of the reduced image formed of Y Y′ by the field-lens B, gives us the diameter of the diaphragm opening. Plainly and without explanation Z Z′ is, under our present assumptions, two-thirds of Y Y′, and as Y Y′, as we have just seen under the same assumptions, equals the useful transmitting aperture of the field-lens, *the diaphragm opening comes to be two-thirds of the aperture of the field-lens.*

This "rule," if it may be so called, is only true under the above assumption—viz., foci of lenses 3 to 1, distance apart equal to half sum, &c., and as these are not the conditions of Fig. 1, Z Z′ does not there equal $\frac{2\,Y\,Y'}{3}$, as measurement will show.

Graphically, the proof of our geometrical assumption is easy enough, for upon drawing Y Y′ = available aperture of lens B, placing Y Y′ at a distance from B equal to $1\frac{1}{2}$ times the distance of the diaphragm from it (the diaphragm being in all such cases as that of our assumed instance, midway between the lenses), and joining the centre of B with the margins of Y Y′ we find that where these lines pass the plane of Z Z′, they define the limits of that aperture. The most elementary knowledge suffices to convince one, without drawing and measuring, that, as the distance of Y Y′ from B is $1\frac{1}{2}$ times the distance of Z Z′ from B, the latter aperture must be two-thirds of that of Y Y′. The proof of the above-mentioned "$1\frac{1}{2}$ times" and other matters can now follow, for the use of those wishing to work out the fundamental principles, so as to be able to apply them to *any* eye-piece, and without limitations, such as those which have led to the above simple makeshift rule just given.

For this, the second part of my humble essay, and in which a certain show of proofs is a necessity, I must, however, assume a previous knowledge on the reader's part of several well-known general principles and modes of representing them: the complete elucidation of the whole *ab initio* would, even in much more ample space, be an absurd attempt.

For facility of reference, I shall number the several steps to be followed.

1. Ascertain the principal focus of object-glass or mirror (or, if compound, the equivalent focus), and $\frac{F}{P} = eq.f.$, where F = principal focus, P = the "power" desired, and $eq.f.$ = the focus of a single lens equal to the effect of the eyepiece combination.

2. Next, determine what relative foci the eyepiece lenses shall have, for, as is well-known, the 3 to 1 proportion in this is by no means either "necessary or sufficient." For example, the lenses in Fig. 1 are of relative focal lengths, $2\frac{1}{4}$ to 1, for certain reasons. The most frequently met with proportions in refractor eyepieces are about 3 to 1.

3. Supposing the above settled, we now find the actual focal length of field and eye-lens to give our desired equivalent focus for (1).

For this purpose readers may consult letter 41097, of May 20, 1898, in which I work out the necessary steps by simple algebraic reasoning.

4. Besides, in using the method there shown, we have to remember that for achromatism in the combination we cannot trust to the simple half sum of the foci for the distance apart, which for simplicity is there used, but must use for "d" a number, which, as shown in 42668, August 11,

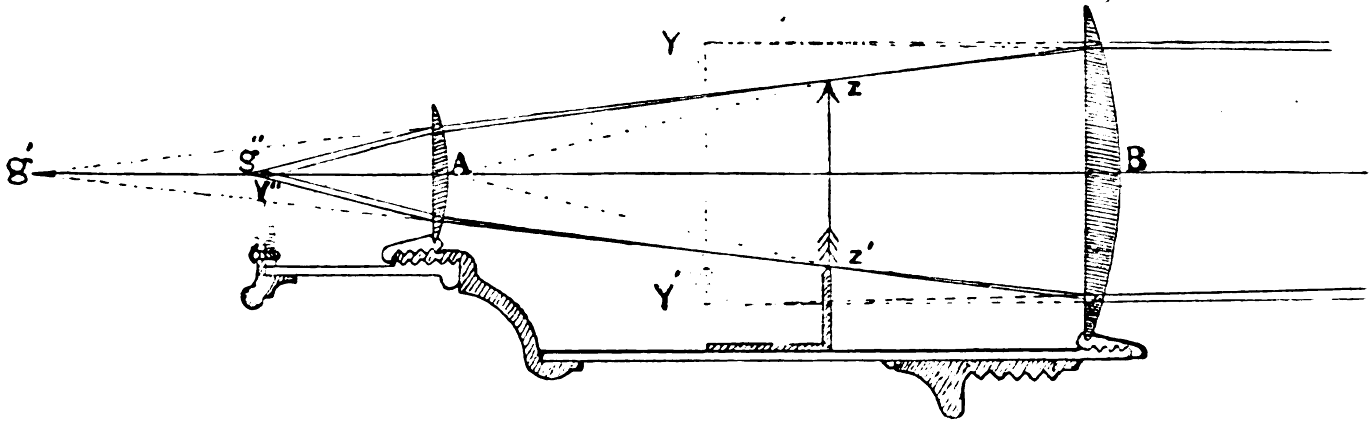

FIG. 1.

depends upon the distance of the object-glass or speculum from the field-lens.

5. Should a certain definite angle of field be not required for some special purpose, then, as already stated in preface, the simple selection of the most appropriate aperture for the necessary lenses leads, along with other procedures, to the resulting aperture

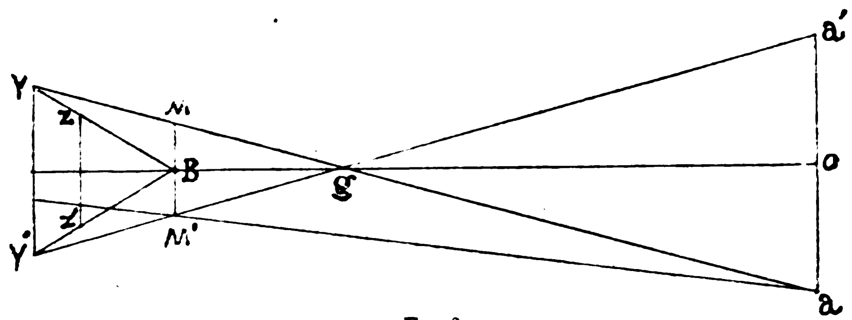

FIG. 2.

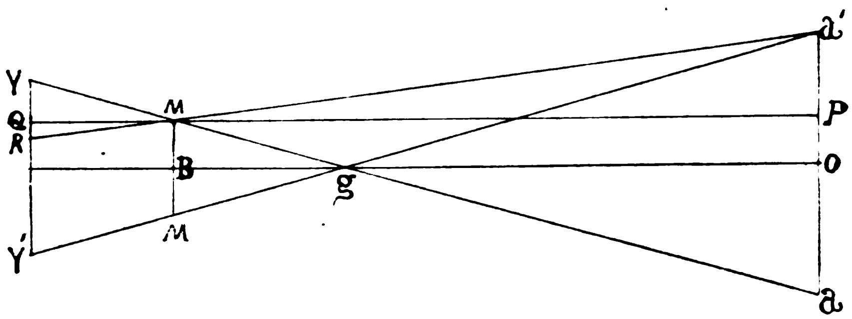

FIG. 3.

of diaphragm, the position of which also is determined by some of the same conditions.

As an example, let our object-glass (or speculum) be of 6ft. focus and 5in. aperture (the o.g. being of the two the better suited to this aperture), and let the power desired be 150 diameters. By (1) $\frac{72}{150}$ = ·48, which = the focus of our equivalent lens. As to (2), let the foci be 3 : 1. The converse of (3) or the equivalent focus of certain lenses of given foci and distance apart, is given, as most amateurs know, by $E = \frac{F \times F^1}{(F + F^1) - d}$, where E is the equivalent focus, F F¹ the foci of the lenses, and d their distance apart. Space prevents the proof of this, which is by no means difficult. Again, we remember a formula, also previously given in these pages several times of late, and which still less permits of exhaustive demonstration here—viz.,

$$d = \frac{F_1 + F_2}{2 - \frac{F_1}{u}}$$

where F_1 is the focal length of the field-lens, F_2 of the eye-lens, and u the distance of the object-glass (or speculum) from the field-lens. (In the compound reflector, u equals equivalent focus minus the distance B Y, or distance of field-lens from secondary focal plane). The refined distance apart given by this means, in order to secure achromatism in the eyepiece, is not used in my simple algebraic deductions from the formula for equivalent focus, as given in 41097, May 20, 1896; neither shall I introduce it here, although to do so would involve no serious complication, as I wish merely to insert here an epitome of the above-mentioned letter for those readers who may not be able to consult it. Therefore (d) in the following is simply $\frac{F + F^1}{2}$, or the half-sum of the focal lengths. To insure correspondence with previous algebraic treatment of the subject, make x = focus of field-lens, and y = focus of eye-lens. Then, as our present conditions give $(d) = \frac{F + F^1}{2}$ the fundamental formula for equivalent focus $\frac{F \times F^1}{(F + F^1) - d} = E$, becomes $\frac{x y}{x + y} = \frac{E}{2}$.

Now, as in the preliminary indications, let us make F : F¹ : : 3 : 1 (other proportions being known to be equally capable of proof as to the present deductions), and as this makes $x = 3y$—

$$\frac{x y}{x + y} = \frac{3 y^2}{4 y} = \frac{E}{2},$$

and by division this becomes—

$$\frac{3 y}{4} = \frac{E}{2},$$

and therefore— $E = \frac{3 y}{2}$.

Our requirements stated above necessitating an equivalent focus of eyepiece, or E equal to ·48in. may now be expressed, therefore, as $\frac{3 y}{4} = \frac{\cdot 48}{2}$, so that $3 y = \frac{1\cdot 92\text{in.}}{2}$ = ·96in., which is the required focal length of our proposed field-lens. For we made $x = 3 y$, and x stood for the focus of the field-lens. From the same, it also follows that our required eye-lens focus (y) is ·32in. We may prove the above arithmetically from—

$$\frac{\cdot 96 \times \cdot 32}{(\cdot 96 + \cdot 32) - \cdot 64} = \cdot 48 = E.$$

The foci being now known, the best practice (for there is no theory) fixes a suitable diameter for the lenses. For example, with F = ·96in., this diameter might probably be made = ·5in., so that B in our diagram (Fig. 1) being made of that measurement, the rest may be worked out (even graphically with fair accuracy).

As before stated, our conditions permit us to make Z Z′, or the diaphragm aperture ⅔ of Y Y′, which, again, our assumptions allowed us to consider equal to the aperture of the field-lens B. Therefore, as the latter has just been found to be ·5in., the diaphragm aperture for our proposed eyepiece becomes ·3in.

For precision, however, we may work out the results numerically from the geometry of Fig. 2. Here all the apertures are enormously increased in order to make the meaning clear. In Fig. 2 (a) represents one extremity of the object-glass (or speculum) diameter, M the margin of the field-lens, and Y that of the image formed by the object-glass unaffected by the eyepiece. A line joining (a), (M), (Y) crosses the axis at (g) and limits the entire possible extent of Y Y′. But to mark off upon Y Y′ the extent of image which receives all possible rays from the object-glass, and is, therefore, fully illuminated, we join $(a$ M′) and produce the line to the plane of Y Y′, upon which it defines a smaller area than did (a) (g) (M). Depending, therefore, upon whether we desire our field of view to be limited to the fully illuminated area, or to include some or all of what opticians call the "ragged edge," we can either graphically or by computation fix upon the required aperture at Z Z′—i.e., at the diaphragm.

Supposing we desire the entire available field, irrespective of equality of light, we must first find the distance B Y and g Y, for o Y and B Z—i.e., the principal focus and the position of the diaphragm are already known (in our case the latter being just halfway between the eyepiece lenses).

Representing the planes Y Y′ and Z Z′ by Y and Z respectively, $\frac{1}{BZ} - \frac{1}{B} = \frac{1}{BY}$, B being the focus of the field lens for parallel rays.

The above in our numbers becomes $\frac{1}{\cdot 32} - \frac{1}{\cdot 96}$ $= \frac{1}{\cdot 48}$, the reciprocal of which is ·48, giving us B Y. To find $(g$ Y) we may now take first the proportion $g o : a a' : : g$B : M M′, and making $x = g o$ and $y = g$ B, we find o B, in Fig 2 to be equal to $x + y$ = F − B Y, i.e., to the object-glass focus minus B Y as found above, and equal to 71·52. We had $a a'$ = 5in., and M M′ = ·5in. Therefore—

$$x : 5 : : y : \cdot 5,$$

giving— $\cdot 5 x = 5 y$

and— $x = \frac{5 y}{\cdot 5} = 10$

so that— $x + y = 11 y = 71\cdot 52 = o$B

and hence— $y = 6\cdot 502 = g$ B.

Again $(g$ Y) is simply $(g$ B) + (B Y) = 6·502 + ·48 = 6 982 and g B : M M′ : : g Y : Y Y′, which in our numbers is 6·502 : ·5 : : 6 982 : ·5369 = Y Y′, from which we readily find the corresponding Z Z′ or diaphragm aperture to be ·3579, as our conditions make Z Z′ two-thirds of Y Y′. Any other proportions of Z Z′ to Y Y′ are equally easy of proof in this way.

Supposing we desire only the field of full illumination which must have a diaphragm aperture smaller than the above Z Z′, let us examine the geometry of Fig. 3, where through the margin of the field-lens is drawn a line, P M, parallel to the axis, and produced to cut the line Y Y′. By similar triangles we find that

$$MP : a'P : : MQ : QR.$$

Now M P is the principal focus minus the distance from that focal plane of the field lens, the latter

distance being M Q of Fig. 3, or B Y of the previous demonstrations, and $a'P = \frac{a a'}{2} - \frac{M M'}{2}$, from which in our numbers we have

$$71 \cdot 52 : 2 \cdot 25 :: \cdot 48 : \cdot 0151 = QR.$$

Then twice Q R, or ·0302, taken from that part of the primary image (the secondary image in the compound reflector) which is limited by the parallel lines drawn through the margins of the field lens, gives the extent of primary image illuminated by the whole area of the object-glass. Our numbers give ·5 — ·0302 = ·4698 for diameter of fully-illuminated primary image, and under our conditions of eye-piece lens proportions, as already stated (3 : 1), the aperture of diaphragm, or Z Z' corresponding to this, is two-thirds of ·4698 or ·3132, a number somewhat less than that found necessary for the case assumed in the introduction, where the field-lens was supposed to receive a parallel beam, in which case Z Z' was found to be ·3.

Or otherwise, we may find the same results from taking into account the value of Y Y', which, as already shown, can be found by using the node g. By similar triangles also (M $a a'$ and M R Y) we have M P : $a a'$: : M Q : R Y, giving in our numbers 71·52 : 5 : : ·48 : ·03355 and Y Y' − 2 R Y = ·5369 − ·0671 = ·4698, the same value found for the fully illuminated primary image by previous method, and consequently ·3132 is again our value for Z Z'.

For other proportions of lens foci than the 3 : 1 used above, and for "(d)" altered to secure a more perfect achromatism, the correct apertures may be found with equal facility, although the proportions more commonly met with have been used in this demonstration. In this way the correct aperture of diaphragm may be found without resorting to rule-of-thumb methods or laborious trials by experiment. Some, however, prefer a practical field, especially for low powers, which is a compromise between the fully-illuminated one just demonstrated and one with dull margins; hence, under these circumstances, the first-mentioned rule comes still nearer what is required. Cooke and all good makers consider the e.p. as part of each telescope, and non-transferable under perfect action.

Note.—Fig. 1 is correct to scale for the lenses shown; Figs. 2 and 3 are mere diagrams, in which all the apertures are much increased. The "field" shown in Fig. 1 is for full illumination, similar to that mentioned in the description of Fig. 3. H.

ADJUSTMENT OF MIRROR AND FLAT OF REFLECTOR.

[43251.]—On account of the interest taken in the reflecting telescope, I send you the following method for the "Final Adjustment of the Mirror and Flat of a Reflecting Telescope," for what it may be worth.

In order to obtain the best results from a reflecting telescope it is essential that the mirror should be absolutely at right angles to the tube, that the flat should be in the central line, or axis, of the tube, and that the surface of the flat should form an angle of 45° with both the mirror and eyepiece. Having approximately accomplished this result by methods often explained in the English Mechanic, I proceed to the final adjustment, as follows:—first, put into the tube which holds the eyepiece, an eyepiece of lower power. Then with a Coddington, or other lens of about ½in. focus, held in front of the eyepiece, in a line with its axis, and about ½in. away, we will see a beautifully clear image of the flat of the speculum, and of the opening of the tube. If these three images are concentric, then the instrument is in adjustment. If they are eccentric, the image will readily show what adjustment of the flat or mirror is required.

I was highly amused to see the remarks of "F.R.A.S." on the Century Question on p. 449, foot of second column, and congratulate him on his change of opinion, for it is evident from his letters in Vol. V., pp. 130 and 206, that he then held a contrary notion as to when the century began. To quote from p. 206, Vol. V., he says: "But I cannot help pointing out the wonderful post against which some of your recent correspondents have run their heads. They seem to conceive that the Christian era began on Jan. 1 in the year 1. It really began on the first day of the year 0. There was no year 1 until this was completed"!

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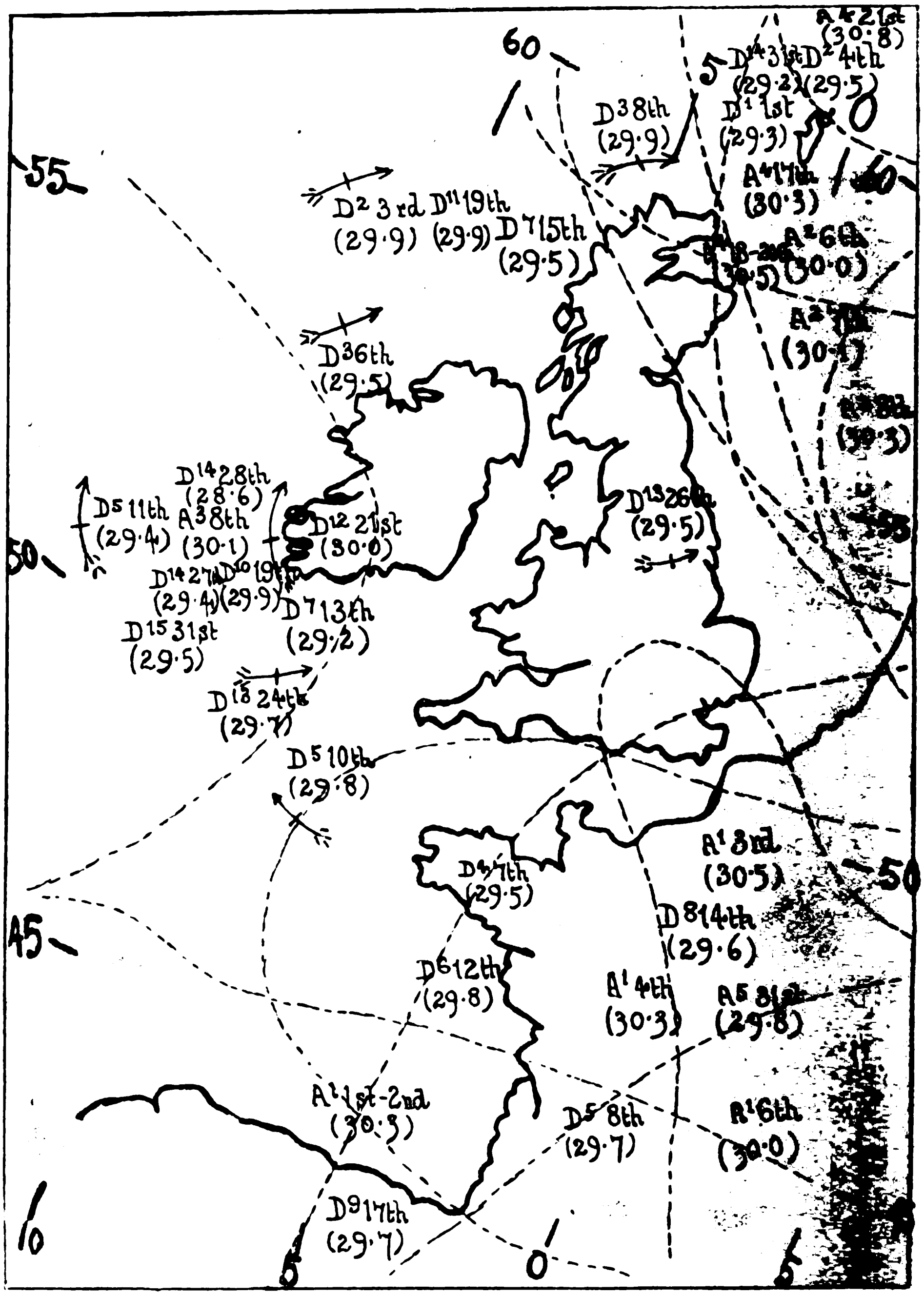
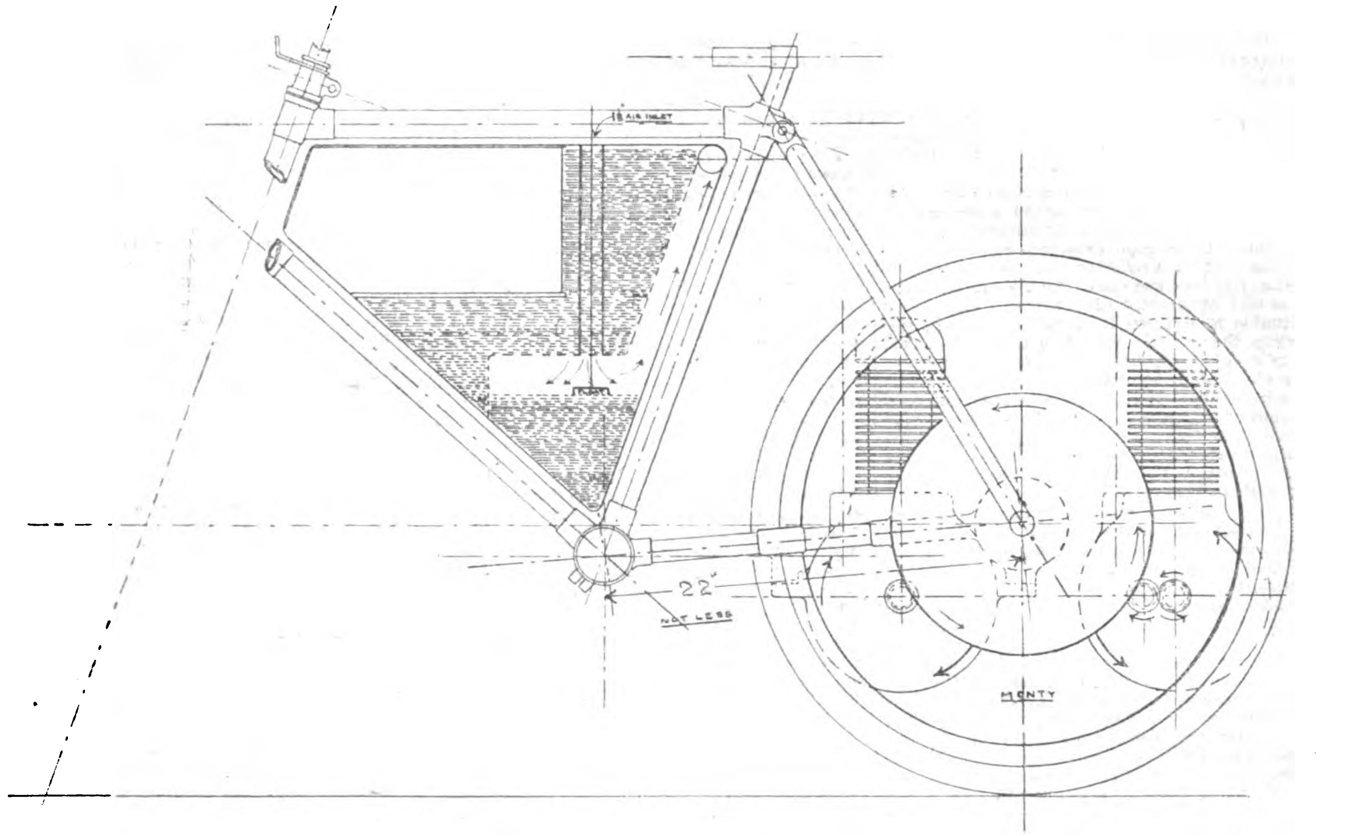
THE WEATHER OF THE BRITISH ISLES IN DECEMBER 1899 — THE RAINFALL OF THE YEAR, 1899 — THE FORTHCOMING TOTAL ECLIPSE OF THE SUN: A QUESTION.

[43252.]—It will be noticed that December produced an anticyclone of unusual intensity on the 21st, when the corrected barometric pressure over the Scandinavian peninsula was as high as 30·8in., whilst on the 28th the abnormally low reading of 28·4in. was registered over our islands.



Date.	Cause.	Effect.
1 to 4	High pressure in the S.E., relatively low in the North.	Fair as a whole in S., but some fog locally. Rain in the N. and N.E.
5, 7	Deep depression over Ireland.	Rain everywhere. E. gales on N.E. coasts.
8	Depression off the Orkneys. Anticyclone over the Baltic. Depression over the S.W. of France. Anticyclone over Ireland.	Fair weather generally throughout our islands. Strong easterly winds on E. and S.E. coasts of England, a N.W. gale at Scilly, light and variable winds elsewhere.
10	Depression off W. of England.	S.E. of Scilly. Fair elsewhere.
11 to 13	Depression off Ireland, and another over the Bay of Biscay, gradually merging into "straight isobars," causing the cold air from the Continent to be drawn in a strong current across our islands.	Strong S.E. winds, fair in the South. Snow and sleet in the E. and N. Northerly gale off the west coast of Ireland. Very low temperatures throughout.
14, 16	Stationary anticyclone in the S.E. Depression in the N.W.	Fog and great cold over E. and S.E. of England. Mild and rainy in Ireland.
17, 18	Depression from the S.W.	Sudden complete break-up of frost.
19	Depression off W. of Scotland. Depression off S.W. of Ireland. Anticyclone over Denmark.	Dull weather in Scotland. Rain in Ireland. Fair, but dull in places, in England.
20, 22	A high-pressure system of great intensity over the Scandinavian peninsula. Depression off S.W. of Ireland.	Dull, gloomy, and showery, with wet fog in places, throughout the entire country.
24, 26	Depression of moderate depth crossing through the central regions of our islands.	Very unsettled and showery, with, however, some bright intervals.
26, 27	Depression central over England, another approaching from W.	Unsettled generally; cold rain, followed by sudden frost, fog, and mist.
28	Unusually deep depression off the S.W. of Ireland.	Rain in England and Ireland. Snow in Scotland.
29, 31	Deep depression off the W. of Norway. Another over Ireland.	Gales of moderate strength, with moderate falls of rain generally throughout the country.

The total rainfall for the year 1899 amounted in this district (East Surrey) to 19·99in.; the wettest month of the year, and at the same time the driest, was November, whose 4·06in. of rain all fell on the first eleven days, leaving the remainder of the month to give us an absolute drought of 19 days.



According to *Whitaker's Almanack*, referring to the total solar eclipse of May 28 next, "the line of central eclipse passes from California across the northern portion of the Gulf of Mexico, and, leaving the east coast of America near Charlestown, crosses the Atlantic." May I ask why I have not seen any mention of an expedition to the United States to observe this phenomenon, as it seems to strike one that that country is in a more healthy condition than either Spain or Portugal? **Meteor.**

FOGS IN FROSTY WEATHER.

[43253.]—THE question was recently put to me, How is it that mist, which is popularly supposed to consist of water particles, with or without dust nuclei, is so often seen when the general temperature is below freezing? Why do these not freeze into solid ice, and fall down?

It is pretty obvious that they must freeze—in fact, that such a fog consists of particles of ice. This suggests a rather pretty sequence of cause and effect. Ice is lighter than water, consequently more buoyant.

Cold air is denser than warmer air; consequently bodies which float in the former (unless contracted by the cold), should do so more readily in the frosty atmosphere.

The lighter ice and the heavier air give the best possible conditions for the permanence of such a fog. **Glatton.**

MOTOR-CAR.

[43254.]—MAY I also as a car owner add a few remarks, in all humility, on the general design of the motor for light car illustrated this week? Before doing so, I should like to say how thoroughly I agree with "Country House" on the points mentioned by him. As to motor. Having settled on employing horizontal valves, for which I can see no reason and which I don't think can be as good as vertical ones, why go out of the way to introduce a quite unnecessary bell-crank lever, with its extra joints and rattle, when it is just as easy (and easier) to drive the valve direct from the cam shaft?

Why also go out of the way to introduce an extra water-joint, seeing what a weak point they always are, when, by casting the combustion-chamber and cylinder breech in one, it may be avoided. By filling up the core holes at the back of the cylinder and connecting the combustion chamber (including valve-jackets, of course) with the cylinder jacket by two small copper pipes, I do not see that any water-joint at all need be used.

Would it not be far simpler to cast cylinder and half the crank chamber in one, the second, or outward, half being bolted thereto with a vertical joint? I fancy it would be easier and practically just as good to build up the crank-shaft, thus saving a forging. Why not inclose reduction gear in crank case, insuring constant lubrication and protection? Of course, I am only referring to the spur-wheel, not the cam.

May I add, in conclusion, that I also am only an amateur?—which, perhaps, may be apparent from the foregoing! **Dragoon.**

[43255.]—A FEW friendly criticisms on the articles describing above from a practical automobilist may not be without interest to your readers, the more so as the car described appears to exist as yet only in design. There seems to be no provision for maintaining rigidity in the front axle with relation to the body, this appearing to depend on the springs alone, which would necessitate their being unnecessarily stout for such a light car. Perch-bars, or some kind of vertical guides, would be preferable, unless semi-elliptical springs were used. I emphatically agree with "Country House" regarding the use of chain steering, having personal knowledge of its liability to failure. There is precedent for it, of course, as there is for most faulty designs in cars. The idea of economising by having a small sprocket is rather amusing, as it means using up a costly pair of chains in much less time. I do not fancy there is any controversy on this point among automobile engineers, and even the difference between a six and eight-tooth pinion is marked—a five-tooth is really too small.

There is much to be said in favour of steel and wood framing, as the wood greatly diminishes the liability of a steel frame to suffer from vibration. Regarding the brake, it is to be hoped that a steel cord going round a pulley does not form part of its design. The Mors car, as constructed till lately, by the way, had a single pedal for brake and disconnection of engine, and was a belt-driven car. Regarding engine design, the writer would not recommend drilling stud-holes through to water jacket if he had had to spend a fine morning endeavouring to extract a broken stud that had rusted in, while his friends on their cars went on without him. It seems a pity, too, that with horizontal valves the bell-crank lever 22 is not dispensed with, and a roller on a straight push-stem arranged to run on half-speed cam, the latter being brought into line with it. The valve springs, with their ends running through valve-rod, seems rather a slipshod arrangement—a key is the best method here. Finally, how is wear to be taken up on small end of piston-rod? **R. W. B.**

MOTOR-TRICYCLES.

[43256.]—THE rough outline sketch shows a method that may be adopted to increase the power on motor vehicles, and at same time lessen the vibration.

To prevent an explosive engine vibrating, it is not only necessary to balance all moving parts, but to counterbalance explosive impulses, it being a well-known law in mechanics that action and reaction are equal and opposite. The tendency of all the makers is toward some form of balanced engine. Many have an idea that by splitting it up into two of three cylinders the object will be gained, whereas nothing of the sort is accomplished.

By the sketch it will be seen that it is simply two ordinary motors coupled one in front of the axle, and the other at the back, the relative positions of the pistons being maintained by the large gear-wheel of tricycle and an intermediate pinion placed between the back motor. It will thus be seen the two motors are running in opposite directions, and the vibrations of the one tend to neutralise the vibrations of the other, more especially that set up by the flywheels, which is greater than that caused by explosions on piston. The engines are geared so that pistons are both at same time at top and bottom of stroke, wheels having gear arranged with even divisible number of teeth, to insure correct timing of pistons. Particular attention must be paid to lightness of moving parts. Pistons, if lightened, are better made in *malleable* iron, or you may blow the bottom out. The flywheels must be balanced either by weights cast in, or holes drilled in rim of sufficient size to balance crank-pin and half the weight of the connecting rod. The cam-gear large spur-wheel may also be balanced with advantage. By a simple arrangement like this, many advantages may be obtained, one being out of date; $1\frac{3}{4}$H.P. engines can be made to give smoother and better running than single $2\frac{1}{4}$H.P.

It is more particularly applicable to racing machines, which makers will soon have to design especially—lighter and more powerful; and it is for these I commend the idea.

I should have mentioned that explosions do not take place on both pistons simultaneously, but alternately, and each then follows through the usual cycle.

Anyone making these small engines can easily couple up a pair on bench to test theory for himself, and by taking off intermediate stud pinion (which by the way, I fear will prove noisy), see the effect of vibration set up by one engine singly, and then when opposed to opposite influences.

Personally, I have found vibration from road far exceed anything set up by engine; even when using larger powered motors; consequently large pneumatic tires are indispensable, 3in. being least size for bad road. These are a costly item on all good cars: hence price of same. A set of three 26in. by 3in. average £5 per wheel, the price being out of all proportion to cost of manufacturing same, even allowing for royalties, &c. **Monty.**

ORIENTATION.

[43257.]—WOULD Mr. Norman Lattey (whose racy rehearsal of "sights" suitable for the delectation of those who use the telescope as an aid to rational amusement I am sure we all enjoy) kindly make it clear to some of us more prosaic users of telescopes what is meant by the following reference to orientation in connection with his pictorial descriptions at p. 505? Here is the puzzle: "(it should be remembered that an astronomical tele-

scope inverts and the north is invariably at the bottom of the picture, though the east and west retain their normal positions)."

Is this to be understood only of the "pictures" which appear in his story—for, from some reason not apparent to the reader, they might have been so drawn—or is it to be understood of the "picture" actually seen in the "astronomical telescope," at least, in an astronomical telescope of the kind which inverts in the usual way?

Now, while the Newtonian reflector (which is not the telescope he uses) may indeed under certain circumstances show an apparent orientation, which may puzzle one a good deal, the simple inverted image as seen in a reflector can scarcely be thus mistaken; at least such has been my experience, as well as that apparently of those who have taken the trouble to mention it in their books. In this inversion, the north is not only where to the naked eye, or to a non-inverting astronomical telescope, the south would be, but the east and west are similarly reversed, and far from having "retained their normal positions," for the "preceding" part of the field, as many observers call it (which as we know is towards the west), appears in the inverting telescope towards the east—i.e., towards the left-hand while looking south.

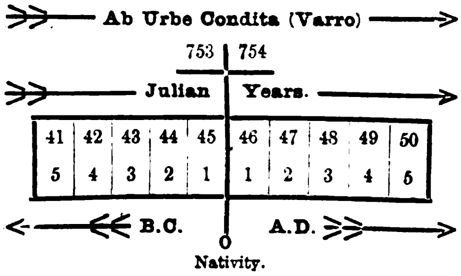
But is it not also somewhat wide of accuracy, even if meant only for the amusement of *dilettanti*, to assure them that "the north is invariably at the bottom of the picture"? No doubt this is so on the meridian, but if much east or west from it (not to speak of circumpolar objects at all), the north comes to be much removed from "the bottom of the picture."

Towards the eastern sky, may not the north appear to occupy that part of the field which corresponds in position to IV or V o'clock on the clock dial, while towards the west may it not appear in the quadrant occupied by VII or VIII o'clock? Therefore, should this be the case, where the east and west line is not only reversed as to its ends, but is, in addition, possibly much tilted, how is the sapient amateur to reconcile matters with the statement that "the east and west retain their normal positions," the north and south only being reversed? With the simple east and west movements of an altazimuth stand the above must be especially hard to grasp. H.

THE TWENTIETH CENTURY.

[43258.]—MAY I, as an old contributor, say something on the curious calendar-strife which the beginning of the 1900th year has revived? Some writers seem not to know what it is that they are writing about; some seem to be incapable of arguing intelligently upon their own data, whether right or wrong. As to "what we are talking about," the following diagram sets out the facts:—

DECADE OF YEARS OF THE JULIAN ERA.



This diagram may need some explanations.

Years *ab urbe conditâ* (A.U.C.) are years counted out from the supposed date of the foundation of the City of Rome. These years are given according to Varro, the greatest authority on that chronology; but the old calendar of the Romans fitted the years like a bad clock fits the time. The calendar was sometimes too fast, sometimes too slow. Not only was the calendar a bad fit for the course of the years, but it was made a football of by political factions, who, being trusted with its occasional correction, sometimes put it on and sometimes put it back, in order to facilitate their electioneering tricks, and with only secondary regard for keeping the calendar in beat with the course of the seasons.

Some forty-seven years before Christ, Julius Cæsar—the then Dictator of Rome, and one of the greatest men of antiquity—the man who did Britain the service of conquering it twice, and introducing to it the Roman language, laws, and civilisation—had his attention called to the vast inconvenience of this state of the Roman calendar, which was then some three months too fast, and indicated the time of spring when the season was really midwinter. He added some ninety days to the calendar for the year 46 B.C., and made that year of the calendar to extend over 445 days, which, in effect, put back the calendar some 90 days. Julius Cæsar then made the year 45 B.C. to commence on the first of January, on the day of a new moon. In order also to make the calendar keep better time, he took up the odd quarter of a day by making every fourth year into what we now call a leap year. This was one of the great services done by Julius Cæsar to the world, and the calendar thus defined with a year of 365 days, but with every fourth year of 366 days, was called the Julian calendar. The seventh month of the year was named Julius, in honour of Julius Cæsar.

The precise length of the real year was not then known; but subsequently the continual revolution of the seasons showed that the Julian calendar was a little too slow. This was because, as we now know, the length of the year is 365¼ days *minus* 11′ 12·43″. Every recurring leap year, therefore, left the Julian calendar nearly 45′ behind time—like a late train (44′ 49·72″). But the Julian year was very nearly the real year, and it was so vast an improvement upon the former calendar that the years from the 1st of January of the first Julian year (45 B.C.) were regarded as the Julian era. Now, the above diagram shows that decade of Julian years which covers the period from the end of the 40th Julian year to the end of the 50th, each year being indicated by a space which represents the interval *in time* covered by that particular year. According to the chronology of Varro, the 45th and 46th years of the Julian era were more or less contemporaneous with the 753rd and 754th years from the foundation of Rome. These years are indicated in the diagram by the two top numbers.

The end of the 45th Julian year was the date adopted by the Monk Dionysius Exiguus in the year A.D. 527 as the commencement of the Christian era. It therefore follows that the 45th Julian year was the first year before the commencement of the Christian era, and that the 46th Julian year was the first year after the commencement of the Christian era. The decade of years of the Julian era from 41 to 50 inclusive was thus contemporaneous with the first five years before Christ (B.C.), and the first five years after Christ (A.D.). If, now, the diagram be considered by the light of this explanation, and the spaces be regarded as representing the respective years, it should be easy to see "what it is that we are talking about."

As to the leap years of the Julian era, Julius Cæsar was assassinated by wretches who wanted to seize Rome, and the putting in of the leap years fell into the hands of the priests. They blundered over it, and for the first 36 years of the Julian calendar they put in a leap year every third year instead of every fourth year. The priests managed this by something like the method of Lord Dundreary, who discovered that whether he had ten fingers on his two hands—or nine, or eleven—depended solely upon whether he counted his fingers forwards or backwards, and where he left off before he summed them up. Whether the priests began, as some sages of this day do, with a zero year, I do not know. But they counted both extremes, as was the custom in Rome, and so made every three years into four. The result was that in the 37th Julian year, the Emperor Cæsar Augustus discovered that the calendar was too slow by three days, and he then ordered that the next three leap years should be omitted. Now the next three leap years would have been 40, 44, and 48 of the Julian era, and these were all reduced to 365 days each. It was not till the fourth leap year, the fifty-second Julian year, and the seventh of the Christian era, that another year of 366 days was let into the calendar. Thus it came about that leap years were non-existent in the Julian calendar at the commencement of the Christian era.

Owing to the Julian calendar, with its leap years, proving too slow for the years by an annual interval of 11′ 12·43″ = 44′ 49·72″, or nearly 45 minutes every leap year, the calendar had got twelve days behind the true season of the year in the time of Pope Gregory. By that time the true length of the year was more accurately known, and Pope Gregory then put the calendar on ten days, so as to correct it for the days it had fallen behind, while, in order to make the calendar in future to keep better time with the revolutions of the earth round the sun, he ordained that all the centurial leap years except such as were divisible by 400, should be left out. This was in 1582. The Julian calendar, thus further corrected, thenceforth was very unfairly called the Gregorian calendar. What the Monk Dionysius Exiguus had done in 527 was simply to steal the Julian Era. Its first 45 years he cut off, and its 46th he called the first of the Christian era. Otherwise it remained the Julian calendar. And all that Pope Gregory had done was to partly make those further corrections in the number of leap years which the Julian calendar in its working for centuries had shown to be necessary. The Catholic countries in general at once adopted the New Style (N.S.) of Pope Gregory. This reformed calendar was ten days in advance of other nations, and the unreformed calendar, for the sake of distinction, had to be denoted as Old Style (O.S.) England, being a Protestant country, did not then adopt Pope Gregory's New Style, nor his omitted leap years. But in 1752 England did this by Act of Parliament (24 Geo. II. c. 23). Russia, being under the sway of the Greek or Eastern church, has even rejected the reformed calendar till this day. Christmas Day, which we held on our Dec. 25, was therefore in Russia the 13th of Dec. Again, owing to the 1900th year with us having its leap year omitted, while in Russia it is still a leap year, as ordained by Julius Cæsar, their calendar will be 13 days behind time on their first of March, 1900. Anglo-Russian documents therefore have to carry two dates in order to avoid confusion. The dates will appear thus:—

Thursday, 1900, March $\frac{15 \text{ O.S.}}{2 \text{ N.S.}}$

Reverting now to our diagram, it will be evident that the years B.C. are merely a retrospective method of labelling time, and that, in counting the years B.C., we count backwards, and in each year we unavoidably begin with the 31st of December, and end with the 1st of January. The years A.D. we count forwards, precisely as we count the years of a man's age, and the early calendar A.D. we regard precisely as we regard the calendar to-day. It is, therefore, evident that the 100th year has to be completed before the 1st century is finished, and that the 1900th year has to be completed before the 19th century is finished. When we come to nineteen hundred *and* one we shall have completed the 19th century and entered upon the first year of the 20th.

As to the sticklers for the precise moment of the real Nativity, we know neither the day nor the month of the Nativity. Historians, moreover, are agreed that Christ must have been born prior to February in the fourth year B.C. But whether Christ were born five years before the date now in use for the commencement of the Christian era, or were born five years after it, or had never been born at all, makes not a particle of difference. Our calendar has been determined by an English Act of Parliament, and it would be alike impracticable and futile for us now to attempt to alter it. Nor does the naming nor dating of our era have anything to do with the number of years which have to be allotted to a century. If a cheque for £100 be misdated, that makes no difference to the number of sovereigns which the payee is entitled to at the bank-counter. So, in order to complete a century, we must finish up its 100th year to the last moment.

James Edmunds.

26, Manchester-square, W.

DOUBLE-ENGINE RUNNING ON RAILWAY.

[43259.]—IT is much to be wished that some of your readers would give attention to the boilers, or, more correctly speaking, the want of boilers on our locomotives. Trains get longer, carriages get heavier, but the new engines won't do more work than the old ones did. The result is that nearly all the heavy fast expresses have to have a second engine or they can't keep time.

What do we see? Two big engines drawing a train that one should draw, and four men being paid to do the work that two should do. There is a fearful waste of locomotive power going on simply because our modern engines have their cylinders too big and their boilers too small. If an engine is to do good work it must have a Large Boiler.

FIELD ARMOUR.

[43260.] — WHILE reading the letters on this (especially present) interesting subject, I am reminded of the famous bullet-proof coat, so much talked of three or four years ago. Can any of "ours" tell me why it was not adopted in our army? I remember reading in a newspaper of the trial before the Duke of Cambridge, where a 9lb. breast plate successfully resisted at close range a rifle ball which a 2ft. oak log could not stop. Surely if our soldiers had been clothed with this remarkable material it would have saved many lives at such battles as Dargai and in the present war, and would be much better than these shields. On looking at the neat sketches of letter 43203, I was struck with the size of the wheels, and they appear to be of iron; if so, they would surely weigh several tons. How are they to be moved about in such a country as the Transvaal by five men? E. R.

[43261.]—THE less must not be held to include the greater: to criticise Mr. Lawler's scheme is not to offer an opinion on the general question of field armour. Thus it is not apropos to quote against me Sir Walter Scott's attitude of mind with regard to the question of gas illumination.

The idea of field armour is an old one; but hitherto practical difficulties have stood in the way of its adoption, even as an experiment. When Mr. Lawler, or some other inventor, can produce a bullet-proof material extremely light and convenient in every way to manipulate, then the pros and cons. of the field-armour question will be the subject of interesting discussion.

Meanwhile it is easy to show that the inventor's schemes (or such of them as I have seen) are, to put it mildly, impracticable, simply because any efficient field-armour would be too heavy for use in the field. By field armour in this connection I mean bullet-proof armour protecting *attacking infantry*,

and intended to secure their *close approach* to the enemy. Now, if you want to protect a man you must do it properly, because a wound disables *pro tem.* (and by hypothesis the protection is only required on an emergency) as effectually as death. A shield 2ft. by 2ft. would do very fairly well if a man kept crawling on his stomach; but I do not think this idea recommends itself. A shield 4ft. high is not good enough, and I think Mr. Lawler (who is evidently in thorough earnest) will, on reflection, admit this. No, a shield must be say 5ft. 6in. high and 2ft. broad as a minimum, and will be 11sq.ft. in area. According to latest experiments, $\frac{3}{16}$in. hardened steel is bullet-proof at forty yards. This is good enough, but unfortunately it weighs about 7½lb. per square foot, and a shield would weigh 80lb. per man. If anyone thinks this a practicable weight let him try and carry an ordinary door in the position in which he would have to carry a shield.

But supposing you were to get each infantry soldier to carry an 80lb. shield over a mile and a half of give-and-take ground to the attack, would our generals in South Africa like to provide the necessary transport? The weight of the shields per battalion would be about 30 tons; to move this would be required 30 carts and 180 mules, or equivalent transport. Though Mr. Lawler is of opinion that "shields would have taken us to Ladysmith long ago," yet he will admit that accidents will happen, and that even with shields Sir R. Buller might have been checked at Colenso. Now, imagine that Buller had shields, that he *was* checked at Colenso, that he retired to Chieveley and Frere (still in possession of his shields), and there waited for reinforcements (with shields), and that he determined on the move which he began on the 10th inst.; as it is, his baggage train we are told extended over 19 miles of road. Under our imaginary circumstances, transport would have been required for an additional 600 tons—that is the equivalent of 600 carts and 3,600 mules. Is that "good enough"? As a matter of fact, although it is sufficient to give the foregoing reasons (the only ones probably which will appeal to "inventors") in support of the proposition that field-armour under present conditions is impracticable, yet the most important reasons are founded upon purely military considerations. With these it is unnecessary to occupy your space; but they are so cogent that even if bullet-proof material were considerably lighter than it is, I believe military opinion would be against its use as field armour. **Sapper.**

USEFUL AND SCIENTIFIC NOTES.

THE Admiralty have ordered a third-class cruiser to be laid down in Devonport dockyard forthwith. She will be 310ft. long, have a speed of 20 knots, and be armed with sixteen quick-firing and two Maxim guns.

THE annual Blue Book relating to canal traffic in the United Kingdom in 1898 has been issued. From this publication it appears that the total mileage of British canals was 3,906, and during the twelve months the traffic conveyed over them amounted to 39,358,394 tons, which earned a total revenue of £2,408,534. Of the total, the share of the Manchester enterprise was 22,118,005 tons. Add to this 6,009,820 tons, the quantity carried by railway-owned canals, and it appears that the other waterways conveyed a little over 11,210,000 tons.

FROM a report recently made by Preece and Cardew on the cost of lighting railway carriages by electricity, it appears that the total annual cost per coach would be £13 16s. 6d., based on the cost of fitting and running 400 coaches with an average of 12 lamps of 8c.p. per coach. The total capital outlay for lighting this number of coaches is estimated at £32,000. These figures somewhat exceed those contained in a report on the subject by Mr. W. Worby Beaumont some months ago, and show that the capital outlay would be about 50 per cent. higher than for compressed oil-gas for equally effective lighting, while the gas would cost about 25 per cent. less for supply and maintenance.—*The Engineer.*

OWING to the growth of the incandescent system of gas lighting in Germany, proposals have been made to reduce greatly the candle-power of the gas provided, with a view to cheapening its production. At Magdeburg, according to the *American Manufacturer*, the question has been seriously debated as to whether it would not be well to reduce the candle-power from fourteen, its present value, to ten, and finally to eight. Experiments show that when used with an incandescent mantle, the poor gas has in certain cases given even more light than the rich. Thus, in one series of tests, a burner of this type was supplied with gas ranging in candle-power from fifteen to two, and the latter actually gave the best light. Probably it contained a considerable amount of hydrogen. With the recent improvements in water-gas manufacture, a gas rich in this constituent can now be very cheaply produced.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96919.]—**Floating Body in the Air.**—Having noticed the wording of the advertisement of Mr. Maskelyne's trick of retaining the body in the air "without any tangible support," I took the opportunity of being for a few nights in London during the middle of October last to visit the Egyptian Hall at an afternoon performance, having with me a good opera-glass, as is my usual habit. I at first took a seat on the ground floor of the auditorium; but finding my view interfered with from any seat available, I went up into the gallery and managed to obtain a seat in the centre that was unobstructed. The conclusion at which I arrived was that there was a very tangible support indeed, which I admit I could not actually see; but I could, and did, see the actual spot where it was located—viz., on the side of the "floating" man furthest from the audience, at or near to the waist of the "floating" individual, whom I will call the subject, and the gentleman who demonstrated (I presume Mr. Maskelyne), the operator. Covering the back part of the stage there was a daïs, about the height of a table from the front part of the floor. On the daïs the subject laid down on his back. The operator was dressed in a pseudo-Chinese costume, including a flowing silk robe of a moderately light-blue colour, if I remember rightly (the colour not being of any special importance). The operator took a good-sized cloth, much like an ordinary table-cover, and placed it over the subject, entirely concealing him, the cloth hanging down a few inches below the margin of the daïs. He then passed behind the subject, and stood near his waist. Slowly and gradually, without noise, the subject rose until he reached about the lower part of the operator's chest, and the latter then removed the covering from the recumbent man, who then appeared to be floating in the air. The operator then went through various manipulations intended to show the absence of any support, including the passing of a hoop, that had every appearance of being complete, and I believe it was so, over the feet and up as far as the operator could bring his left hand, then back again. Then taking the hoop in his right hand, he passed it over the head of the recumbent figure to a part about one foot or so nearer to the feet than the spot to which he had brought it from the other end. But he did not at any time pass the hoop over the subject from one end to the other completely. And, moreover, I noticed particularly that the hoop, when at its extreme limit from either end, was held obliquely, but in opposite directions, thus, Λ, so that in both cases the part of the hoop next the audience passed a certain spot on the subject, while the part of the hoop away from the audience did not do so. So much for the facts. Now, my conjecture is that while the subject was lying covered, a substantial support was attached at the spot above indicated. The operator stood just behind that spot while the figure rose, and practically concealed the support by a fold of the robe. He may possibly not have actually concealed it, but only rendered it so inconspicuous as not to be noticed by the audience, for the support may have been painted the exact colour of the robe, and even bent into some curve resembling a fold in the robe. I have generally observed in these tricks that something quite unconnected apparently with the object is precisely that on which the *crux* of the whole depends—hence the adoption of the Chinese robe. GAMMA SIGMA.

[97016.]—**Electro-gilding.** — As PC dissolves very readily in water, why not add more water? REGENT'S PARK.

[97032.]—**Ink.**—Dissolve gluten in pyroligneous acid. Soap-like fluid is obtained, which is diluted to strength of ordinary vinegar. To every pint add, lampblack ¼oz., indigo 20gr. Or lampblack 1, potash water-glass (syrupy) 12, aqua ammoniæ 1, distilled water 38. REGENT'S PARK.

[97045.]—**Sanitation Watered Silk Paper.**—If you mean satin paper stains. Grey light: dissolved parchment shavings 8¾oz., water 1¼gallon. Mix pulverised chalk 4¼lb., Frankfort black 8¾oz., Paris blue 1oz., wax soap 3½oz. For glazed paper. Black: glue 1lb., water 1¼gal. (triturate with lampblack previously rubbed up in rye whisky). Frankfort black 2¼lb., Paris blue 2oz., wax soap 1oz., add liquor logwood 1¼lb. REGENT'S PARK.

[97174.]—**Water Power.**—All information of the kind required is to be found in Molesworth's Pocket-book, published by E. and F. N. Spon, 125, Strand, W.C. The calculations necessary to answer the query definitely would occupy more time than I could spare. The fall being only 4¼ft., probably a breast wheel would give the best results; but everything depends on details as to the "best" arrangement. The work above mentioned gives useful information on the subject. METOPS.

[97180.] — **Marine Navigation.** — Thanks to "J. J. H.," but will he tell me in which of the "guides" to marine engineering I can find full information about the exhaust steam from the auxiliaries being used to drive the main engines of a liner? It seems strange that the exhaust steam from auxiliaries should have so much power left in it; but it is easy to understand that it can be used for "evaporating fresh water for the boilers," though it is rather puzzling to know what the boilers do with the evaporated water. However, no doubt "J. H. H." speaks from knowledge, and can refer me to an authority. It seems to be peculiar work to use so much steam in auxiliaries that the exhaust can drive the big engines. Rather wasteful, is it not? G. S. N.

[97212.]—**Molybdenite.**—If you were to write the Secretary, Metals Exchange, London, E.C., I have every reason to believe he could quote approximate prices very seldom mentioned, if at all, in London or market reports. REGENT'S PARK.

[97218.] — **Potash - Making.** — Caustic potash made by adding slaked lime to boiling solution of potassium carbonate in not less than 12 of water, when calcium carbonate remains at the bottom and potassium hydrate remains in the clear solution. If solution be too strong, lime will not decompose carbonate, for reaction is reversible. When solution is evaporated, potassium hydroxide remains as clear oily liquid, which solidifies to white mass as it cools and forms fused potash of commerce, and often cast into cylindrical sticks. Potassium hydroxide is vaporised at high temperatures without decomposition. Half its weight of water suffices to dissolve it with great evolution of heat. Alcohol dissolves it easily. Bloxam. For further details see T. E. Thorpe's "Dictionary of Applied Chemistry." REGENT'S PARK.

[97221.]—**Telectroscope.**—"T. P." asks "will anyone be able to see round a corner?" We do, in fact, now see round a corner every time we view an image reflected from a reflecting surface. For example, if we focus the image of the sun reflected from a mirror a few feet from us, we find that we have the focal distance for the sun 92,000,000 miles away, and are entirely out of focus for the surface of the reflector, proving that there is no image formed there. This holds good for all distances and all angles. See proposition, "E. M.," No. 1807, "Where is the image?" I can see only one explanation of this fact: the sun and every object around is sending out vibrations, original or reflected, in every direction. Now, if a cone of vibrations from any object strikes a reflecting surface it is turned from its course, according to the well-known laws of reflection and incidence, and enters an eye in position to receive it. The diverging rays cannot form an image, and the particular rays of the sphere of divergence which converge to form the image depends upon the position of the observer with respect to the object and mirror. After entering the eye it is difficult to follow the vibrations of the locus of modification; but it seems probable that the vibrations pass through the soft layer of nerves without affecting them, reach the rods and cones, and through them set up vibrations at the ends of the nerves, which travel backwards to the sensorium, and are there modified into the image of the object from which they proceed; light and all the phenomena of vision thus being the luxuries of intelligence. By this bending of the cone of light at the surface of a reflector, we are able to see objects that may be behind us, or off the radius vector which joins the eye to the mirror; we see, in fact, round a corner. F. H. E.

[97235.]—**Melting Old Brass.**—It may be of interest to "Regent's Park," who, on p. 430, thinks it doubtful, to learn that brass is easily melted in a crucible on a smith's fire. In fact, if "R. P." puts a bit of brass wire into a kitchen fire when there is a good draught he will not see much of it afterwards. The temperature of the fusing point of brass varies according to its composition; but it must be a highly zinced brass which melts at 1,650° Fahr. The average temperature is nearer 1,800°. Which book has misled "R. P." this time? C. S.

[97259.]—**Keeping Oil - Engine Cylinder Cool.**—Doubtful whether it can be done satisfactorily without water; but the best way without is probably to have the outer surface of the cylinder covered with a spiral web of metal exposing large surface to the air, so as to radiate the heat. R. T.

[97261.] — **Pattern - Making.** — The querist should turn up the articles on pattern-making which appeared in this paper some time ago, and which were afterwards published in book-form by, I think, Lockwood and Son. If the querist is not going to do the casting himself, the foundry would make the patterns to his drawings. D. L.

[97263.]—**Organ - Building.** — In his remarks "W. A. J." states he has seen small organ-pipes, but never a full compass stop of 2ft. tone—surely he has not seen many organ-pipes or he would know that such stops as piccolo, flautina, flageolet, and 15th are all 2ft. stops, and in organs nearly always

have the full compass of the manuals, but if incomplete the top octaves are always inserted. "W. A. J." also asks about size of these small pipes in the upper octaves, he will find that top G of the Piccolo would be about $\frac{3}{4}$in. long (open pipe). I should certainly advise "W. A. J." to examine the interior of almost any organ: he would soon satisfy himself as to the size and range of 2ft. stops.

DIAPASON.

[97272.]—**Languages.**—For works in all European languages try Crosby Lockwood and Son, Stationers' Hall-court, E.C.; or D. Nutt, Strand—just by St. Clement Danes, if you are in London. Williams and Norgate, Henrietta-street, W.C., have also lists of such works, and would no doubt be able to show you suitable works; but it is not exactly clear what you want. Lockwood and Son have "Weale's Series," and there are grammars and dictionaries of, I believe, all European languages in that. The volumes may, however, be out of print.

LINGUA.

[97284.]—**Geometrical Progession.**—I accept the remarks of "Quivis" in the friendly sense intended, and do not suppose, when each has fully stated his case, there would be much room for divergence of opinion. Of course, in attempting to solve the equation $r = \frac{315 - x}{150 + x}$, which is indeterminate, by a convenient assumption one is exposed to a variety of objections, since r may stand for any integer we please, or for zero. Still "Quivis" has not attempted to disprove that on the hypothesis of r and x being positive integers, we could not arrive at any other conclusion than $r = 2$. But in these and similar cases the results obtained are only admissible by testing their applicability to the question in hand, and cannot be affirmed correct otherwise. Hence, while algebraically we can accept the solution $r = -1$, x = infinity, we cannot admit the trial results $r = o, 4$; $x = 315 - 57$. I do not know whether "Quivis" is referring to the closing remarks of my letter or to those of Mr. Paris when he says, "I should like to know what it means"; but as the subject may possibly interest others, and lead someone to discover a better method of solving general biquadratics, perhaps space may be spared for the following. As matters now stand, we solve biquadratics (when not directly resolvable into lower factors) by means of a cubic, but if it be possible to put the general biquadratic—

$$x^4 + a x^3 + b x^2 + c x + d = o$$

under the form $(z^2 + A x + B) z^2 + C x + D) = o$, where A, B, C, D are expressions involving a, b, c, d, then we can solve the general cubic—

$$x^3 + ax^2 + bx + c = o.$$

For, multiplying by x, we get—

$$x^4 + ax^3 + bx^2 + cx = o,$$

and putting $x = y + 1$, we have the biquadratic—

$$y^4 + (4 + a) y^3 + (6 + 3a + b) y^2 + (4 + 3a + 2b + c) y + (1+a+b+c) = o,$$

or— $$y^4 + \alpha y^3 + \beta y^2 + \gamma y + \delta = 0.$$

The four values of y obtained of course refer to the biquadratic in y; but if to each of these we add unity, *three* will be the solutions of the general cubic, and the fourth will be zero, corresponding to one obvious value of x in the multiplied cubic, and which gives $y = -1$ in its transformation. I have not succeeded with the suggested quadratic reduction, and so far no advance on Cardan's formula has been made; but I do not think we have reached finality yet—or, at least, I hope we have not.

West Norwood. HENRY T. BURGESS.

[97308.]—**Salicylate of Soda.**—This, though a valuable medicine, should be used with caution, as it is a very powerful depressant, and caused an inquest a few weeks ago.

West Didsbury. M. COLE.

[97336.]—**Roller Bearings.**—We beg to state that the application of properly constructed and properly manufactured straight and end-thrust roller bearings would be most useful on the various things referred to in that communication—namely, cabs, omnibuses, locomotives, traction engines, &c. We speak from an experience of nearly ten years, and are prepared not only to make applications in any of the cases we cite, but guarantee efficiency and durability. The matter in question is one of interest to engineers, and it will no doubt be of interest to them to know that the roller bearings manufactured by this company at their works at Birmingham are made from British material and by British labour, and they are the most successful roller bearings that have ever been manufactured.

MOSSBERG ROLLER BEARINGS, LTD.

[97359.]—**Flash-Powder.**—I should advise querist to leave the flash-powder described alone. He should bear in mind that picric acid is also known by another name—lyddite. R. W. M.

[97361.]—**Clock-Weight.**—Without seeing the two clocks, I am afraid it is rather difficult to explain the difference in motive power—that is, if they swing the same arc, and the pendulums are alike. Of course, if one only swings, say, $1\frac{1}{2}°$, and the other over 2°, that would account for the extra power required; and one reason I forgot to mention is a very confined space for the pendulum to vibrate in. I know one of my clocks with a dead-beat escapement and a very small space for the pendulum will very soon increase its arc a good degree on each side of zero when the case is removed. As regards the dead-beat escapement, the usual proportions are to give $1\frac{1}{2}°$ of impulse to each pallet, so divided that the impulse begins $\frac{1}{2}°$ before zero, and ends 1° afterwards, and these proportions are generally adhered to. With an escapement so planned you will find you can get plenty of swing if you largely increase the motive power, and to give much lift to the pallets is not considered advisable. But if your clock-weight is only about 5lb., falling 6in. a day, I should say you have nothing much to complain about, let the Cook and Son clock have what it may.

Ealing. F. M. MANN.

[97382.]—**Rats.**—To catch rats you must deceive them. Get an iron trap (gin) and adjust it so that a 2oz. weight will spring it when placed on bridge. Next get a box large enough for trap to lie in, and about 4in. or 5in. deep. Now set the trap, and lay it carefully in the box, and cover it over with tissue paper, and sprinkle a few bits of bread over it. The rat smells it, he finds it, and jumps on to the solid bottom (as he thinks), and is caught by the fore-legs. I have been quite successful that way. But, better still, keep all food out of their way, and as far as you can out of their smell, and do not drop or throw any food about. Food is what they come to seek. At my house we are very particular that way, and I have not heard or seen a rat, mouse, or beetle for a long time, and yet my neighbours are pestered with them. I have an earthen pan with cover for bread, and a hanging cupboard for other foods, and no rat or mouse can get in, and all crumbs are swept up. Starve them and set your dogs on them, and I think you will soon be free of them. W. M.

[97382.]—**Rats.**—Sixty years of observation have shown me that any one using poison for rats finds that he has poisoned something that he did not want to poison. Nevertheless, if poison must be used, I am assured by an old gamekeeper that the safest manner to do it is to mix a little strychnine with oatmeal, and scatter it about the rats' haunts. The use of cork or sponge saturated with grease, honey, &c., is abominable cruelty. In these cases the poor beast dies from enteritis after suffering lingering torture; whereas strychnine kills rapidly by fixing or "paralysing the muscles of respiration" (according to the notes of Palmer the poisoner). I know of a case where some rather ruinous farm buildings were made rat-proof by coal-tar asphalte poured into all the foundation interstices.

HAMMER.

[97391]—**Spun Glass.**—This was one of the stock exhibits at the Polytechnic in the old days, and the operator used to sell skeins of spun glass; but I agree with M. Cole (p. 520) that it is very "nasty stuff to handle." If I remember, the old gentleman at the Polytechnic had a gas blowpipe to heat the rod of glass, and the thread of glass was drawn out on a wheel worked by a treadle. Rods of coloured glass were used, and the "skeins" produced were "pretty." I do not think they were of much use. S. R.

[97398.]—**Climate of China.**—Madrid is also 40° N. lat., and it is very cold in winter; but it stands very high above the sea in the centre of Spain. But New York on the sea-coast is also about 40°, and it is also very cold in winter. The climate of England is affected by the Gulf Stream, which warms us in winter. G. A. HAIG.

[97406]—**Ulcer in Stomach.**—Drink tar-water.

COSMOPOLITAN.

[97407.]—**Carburator.**—You had better refer to back numbers of "E.M." for view of carburator given in articles on "Motor Tricycles." This will give you a good idea of general construction of the Longuemare type. Instead, however, of using a cotton wick, have a loosely-knitted sleeve of single Berlin wool made; this is much quicker in capillary attraction than the cotton, and should be changed regularly. There are two kinds of the Longuemare—one for motor-tricycles, the other for motor-cars. The chief objection is use of floats and levers, which require attention from time to time to keep in good order. I saw a simple form of carburator in use a short time back, made apparently out of an old square biscuit-box. Inside was a perforated plate fitted a few inches from the top, crammed with worsted, standing about 1in. above plate, the ends being clipped and then frayed out into a mop-like form. The hot air was drawn in at one side and over the surface out at the other. The owner would not give me much information; but I could see that it was reduced to simplest possible form, and afterwards I saw the car running very well with it. By pure air valve you mean early arrangement of Benz, now discarded. See "Auto-Car's" reply to yours for other information; also letters on troubles of Benz cars, which are interesting. See all your pipes, valves, and connections are large enough, and do not throttle anywhere, if you want high speed with engine. This has been a great fault with many would-be engine-makers.

MONTY.

[97413.]—**Electrical.**—To work a coil having 10oz. No. 16 on the primary and $2\frac{1}{4}$ No. 36 on the secondary, from four to six cells would be ample. It would be advisable to use the smaller number, if possible, as, with more cells, the primary wire would probably heat much, the platinum contacts of break might stick, and there would be risk of breaking down the insulation of the secondary. The size of the plates in each cell should be about 7in. by 5in. S. BOTTONE.

[97415.]—**Automatic Boiler Feed.**—"Electric Light Installations," Sir D. Salomons, pp. 100 and 101, gives elevation, section, and parts of Fromentin boiler feeder. This is probably what you require.

W. J. SHAW.

[97415.]—**Automatic Boiler-Feed.**—You have looked in the wrong "work." He has written a smaller work in one volume. "Electric-Light Installation and the Management of Accumulators," price 6s., Whittaker and Co.

RICHARD HUDSON.

[97418.]—**Microscopical.**—The magnification (linear) is directly as the distance. Hence if at 10in. the magnification is 40 diameters, at 33in. = 3·3 times the distance, the magnification is 132 diameters. S. BOTTONE.

[97419]—**Moisture in Showcase.**—Make showcase perfectly air-tight. Remove coloured or metallic goods. Place saucer with $\frac{1}{4}$lb. chloride of lime on each shelf and renew until cured. The saturation of CaCl will depend on the copiousness of moisture source. J. W.

[97420.]—**Swiftograph**—The publishers of the system are Jarrold and Son, 10 and 11, Warwick-lane, London, E.C., price 2s. COSMOPOLITAN.

[97420.]—**Swiftograph.**—I have tried this and gave it up in preference to Pitman's, which is the universally used system. "Teacher" may be had from Jarrold and Sons, 10 and 11, Warwick-lane, E.C., price 2s. If you are thinking of taking up shorthand, I should advise your starting with Pitman's, with which you can get assistance so easily. This assistance is really required, as there are many little difficulties to be overcome.

W. J. SHAW.

[97423.]—**Mercury Break for 10in. Coil.**—First, I have never seen paraffin oil used to cover the mercury, but do not know of any reason precluding its use. Alcohol is generally used; and if the layer is thick enough so that there is a considerable thickness above the highest point to which the "dipper" rises, there is no fear of firing. Some use distilled water, and these speak highly of it. In most cases a small quantity of finely-divided platinum is added to the mercury, so as to form an amalgam. S. BOTTONE.

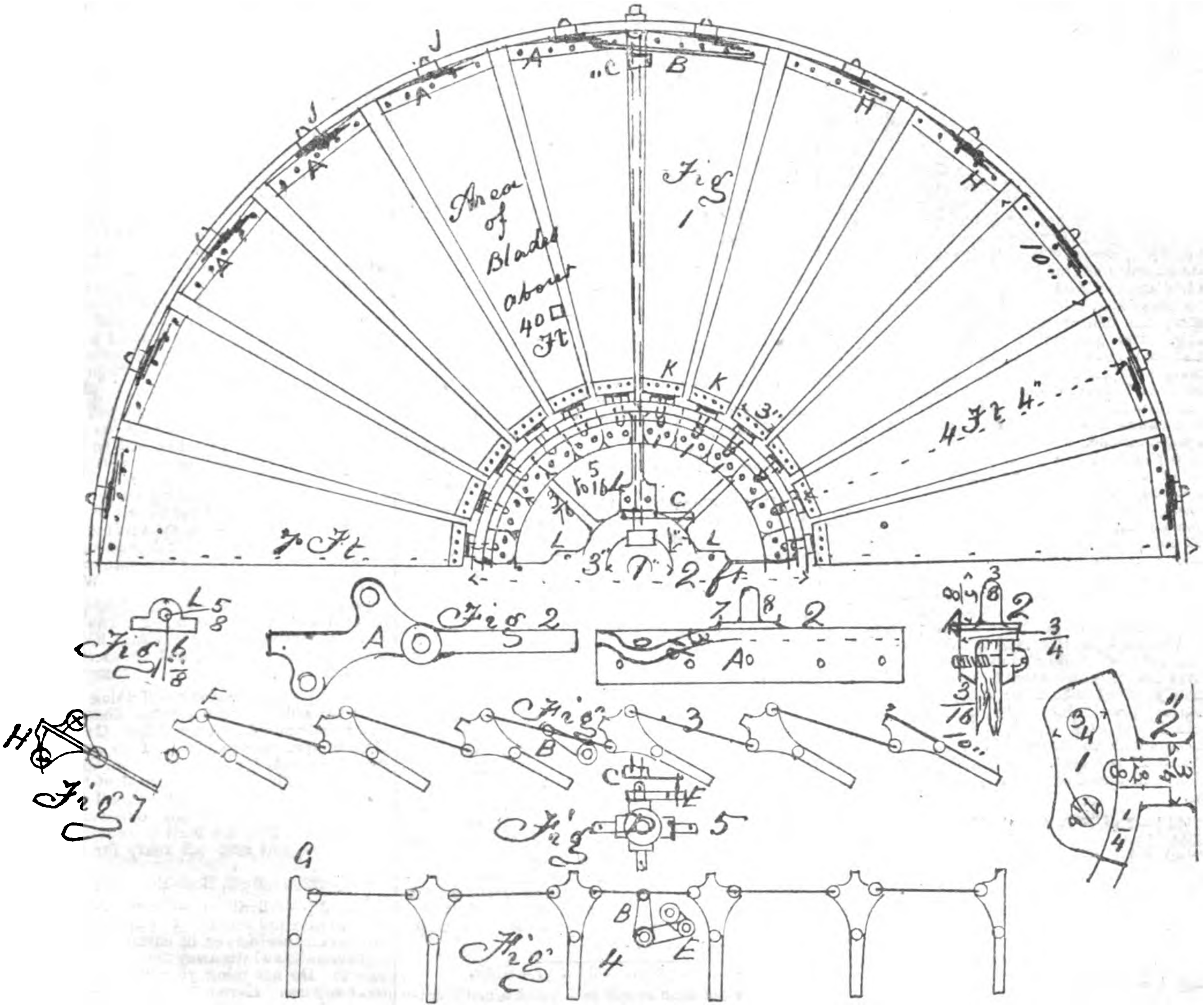
[97425.]—**Eyepieces.**—If, which is probable, the compound microscope is of the positive or Ramsden construction, it must be placed outside the cone of rays at a distance depending on its power of focal length. This distance can be experimentally found by viewing, with the eyepiece alone, any small object, and noticing its distance therefrom when in focus. This will be the distance it must be placed from where the image is formed by the o.g.

Corporation-street, Bolton. W. BANKS.

[97426.]—**Accumulator Charging Dynamo.**—To MR. BOTTONE.—Procure a sufficiency of tripolar laminations 2in. bare in diameter, to make up an armature 2in. long. Mount these on a suitable spindle and fit thereto a tripart commutator. Dress as usual, and wind with 6oz. No. 22 d.c.c., 3oz. in each channel. Wind the field-magnets with 2lb. No. 22 d.c.c., and connect up in shunt. At a speed of about 2,500 revs. per minute, this dynamo will give about three ampères at 15 to 20 volts pressure.

S. BOTTONE.

[97374.]—**Windmills.**—You do not give any particulars, but perhaps the following will suit you. Now we will say one 7ft. in diameter (that is rule of thumb) three of 22ft. × 12 = 264in., now allowing 1in. clearance, there being 24 blades or louvres to the fan—264 − 24 = 240, and 240 ÷ 24 = 10in. Here we have 24 louvres 10in. wide. Now the hub or boss of wheel will have to be 2ft. in diameter. That will make the blade at the junction of boss 3in. wide, and length 4ft. 6in. over all, less clearance. Now that will give 40sq.ft. of surface. Now the normal position of the louvres when at work for a gentle breeze will be an angle of 30°. They will not close more, but will open at right angles. I should think, as near as my judgment will carry me, this will be about what you require. About $\frac{3}{4}$H.P. to 1H.P. I have had no experience in these things and nothing to go by, and the dimensions you will find will, I think be about right. I have not the least doubt but what I shall be picked up if wrong in my calculations. The



question is, What do you mean to fix it upon? You will see that this is designed for a post about 8in. in diameter, and it will want some stays or guys to keep it safe—however, that is to come. Fig. 1 is the fan, and I have marked the dimensions. Fig. 2 2 2 are the shoes for the top end of blades A, and the shoes for the bottom are shorter and without ears. Fig. 2 is the thimble stop, the blades are shaped into the bottom, and returned through the hoop at the top; then the stop put in, as see 1 1 1, with two bolts, thus keeping it in its place. Fig. 3 shows you the blades coupled up in nests of six, so that there are four rods—i.e., striking gear, one each quarter of the diameter. That shows position (I might say normal working position) for working at angle of 30. (Fig. 4.) I ought to have said when the weight is on; when off it is at right angles, as shown, Fig. 4. B is the bell-crank that gives this motion: it is conveyed to it through the hole in the centre of shaft by a thrust-pin with a cross and links (as see Fig. 5), C the bell-crank near the eye, E the link, and D the cross, C H upon the face of fan giving the position. Fig. 6 is the step bearing for shaft L. Now, if you step out the arrangement showing blades, you will find that they do not correspond, and I have shown at Fig. 7, H, how they should be made: the shoes are made of malleable cast-iron, and the ears twisted, as shown, to bring them lineable with each other. The same etters refer to the same upon fan. The first view of shoe at Fig. 2 to the left is not right, but merely to illustrate the others; end and side views are right. Now you will want a post about 8in. in diameter to mount that upon, and it must be well stayed. There is some work cut out for you if you intend going in for one, but it will pay for doing, I think. The worst of them is that they roar with a breeze—at least, that is my experience when I have been to the Agricultural Exhibitions, but then it was blowing stiff. JACK OF ALL TRADES.

[97427.]—**Hard Compo.**—Is vulcanite, as used for roofing purposes, too expensive? REGENT'S PARK.

[97427.]—**Hard Composition.**—How would "Carton Pierre" do? Sort of paper pulp moulded up with plaster—used for ceiling ornaments. Several things of the kind nowadays—made from cellulose or paper. S. R.

[97428.]—**Grease.**—Cannot this grease be cleaned by simply dosing it with boiling water? The grease will float, and the "gritty matter" fall to the bottom of the vessel. Use plenty of hot water, and skim off the oil, or run it off through a hole inside of vessel. The grit will settle if time is allowed. S. R.

[97428.]—**Grease.**—Try a strong solution of sulphuric acid, especially if heated, and bichromate of potash added. REGENT'S PARK.

[97432.]—**Double Star in Cetus.**—The only reference to it I have been able to obtain is in Flammarion's *Les Etoiles*, where he says:—Preceding ζ and χ, there is a star of the 6th mag., often called χ^1 by mistake, which bears the No. 147 in the catalogue of W. Struve. It is a pretty double, sufficiently close; 6 and 7, at 3·5", white and bluish. Its co-ordinates are, for 1880, according to Flammarion, 1h. 34m.—11° 54'. There is no reference to this star in Webb's 4th edition; nor in any other work in English I possess. S. B. G.

[97432.]—**Double Star in Cetus.**—The star is Harvard Photometry No. 267 = Lalande 3137 = 263 Greenwich Catalogue 1880 = Σ 147. Its magnitude is in H.P. 5 89, in U.A. 5·8, in Heis 6, and in Manometria Nova 6. J. R.

[97432.]—**Double Star in Cetus.**—From the description given it is evidently 251 Ceti (Σ 147). R.A. 1h. 36m. 18s., dec. −11° 51·6', position 88·0, distance 4·0", epoch 1877, Dembowski; primary 5¼ mag., companion 7¼ mag., both white. It is shown in Peck's "Atlas," about 3° west of ζ Ceti; but not marked as a double star. W. B. D.

[97433.]—**Dynamo.**—The wire on the F.M.'s is not of sufficient resistance to balance the running resistance of the wire on the armature. Thus wire on A. = 6·5 × 0 67 ÷ 4 = 1·08 ohm; wire on fields 23 × 5 = 115 ohms, or, say, roughly, the ratio is at present as 1 is to 100, instead of being at least as 1 is to 350. If well constructed, with the armature running close to the tunnel, you have enough wire on your armature to give you about 100 volts and about 10 ampères of current, the machine running at, say, 1,200 revs. per minute, and absorbing about 2¼ to 3H.P. at work. To attain this result, you must get more wire on the fields. If there is room enough, you can do this by adding on 62lb. of No. 22—say 31lb. on each limb; if not, remove what you have on, and rewind with 46lb. No. 24 d.c.c. S. BOTTONE.

[97436.]—**Stamping Notepaper.**—It is not probable that you will be able to make the varnish yourself for this; but copal varnish coloured to suit is the nearest. To use, the die is removed, the colour painted on, then the surface wiped on waste paper, which removes all from the smooth surface, leaving it in the hollow letters; replace the die, impress, and stamp the paper.

West Didsbury. M. COLE.

[97438.]—**Gun-Cotton or Pyroxilin.**—Presuming you refer to the explosive variety and not to the soluble form, the following recipe will give good results:—Oil of vitriol, sp.gr. 1·845, 18fl.oz.; nitric acid (free from nitrous acid), sp.gr. 1·45, 6fl.oz; good cotton-wool 300 grains. Pull this latter out into ten little tufts, weighing about 30 grains each. Have two large and deep porcelain basins at hand, the second of which must be full of cold water; also two glass stirring rods. Now mix the acids together in basin No. 1, then immerse the tufts of cotton-wool one at a time, pushing them well under the acids as quickly as possible. Let the wool remain under the acid for nine minutes, remove by means of the rods to a flat dish, squeeze out as much acid as possible by the rod, then dash the cotton-wool into basin No. 2; stir about, place the whole under a running tap for 24 hours to wash away every trace of acid, collect the wool, dry in a cloth, pull out the tufts, and finish drying in a current of air. S. BOTTONE.

[97438.]—**Gun-Cotton.**—Gun-cotton ($C_{12}H_{14}O_4(NO_3)_6$) is formed by acting on cellulose or cotton-wool ($C_6H_{10}O_5$) with nitro-acid (a mixture of strong nitric and sulphuric acids); the cellulose does not undergo any apparent change, but on drying, it is found to be very inflammable. It is a nitrate or nitric ether, being cellulose, in which six atoms of hydroxyl are replaced by NO_2. H. F. L.

[97438.]—**Gun-Cotton.**—Gun-cotton has the formula $C_{12}H_{14}(NO_3)_6O_4$, and is, therefore, cellulose hexa-nitrate. It is made by soaking cotton wool in 10 parts of a mixture of one part of nitric acid (sp.gr. 1·5) and three parts of concentrated sulphuric acid. The clippings and other waste from cotton mills (such as is used for cleaning machinery), after purification from oil and fatty matters by treatment with alkali, and removal of string and rag, are passed through a machine, somewhat similar to a carding-engine, for the purpose of opening up the material, and subsequently through a cutting-machine. It is then rapidly dried by a powerful current of hot air in an automatic apparatus, and weighed off while warm into metal boxes holding 1¼lb., closed with well-fitting lids, and left in a cold chamber for 24 hours. The contents of each box are immersed by small quantities at a time in the usual acid mixture, remaining in for a few minutes, the temperature being kept down by cooling. The gun-cotton is removed from the mixture and pressed until it contains only 10 times its weight of acid. In this condition it is transferred to earthenware pots, closed with well-fitting lids, and left for 24 hours, the pots being surrounded by cold water. Then acid is extracted by centrifugal wringing-machine, and gun-cotton is carried in small portions at a time with great rapidity by means of a large paddle-wheel, revolving with a high velocity, into a large tank of water, and is thus drenched and rinsed. After two rinsings, and a complete wringing between each, is allowed to soak for 24 hours in water, maintained at 100° C. by injection of steam. The gun-cotton is then rinsed, placed in a pulping-machine, and again washed. It is then placed in a large washing-machine, and agitated with water for several hours, samples being tested for purity from time to time; 10cwt. are washed in one operation, and as this is the product of hundreds of distinct converting operations, a uniform lot of gun-cotton is obtained. Is now intimately mixed with 2 per cent. of alkaline carbonate and pressed into slabs (sp.gr. = 1). These contain 15 per cent. water, and may be cut with band-saws without danger. Now soaked in water to absorb 25 per cent. water, and then packed in wooden, well-closed cases in an uninflammable condition. R. W. M.

[97442.]—**To "F.R.A.S."**—The theoretical limit of vision of telescopes has reference to one of several empirical rules laid down by astronomers, and derived from a large number of observations. The one generally used is: Log. of aperture × 5 + 9·2 = magnitude of star seen with any particular aperture. The following example, taken from "Chambers," will explain. What is the smallest star visible in a 4in. achromatic?

$$\begin{array}{rr} \text{Log. } 4 = & 0{\cdot}6020 \\ & 5 \\ \hline & 3{\cdot}0100 \\ \text{Add} & 9{\cdot}2 \\ \hline & 12{\cdot}2100 \end{array} = \text{magnitude of star seen.}$$

(2) The formulæ here asked for has been given many times this last few years. For Ramsden or positive eyepieces, the formulæ is: Divide product of focal lengths of both lenses by their sum, minus the distance between them. Lenses both one focal length, say 2in., and separated 1·5in.

$$F = \frac{2 \times 2}{2 + 2 - 1{\cdot}5} = \frac{4}{2{\cdot}5} = 1{\cdot}6.$$

For negative or Huyghenian eyepieces, divide twice the product of focal lengths by their sum. Focal lengths as 3 to 1. Ex. Field-lens 3in., eye-lens 1in.

$$\frac{3 \times 1 \times 2}{4} = \frac{6}{4} = 1\tfrac{1}{2}.$$

(3) The field of view actually decreases. If the sky was divided into square degrees, and with one eyepiece four squares were seen, any stronger eyepiece would not show four squares. Field of view is governed by magnifying power chiefly, and is not influenced any way by a stop.

Corporation-street, Bolton. W. BANKS.

[97443.]—**Face-Plate.**—The weight certainly seems excessive. Extra thickness is, however, rather an advantage, as it renders the plate less liable to spring out of truth when irregular work is being clamped on it. I have seen face-plates sprung very much with the strain of the bolts. On the other hand, a heavy face-plate is cumbersome to get on and off the lathe, and also adds to the wear and tear of mandrel bearing, as well as running away with more time in stopping and starting the lathe. No; there is no fear of bending the mandrel, neither is there any reason why you should not employ as large a plate as the lathe will swing. No, you will not bend the saddle, but with 8in. of overhang there will be a lot of chatter. This may to a great extent be obviated by packing up between the underside of saddle and bottom of gap. Iron packing is best, and should be placed as near the front of bed as possible. You must expect to find the turning rather a tough job. I prefer a thick plate with a large number of slots to a thin one with few slots; these should be suitably arranged, where possible, for holding wheels with 3, 4, 5, and 6 arms, also to suit any angle-plates that you may have by you.

J. T. A.

[97446.]—**Deflection of Oak Beam.**—Timber beams supported at both ends, deflection allowed is $\frac{1}{40}$in. per foot run.

$$V = \frac{n\,W\,c^3}{e\,I}$$

V = deflection in inches.
W = load in pounds.
c = length in inces for beams fixed at one end; half length if supported at both ends.
I = moment of inertia.
e = modulus of elasticity.

Rectangular and square the inertia—

$$I = \frac{b\,d\,3}{12}.$$

Strength of rectangular beams: b = breadth; d = depth; L = span. For fir, safe distributed dead loads in cwts. $= \dfrac{b\,d^2 \text{ in inches}}{\text{L in feet}}$. For English oak, 1½ above load for fir. Value of a: Supported at both ends, loaded in middle, uniform cross section, ½; uniform strength and depth, ¼; uniform strength and breadth, ⅓. (Kempe tables.)

REGENT'S PARK.

[97448.]—**Cement.**—Caseine 10, water-glass 60. Apply quickly, and dry in air. Or: Pyrolusite 80, zinc-white 100, water-glass 20. When once fused forms glass-like mass, of great adhesive power.

REGENT'S PARK.

[97448.]—**Galvanometer.**—These galvanometers are not graded to any standard. Hence your only plan will be to take a fairly good cell, which has been made up about 12 hours, and test it on the quantity side for current, and note the deflection; then on the intensity side for voltage or pressure, and note this likewise. Measured in volts, all Leclanchés give about 1·4 volt per cell, while the current may vary from 0·1 to about three ampères per cell, according to its condition, resistance in circuit, &c. S. BOTTONE.

[97449.—**Velocity of Sound.**—The elasticity of a gas is to be measured by the pressure which is on it. If we take the pressure of the air as 15lb. to the square inch, the pressure in poundals per square foot will be = 15 × 144 × 32. The density of the formula is absolute density—that is, the ratio between the mass of a body and the space it occupies. A body has unit density when a cubic foot of it weighs 1lb.; the density of the air will thus be $\frac{1}{13}$. Hence the formula becomes—

$$V = \sqrt{15 \times 144 \times 32 \times 13} = 940\text{ft.}$$

A slightly different result will be obtained if more accurate values be taken for gravity, and for the density and pressure of the air. ARITHMOS.

[97449.] — **Velocity of Sound.** — E = bulk elasticity of air = ratio of small increment of pressure to small decrement of volume for unit volume. According to Boyle's law—

$$\begin{aligned} PV &= (P + p)\,(V - v) \\ &= PV - Pv + pV - pv. \end{aligned}$$

Neglecting the small quantity $p\,v$ we have—

$$Pv = pV$$

$$\therefore P = \frac{p}{v}V = E.$$

P is atmospheric pressure at time of experiment. Taking atmospheric pressure = 1,016,000 dynes per sq. cm., and density of air = ·001293, we have—

$$\begin{aligned} V &= \sqrt{\frac{1{,}016{,}000}{{\cdot}001293}} \text{ cm. per sec.} \\ &= 28{,}000 \text{ cm. per sec.} \\ &= 920\text{ft. per sec.} \end{aligned}$$

R. W. M.

[97450.]—**Drum Armature.**—To MR. BOTTONE.—Whether you will be able to rewind the drum without removing *all* the coils depends entirely on the extent of the injury. If only the coils last wound on are affected, you possibly may not have to remove all; but if any of the first arcs are implicated, it will be impossible to repair without. As you have my book, you will see at p. 86 that the sections on the armature are numbered 1, 1*a*, 2, 2*a*, &c.; so if you turn the armature over, after having wound each section, so as to bring the divisions marked 1, 2, 3, 4, &c., to the top, you will be doing right—whether you turn it over to the right or to the left. S. BOTTONE.

[97451.] — **Commutator.** — Besides your usual insulating packing between commutator sections and clamping nut, put a stoutish washer of ebonite or vulcanised fibre. This will take off some of the twist strain. Mica can be bought of practically uniform thickness, and if desired can easily be split thinner by means of the blade of a thin knife.

S. BOTTONE.

[97452.]—**Show-Case.**—Under similar circumstances I have found a shallow tray of sulphuric acid very effective in reducing the deposition of moisture. There is no cure so long as the inner and outer surface are at considerably different temperatures, and moisture present.

Corporation-street, Bolton. W. BANKS.

[97454.] — **Overtype Dynamo.** — To MR. BOTTONE or MESSRS. WEBSTER MICHELSON.—Armature 8in. dia., 8in. long, before winding, F.M. tunnel 8⅜in. dia. Pole-pieces should embrace together two-thirds of the armature; armature to be wound with 22lb. No. 14; pole-pieces 9in. long, 16in. across the face, including the aperture of tunnel; F.M. cores 5in. dia., 9in. long, cylindrical, wound with 78lb. No. 20, and connected up in shunt. For the series coil use 12lb. No. 12; speed about 1,300 per minute; commutator at least 4in. dia. in 36 sections. A machine to run three lamps of 16c.p. 55 volts, overtype drum pattern, would have an armature about 6in. long, 2¼in. dia., wound in 24 sections with 1lb. No. 22. The field-magnets should be of 1in. substance, 6in. long, with 3½in. winding space; and the tunnel, embracing as before two-thirds of the armature, should extend the whole length of armature; the field-magnets should be wound with 11lb. No. 24 d.c.c. S. BOTTONE.

[97456.]—**Launch.**—I should put a ½ or 1H P. motor in; the ¼-horse will not be of much use, particularly as the propeller will be working at a disadvantage, inasmuch as you wish it to be above the level of the keel. The best way to get over the difficulty is to have a lifting propeller—that is, a shaft with a universal joint in it. The size of propeller will be governed by the amount of water your boat draws. The pitch will depend upon the speed of the engine and the pace you want to go. Allow 40 per cent. for slip. W. J. SHAW.

[97456.]—**Launch.**—Seems rather small for 18ft. long; 1H P. would be better. The Yankees, or some of them, in their naphtha launches, allow 2H.P. for 18ft. length, and about 12in. by 12in. dia. and pitch. REGENT'S PARK.

[97458.]—**Observatory.**—Nothing less than 8ft. diameter will do for a 6in. tube. There is no objection to galvanised iron for sides. Cost depends on class of structure required. I do not remmend a revolving dome for so small a telescope. A square structure, with ridge roof formed of light sailcloth shutters, answers admirably. I shall be pleased to lend querist plans of an observatory of this description. They are built in sections, same as a greenhouse, and sent out ready for fitting up by levels.

Corporation-street, Bolton. W. BANKS.

[97462.]—**Vibration.**—I have no doubt you will have to grin and bear it. It is always the case near railways on viaducts or in cuttings, and very often more vibration a little away than if you were planted on top. Do not think your trench operation will be of any use. Have noticed the nuisance on or by South-Eastern and North-Western, and no doubt on all lines it is the same. Of course, if companies laid their metals on stout rubber it would go some way towards prevention; but that you can hardly expect them to do. Wet and dry makes a difference, I have noticed. REGENT'S PARK.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

97054. Mandoline, p 325.
97058. Poker Work, 325.
97060. Ether Freezing, 325.
97070. Oil-Engine, 325.
97074. Water-Power and Electric-Light, 325.

97233. Isle of Man Steamers, p. 411.
97234. Model Boiler Blow Lamp, 411.
97239. Motor for Safety, 411.
97240. Invalid Carriage, 411.
97243. Razors, 411.
97245. Horse-power for Car, 411.
97250. Phonograph, 411.
97253. Crankshaft, 411.
97262. Frogs, 411.
97273. Magnet, 411.
97274. Motor Cycle, 411.
97279. Harp Playing, 411.

Queer Cannibal Rites.—That cannibalism still flourishes in parts of West Africa, in spite of the advance of civilisation, is shown by the letter of an officer now serving in Nigeria. The people of the town of Igigger, for instance, eat all their prisoners, and even the bodies of the slain after a battle. Their burial customs are also strongly reminiscent of cannibalism. After a death the relatives of the lamented one strip the body, and at the end of four or five days roast it over a slow fire on a bed, with pots of yams, rice, and meat below. The body is basted with palm oil, which drips on to the food, of which everyone has to partake to show that they did not poison the deceased.

QUERIES.

[97464.]—**Shortest Day in Trinidad.**—I am living in Trinidad, 10° north of the Equator, and expected to find that the 20th of December would be the shortest day of the year. So far as my observations extend at present, the shortest day appears to be somewhere in the latter half of November. Can this be possible? Or can it be due to an increase in the length of the twilight making the days in December apparently longer?—TRINIDAD.

[97465.]—**Carbon Transmitter.**—In making a carbon transmitter, say the Ader type, is it absolutely necessary for the diaphragm to be of pine? Would teak or deal suit as well? If not, what sort of pine?—ANGLO.

[97466.]—**Torpedo-Boat Destroyer.**—Can any of your readers tell me where, in London, I could see an exhibition model of a torpedo-boat destroyer? To the best of my belief, there is no such thing in South Kensington Museum; at any rate, there was not one when I visited that place some months ago.—T. J. HOAR.

[97467.]—**Rook Rifles.**—Can any of "ours" give full information *re* ·22 rim-fire rifles? Any tests as to distance carried, accuracy, and penetration with both the ·22 long and ·22 short rim-fire cartridges would greatly oblige. The ·300 I find too powerful; but I am just afraid the ·22 would be weak enough for either rooks or rabbits. Any information as to the most suitable magazine rifle for this size of cartridge, or guidance as to the best bore of rifle to use, would be of interest.—W. S.

[97468.]—**Protecting Steel Surfaces.**—Wanted, information as to best method of protecting finished steel rods and pins subject to light friction (but which cannot be greased or lacquered) from rust. Perhaps the oxidising process as applied to watch-cases might answer, if anyone can describe the process?—F. L. H.

[97469.]—**Tender Feet.**—Can any of "ours" give me advice? My duty compels me each winter to stand and work on flagstones, some of which are cold and others warm, in a large public kitchen, and the ball of right foot is so tender that I limp. Is it rheumatism? How can I get ease? I have seven more weeks to be there. Is it caused by the stones, or what? A remedy would be a blessing.—A. STACEY.

[97470.]—**Motor-Cycles.**—Will the writer of the articles on motor-cycles kindly say where ball-bearings suitable for the back axle (of the tricycle illustrated) can be procured, as I am quite unable to get bearings at all like those illustrated on p. 542 of the "E M." of Aug. 4, 1899.—J. S. BROWNE, Ashfield House, Belfast.

[97471.]—**Piano Organ.**—I have a piano organ with the usual handle. I wish to make it self-acting. Information as to electric, clockwork, or other motor, with details, would be greatly esteemed.—A. SIMS.

[97472.]—**Oil-Engine.**—Will someone give drawings sufficient to enable me to make an oil-engine of $^{1}/_{10}$H.P. to ½H.P.?—GERARD S. PECK.

[97473.]—**Pocket Accumulators.**—I have a pocket accumulator, 4-volt cells, 4in. by 5in. by ¾in., with two plates in each cell. I have put new plates in them, and would like to know what to seal the tops with. The cells are of ebonite.—AN OLD READER.

[97474.]—**Knocking in Gas-Engine.**—I have read with interest the recent replies *re* the above. I, too, have a small half-horse oil-engine which makes a fearful noise at every explosion, as if it would break the whole thing to pieces. I have put a new pin, well-fitted, into piston-head, but it is no better. The rings are new, and part of explosion escapes. Can this be the cause of the noise? If you could suggest a cure, I feel sure you would oblige more readers than you can imagine.—A COUNTRY PARSON.

[97475.]—**Telephones.**—I have a pair of these between two rooms but sometimes can scarcely get a sound. They are evidently foreign manufacture. The microphone (Hunnings) is placed horizontally — two semicircles of tin-plate separated by ebonite slip, with granulated carbon resting upon all. I sometimes think the ebonite slip must prevent the two half-circles vibrating. I use two cells at each end. The cell bells work well, but the speaking is a failure. Could anyone suggest a cure?—A COUNTRY PARSON.

[97476.]—**Soldering.**—Will some reader kindly inform me how to tin carbon ready for soldering it to brass, for bichromate cell?—SEEKER.

[97477.]—**Brasswork.**—Will someone please tell me how to clean and brighten brass or copper beaten work, so as not to tarnish?—SEEKER.

[97478.]—**Electric Light and Gas.**—With price of gas at 3s. 8d. per 1,000, what price would electricity have to be to make lighting bill about the same? It is a factory that has to be lighted, and nothing would be saved in lessened cost of decorations.—G. E. O.

[97479.]—**Induction Coil.**—I have made a coil which gives a spark of 1in. in length. If I pass its current through a Tesla coil, can I increase it to 5in. or 6in.? May the secondary wire of the Tesla coil be covered with cotton instead of silk? Is there anything more known about the system of winding coils invented, I think, in Belgium, which gives 6in. or 7in. spark with not much more than 1lb. of secondary wire? I put my coil in a jar full of paraffin, in which I had dissolved paraffin-wax to the extent of making it a thick liquid; but it only slightly increased the length of spark. If the secondary wire were to be double-covered and the layers separated more, is it probable that a liquid insulator would be superior? It would be no trouble to keep a coil in a small tank, if it greatly decreased the cost of making.—H. M. S. L.

[97480.]—**Chlorine and Fluorine.**—Would some of your chemical readers kindly state briefly the method which was used to isolate fluorine, and also give its appearance and properties? Has chlorine ever been solidified?—HALOID.

[97481.]—**Platinum Resistance Thermometer.**—Could any reader give full description, with method of making and using, of the above? Details wanted.—RUN.

[97482.]—**Lichens.**—Will any reader inform as to the best method of preserving fungi and lichens for collection purposes?—BOTANY.

[97483.]—**Stains for Gun-barrels.**—Could any reader of the ENGLISH MECHANIC give me any information as to the best stains for gun-barrels, and how applied?—MECHANIC.

[97484.]—**Lens Problem.**—A lens is closed completely by an iris diaphragm. The diaphragm is opened with uniform motion from nothing to full aperture. Compare the amount of light that passes through with the amount that would have passed through had the diaphragm been fully opened all the time.—IRIS.

[97485.]—**Sparking Coil for Motor-Car.**—Will any friend give particulars of coil similar to Blake's coil? I simply want the sizes and weights of both primary and secondary, the primary to be supplied from a 4-volt secondary battery.—F. W. B.

[97486.]—**Organic Identification.**—I should be extremely obliged to any readers who could tell me of a good book on "Organic Identifications."—H. J.

[97487.]—**Heating by Gas.**—Some time since it was stated by a very good authority in these columns that although the incandescent mantle light was caused primarily by an atmospheric Bunsen flame, rendered incandescent by its action on the mantle, yet that the product of combustion was mainly carbonic-acid gas, and not the poisonous carbonic oxide. Does the same hold good with regard to open-fire gas warming stoves, where a Bunsen atmospheric flame plays on asbestos (so called) fuel or on asbestos fibre, causing the fuel or fibre to become incandescent, giving out both light and heat? I notice that some of these open fires are provided with condensing tubes which condense vapour into water, and remove the same with, no doubt, sulphur and ammonia impurities, and probably a little carbonic acid. They have no flues, so that the other products of combustion escape into the room, from which I infer that the makers recommend them as not more harmful than the flames from ordinary illuminating jets. If they emitted carbonic oxide (CO, monoxide of carbon) in any considerable proportion other than a mere trace, one would think they would be dangerous to life.—R. L. S.

[97488.]—**Soap.**—Two or three years ago "Lancastrian" gave details for making emollient soap without boiling, on the domestic scale. I have made several lots quite satisfactorily, and costing next to nothing, except for scent. I cannot scent it strongly enough to kill the crude smell of the fat. Delicate scents, as oil of geranium, are too fleeting; oil of cloves is more lasting, but too pungent. Can anyone help me to produce "Brown Windsor," or similar aroma, and the quantity necessary for 9lb. or 10lb. of soap—i.e., 6lb. of fat?—BUSHMAN.

[97489.]—**Rotundity of the Earth.**—Would "F.R.A.S." be good enough to say when was enacted the curious statute forbidding the teaching of the rotundity of the earth? I thought the rotundity of the earth was known and taught long before any of our statutes were framed.—ROTA.

[97490.]—**Motor-Car Carburator.**—Will any of "ours" give rough sketch of carburator similar to the one used on the Benz Ideal, and also dimensions of same for 4H.P. engine? Any information will be thankfully received.—F. W. B.

[97491.]—**Moist Air in Rooms.**—I have a room lighted by long, narrow window and a big skylight (nearly full length of room). The room is heated by a gas-fire on Bunsen burner principle, the waste heat going up the chimney. Finding that a great deal of moisture is caused by heating, I should like to know if air warmed by gas is not so dry as when coal is used; or is the skylight (with the consequent condensation from the cold outside) a sufficient explanation, no matter how the room be heated?—STUDIO.

[97492.]—**Collapsible Canoe.**—I wish to hear where I can find good designs of collapsible canoes or punts. Also, would a canvas boat, 12ft. long and 3ft. wide, be safe?—R. W.

[97493.]—**Excursion Trains.**—I have always understood that Thomas Cook was the inventor of excursion trains in 1841; but in the account of the life of a gentleman who died only last week it is proved he travelled by an excursion in 1840, and the original "bill" relating to this train is in the hands of his relatives.—EXCURSION.

[97494.]—**Shanks' "Times" Patent Enamelled Cast-iron Bath.**—Please give No. and date of this patent specification, or else tell me how to get at the screw-down valves to repack them, and at the waste valve in order to shorten the wire or chain by which it hangs. I began unscrewing the +-shaped handles in order to lift the porcelain cover which forms the soap-dishes. Their threads fit so tightly, however, that I feel sure they are not intended to be removed from their spindles, and that the porcelain can be detached in some other way.—GLATTON.

[97495.]—**Galvanometer.**—Can any reader give instructions for making a galva. for use with a magneto generator? Required also the resistance one of "Ericson's" telephone call generators, will ring through. The one I have appears to be wound with 40 wire.—CONSTANT READER.

[97496.]—**Silicate of Alumina.**—Said to be a combination of aluminium and flint. Where could I obtain a small quantity of this? or how could it be made?—S. W.

[97497.]—**Carburator.**—Can any reader kindly inform me how to construct a carburator for petroleum spirit, to be used with a 2¼H.P. motor?—O. H.

[97498.]—**Gas-Engine.**—If any of your readers could give me some information about a gas-engine, I should be much obliged. I have made an engine, 2in. bore cylinder, 3in. stroke, and the difficulty is that the explosion takes place too soon, and drives the wheels backwards. Does the fault lie with the ignition-tube? At first I had one 4in. long with a ⅝in. hole up it; but I replaced it with one of the same length, but with a $^{3}/_{16}$in. hole up it. I may mention that it gets red hot about 1in. from the bottom. How can I prevent the exhaust being drawn back into the cylinder? I have tried a stronger spring, but I find it is not much better. If I turn the gas and air supply taps nearly off, the piston sucks the exhaust-valve back. I also find that I cannot keep the wheels going round on account of the high compression—it stops the engine completely. Do I get too much gas and air in, or is this very high compression necessary? Are two wheels 8in. diameter large enough?—DAVID BARRATT.

[97499.]—**To Mr. Bottone.**—We have the electric light in our streets, and I believe it must be an alternating current. I notice, when swinging my walking-stick around, so that the light from one of the street lamps shines on the same side that you are standing on, the stick, instead of going smoothly round, seems to go by a series of quick moves and stops, as near as I could make out, from 38 to 44 moves per second. I also note that the light only lasts about one-third, and the dark about two-thirds. Do we have only one-third of the light that we would have from a continuous current, or does the retaining power of our eyes make up for the defect?—MACKIE.

[97500.]—**Cutter-Bar for Slide-Rest.**—Can any reader recommend me a cutter-bar or tool-holder for the slide-rest for general work? I have tried a Haydon bar, and find the cutters slipped through, and were not properly gripped after I had only used the bar for about a week. The jaws appeared to be soft, and to lose their shape and place.—C. W., Hull.

[97501.]—**Breech for Model Cannon.**—I am making a model cannon, 9in. long, to fire ·221 rim-fire cartridges. Will someone please give me some idea how to construct a simple breech? I want something that is quick to work, safe, and easy to make.—LENS.

[97502.]—**Motor for Car.**—I am desirous of constructing a motor similar to designs now appearing in "E. M.," but want to use the crank-cheeks as flywheels, and inclose them in crank-chamber. Will the writer of the articles kindly advise as to what diameter, thickness, and weight the two flywheels should be, and how to calculate same? Is it advisable to counterbalance them? If so, please say how to lay it out?—VOLANT.

[97503.]—**Fancy Mice.**—Can some reader kindly describe suitable dietary, &c., for Japanese "waltzing" mice? Also, in what respect does this breed differ from the more common of the tame varieties?—MAUSER.

[97504.]—**Electrical.**—In an electrical experiment, it is desired to "cut-in" and "cut-out," one by one, the ten cells of a battery. Please describe a simple switch-board, or other suitable apparatus, for doing that.—X. R. Y.

[97505.]—**Nicol Prism.**—To LEWIS WRIGHT OR OTHERS.—My Nicol prism polariser (1in. clear field) for projection microscope has got badly scratched right in the middle of the field of one of the end faces. Can this damage be rectified without injuring the prism? If so, how? Would recutting or repolishing the scratched end impair the effectiveness of the prism?—SCOTUS.

[97506.]—**Bleaching Wax.**—Would any reader kindly tell me how to make brown wax white—in large quantities?—EMBOSSER.

[97507.]—**Frame Food.**—I have been told that "Frame Food" is a valuable preparation for invalids. Can any reader give particulars, and, if possible, an analysis of same?—O.

[97508.]—**Dead Batteries.**—Having some dry E.C.C. batteries gone dead or exhausted, will Mr. Bottone kindly tell me how they can be made effective again? I have a dynamo charging twelve lithanode cells for house lighting.—STRAX.

[97509.]—**Engine Priming.**—I have a 8H.P. portable engine which primes a great deal. Cylinder-bar rebored, and new slide fitted, and is constructed different to the old one. It has a deeper and larger recess for exhaust steam, but is worse with the new. Will some kind reader give most likely reasons for same?—W. D. M. O.

[97510.]—**Finlay's Comet.**—Will some of "ours" please say how far the path Finlay's comet is now travelling on is from the path it followed in 1893? And if the fact of our planetary system travelling so rapidly (please say how far a year) has anything to do with the so-called lost comets that used to be periodic? Further, what effect would our moving have on the lately expected Leonid showers?—EFE.

[97511.]—**Radiometers.**—What is the latest accepted theory as to why the vanes revolve?—EFE.

[97512.]—**Manchester Dynamo.**—Will Mr. Avery advise me for dimensions and quantity of wire for a Manchester dynamo output, 5 amps. at 50 volts pressure? Also dimensions of cores, fields, and armature?—JOHN ELLIS.

[97513.]—**Sporting Requisites.**—Can some of "ours" say what restriction there is to carrying ammunition on board steamers for the Cape? I have a young friend who is very anxious to take out a small rifle, costing only 15s., which fires bulleted caps, and also takes the short and long ·22 rim-fire cartridges. Will he be charged according to number or space occupied?—because 1,000 of these take up less room than 100 ordinary rifle cartridges. Any information regarding the carriage and duty on larger sporting requisites would be welcomed by—A CONSTANT SUBSCRIBER.

[97514.]—**Hydraulic Lift.**—Will someone tell me what horse-power will be required to drive a hydraulic jack to lift 100 tons to a height of 10in.? The ram is 5in. diameter; the small plunger is 2in. diameter and 3in. stroke. A steam turbine is to be used, running at a speed of 30,000 revolutions per minute, which is reduced to 500 revolutions per minute. The plunger works both ways. If 500 strokes is too quick for the plunger to work, it can be further reduced.—T. W. D.

[97515.]—**Waterwheel.**—I have a supply of water which will give 4,400c.in. per minute at a pressure of 200lb. per square inch. Will someone kindly tell me what horse-power this will give with a wheel running at a speed of 30,000 revolutions per minute, and state the size of the nozzle and the diameter of the wheel?—W. D.

[97516.]—**Edison-Lalande Battery.**—Could Mr. Bottone or any other electrician inform me what differ-

ence it would make to charge the Edison-Lalande battery with caustic soda instead of caustic potash, the former being cheaper than the latter, and what chemical reaction takes place in each case? I have tried both, and find that the potash gives better results—whether more pure or not I do not know; the oxidation of the zinc in both cases is alike. The old battery I had for igniting the vapour in my oil-engine had a carbon and a zinc pole, and potass. bichromate was the chemical used. Which do you consider is the best of the two, or is there a better battery for such work in the market?—CYMRO.

[97517.]—**Propellers.**—Will some of "ours" please give the general average "slip" of the propellers in a knot of such ships as the *Majestic* when going at the rate of 15 knots an hour? This can be got at by giving the "pitch" of the blades and the number of revolutions per knot. Also give "working" surface of blades. An answer to the above questions also, when vessel is going at the rate of 20 knots. If "head resistance" is a fallacy, I want to see what proportion of friction the blades are responsible for in comparison with the hull at the increased speed, leaving out of the question air resistance? Any ship will do as an illustration of the above questions. —EFE.

[97518.]—**Clock Weight.**—How is it that a reduction of weight tends to increase the pendulum arc? Two clockmakers, in different towns, say this is so. One would expect that increase of weight would give increase to the force which produces the oscillation. I tried the experiment on a sidereal regulator, removing about an eighth part of the weight. The arc, which was small before, is certainly no less, possibly a trifle greater, and the beat is more even. The escapement is dead-beat.—ANTARES.

[97519.]—**Angle of Double Stars.**—One is accustomed to take the larger star as centre, to measure the angle of a pair. When the two are sensibly equal, as ζ Aquarii (p. 484 of last week), which should be selected for centre? Perhaps "F.R.A.S." would kindly state his practice? I have missed the "E. M." for a long time, and am delighted to find his letters as excellent as ever. —ANTARES.

[97520.]—**Cataloguing Books.**—Can any of our kind readers inform me the best practical way of cataloguing a private library, comprising about 1,500 books, or what books I can get bearing on the subject? The books are contained in two bookcases and a series of shelves arranged each side of fireplace.—J. C.

[97521.]—**Pronunciation of Astronomical Terms.**—Is there a dictionary which gives the pronunciation of astronomical terms? For example, how is "mare" pronounced—with the *a* broad or sharp? In designating the stars, how are the Greek letters pronounced?—N.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 24, and unacknowledged elsewhere:—

J. H. EVANS.—Filter.—A. H.—H. A. H.—R. H. Parsons. —Young Mechanic.—H. Jay.—M. B., Galway.—J. R.— Arcturus.—A. Stamwitz.—Richard Inwards.—S. Jesse. —Glatton.—Jack of All Trades.—Theodore Brown.

C. G. ROBEY AND OTHERS.—It is simply impossible for us to insert a tithe of the letters that have reached us on Field Armour or the Date of the Century, and in no case can we either return letters sent or spare time or space to argue with individual correspondents about the merits of their suggestions. We are not infallible, but our business here is simply to print *what we think readers will read*, as far as space permits.

A. HORNER.—Thanks for recommendation. The set of "best books" has been sent to your friend, and your card inclosed. We venture to think it will be not the least appreciated of her wedding presents.

CHARLES WHITFIELD.—Yes, several; we must refer you to back volumes for dates and details. You give no address in your letter, so if papers, which are being sent simply to Wantage, do not reach you, it is not our fault.

CHARLES THOMAS.—You can probably achieve your object by passing some of the strongest alcohol through caustic potash. There is no "particular kind of sugar" from which to make it, and a license would be required if you set up a still. (2) Use the ordinary rubber solution sold at the leather-sellers' shops.

HENRY CARR.—Some use gum with the starch, others use glue. There are many recipes in back volumes, and probably the best is the old-fashioned starch to which some shreds of spermaceti are added, or paraffin-wax.

PRONUNCIATION.—Do not think much attention is paid to the actual sound of the vowels; but query is inserted in a modified form, and perhaps some of our readers who attend the meetings will reply. Usage settles the matter, if there is any settlement.

AMATEUR.—There are several works on brazing and soldering, and many replies in back volumes. Useful works are advertised weekly in the "Sale" Column. See p. vi. last week.

W. INGRAM WHITE.—You could look through the library at the Patent Office, and consult the catalogues of such publishers as Longmans, Spon, Lockwood and Son. Mitchell's "Manual of Practical Assaying," Longmans, is a good work. You can see many at the library mentioned, and can then form an opinion as to which will suit.

TRITON.—Have heard of Eucalyptus oil being used as an inhalation; but do not know of any physician who has recommended lozenges containing that oil as a preventive of influenza.

J. B. R. S.—Salicylic ointment is stated to be a good remedy for corns and warts. (2) Dry rot is a fungus. The holes in the furniture are caused by a species of Anobium - the Death-watch beetle. Please see the back volumes for many replies.

PHOTO.—Please send sketch of the hand-camera shutter (97364).

IN TYPE.—Hugh Alexander.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1710.—By T. TAVERNER.

Black. [6 pieces.

White. [10 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Feb. 5.*)

Solution of PROBLEM No. 1709.—By J. JONES and W. SHINKMAN.

Key-move, B-K 2.

NOTICES TO CORRESPONDENTS.

PROBLEM No. 1709.—Correct solution has been received from N. M. Munro, Richard Inwards, A. Tupman, A. H. W., J. E. Gore, Quizco, Rev. Dr. Quilter, H. Hall, F. B. (Oldham), W. Masters, Jas. Mason, W. Taylor.

H. B. F.—Only solution as above.

PROBLEM No. 1710.—In consequence of two misprints in the diagram, which we much regret, it is again published, and will be found to be a very excellent problem. Solutions are requested by Feb. 5.

SPECIAL OFFER.—CHEAP VOLUMES.

In the course of the next few months we are compelled, owing to the making of the new street from Holborn to the Strand by the London County Council, to remove our Offices and Printing Works. Due notice of our removal will be given shortly. In the mean time, to reduce stock and save trouble of removal, we offer readers desirous of making up sets of back volumes *any volume* in the list below at HALF PRICE, or post free for 4s. 1d.

Any reader desirous of making a free library or working men's club a present of a few sets of volumes will find this a favourable opportunity. The offer is only available till our removal.

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Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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The "Practical Engineer" Pocket-Book. price 1s. and 1s. 6d.; postage 2d.—TECHNICAL PUBLISHING Co., Ltd., Manchester.

The "Practical Engineer" Pocket-Book AND DIARY, 1900. First edition almost exhausted. Order at once.

The "Practical Engineer" Pocket-Book AND DIARY, 1900. Best Engineer's Pocket-Book published.

The "Practical Engineer" Pocket-Book AND DIARY, 1900. Over 2,000 copies sold in America alone!

The "Practical Engineer" Pocket-Book AND DIARY sells extensively in all parts of the world.

The "Practical Engineer" Pocket-Book. 1s. Gilt-edged edition, with pocket and elastic band, 1s. 6d., postage 2d.

The "Practical Engineer" Pocket-Book AND DIARY, 1900.—TECHNICAL PUBLISHING Co., Ltd., 31, Whitworth-street, Manchester.

Symphonion, splendid tone, with 23 discs; exchange good Bench Lathe.—GEO. HUTTON, 85, Myrtle-road, Sheffield.

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Dynamo, new, Swedish iron fields, double-wound drum armature, 6in. dia 10in. long, sell cheap or exchange Optics, Music.—FREEMAN, 17, Railway-terrace, Slough, Bucks.

The English Mechanic

AND WORLD OF SCIENCE AND ART.

FRIDAY, FEBRUARY 2, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—V.

FIG. 14 shows two sectional views of the piston at right angles to each other. The grooves for the piston-rings are not to be cast in, but turned from the solid. The core-box is made exactly the same shape and size as the interior of the casting, allowing

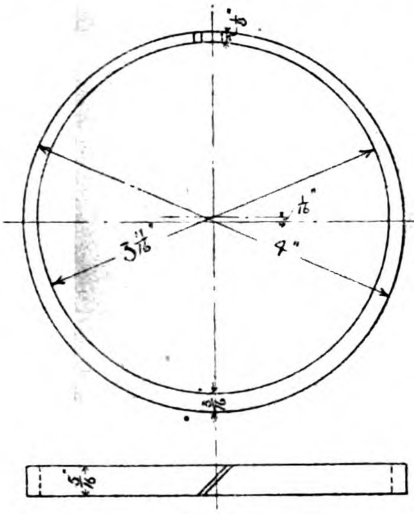


FIG. 15.

for shrinkage, and provision being made for the print, which should be rather long to balance the core—say about 4in. The bosses for the gudgeon-pin are put in the core-box, one in either half. To facilitate turning the piston, cast a boss on the centre of the closed end about 1¼in. diameter and 1in. long. The piston should be cast from the same metal as the cylinder, and blow-holes should not be tolerated. Should they be seen in the casting, refuse it, and have another.

To machine this casting grip it in a chuck by the boss on the back end, and turn the outside true, making it such a fit in the cylinder that it can be just pushed through the bore by hand. Take care to make the piston the same diameter all along, as if turned taper it will knock, and may score the interior of the cylinder. Before removing it from the lathe face off each end, the back to be faced down as far as possible. The grooves for the piston-rings are also turned in at this setting. Scribe a light circle around the piston, on which to mark off the centres of the holes for the gudgeon-pin. These centres can be marked off in the lathe if the headstock is fitted with a dividing-plate; or the gear-wheel on the mandrel, if an even number of teeth, can be used as a dividing plate if some kind of stop is rigged up. Whether marked off in the lathe or on vee-blocks on the surface-plate with the scribing block, great care must be taken to insure the hole being in the centre of the bosses cast on the inside of the piston. Another point which must be looked to is to get the gudgeon-pin *exactly* square with the sides of the piston.

The gudgeon or piston pin is to be made of mild steel, quite straight and parallel. Turn it to such a size that it will just require light driving with a mallet to get it into the holes bored for it in the piston, reamering the holes if required. To prevent it rotating in the piston, drill, tap, and countersink a hole for a ¼in. vee'd head set-screw, the screw to be half in one end of the pin and half in the piston body. After this screw is fitted, the gudgeon should be case-hardened. See that the ends of the gudgeon and the head of the screw do not project beyond the piston body. They should be rounded to the same curve as the outside of the piston.

The piston rings, of which we require three, with one or two over in case of breaking one, are of cast iron or mild steel, as preferred. Figs. 15 shows one of the rings when pinched together, ready for putting in the cylinder. Cast iron is the preferable material, but it requires rather careful handling in making and putting in, being brittle. The rings are first turned up roughly to 4⅛in. diameter outside and 3⅜in. diameter inside, and cut off to the required width. They should fit the grooves rather easily to avoid their binding. They are at this stage concentric. A piece ⅜in. wide is now cut out of each

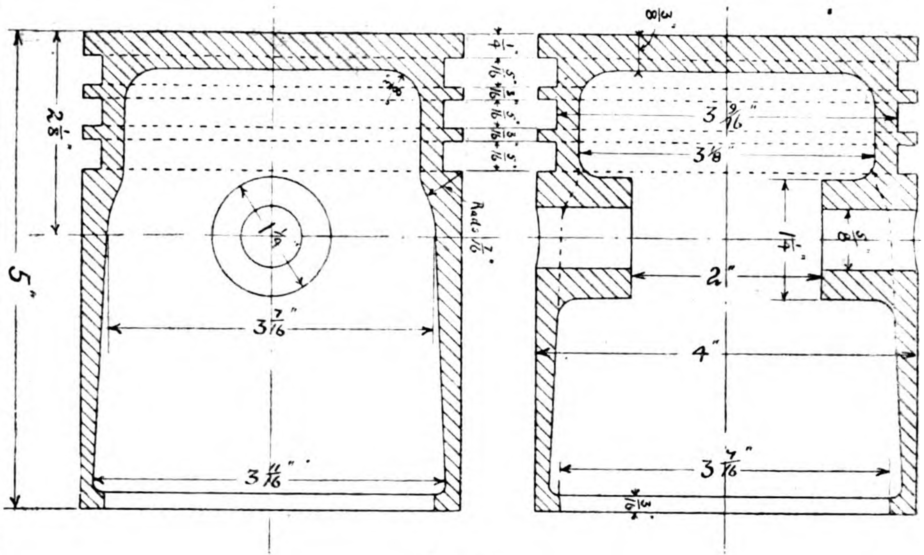


FIG. 14.

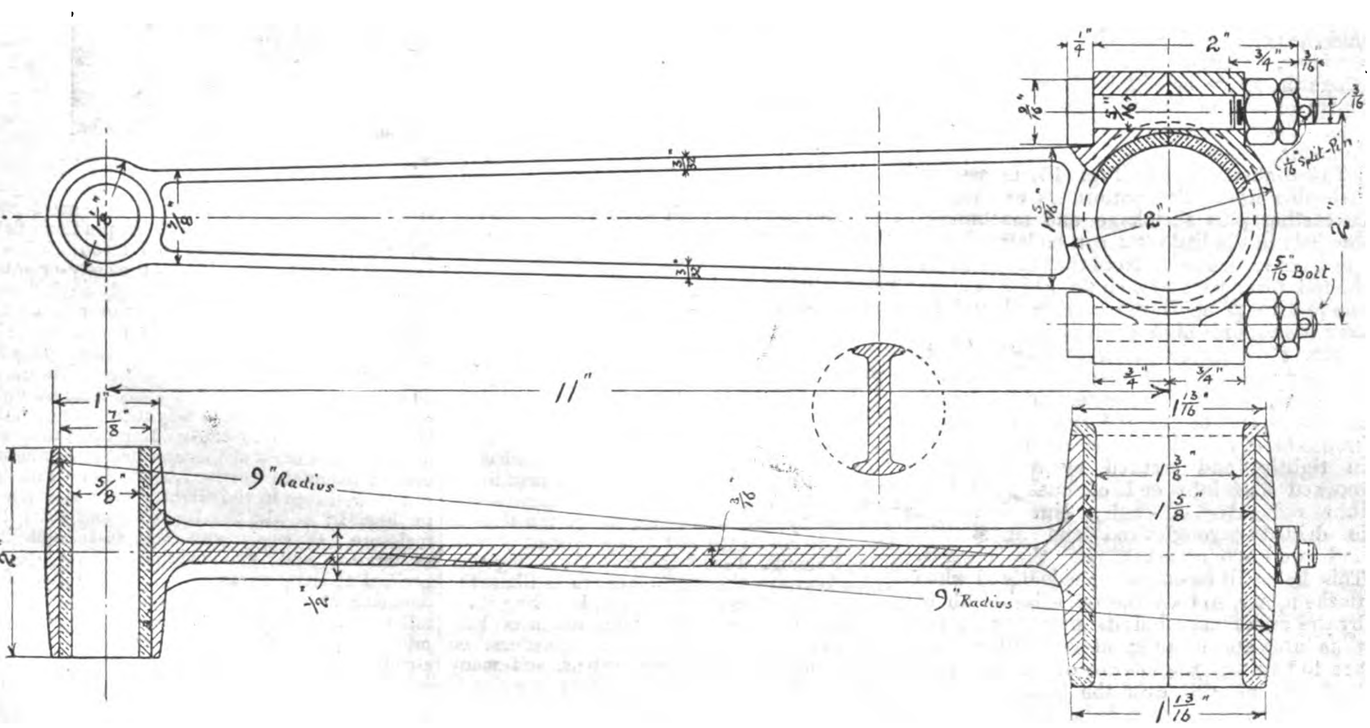


FIG. 16.

ring at an angle, and the ring sprung in and held by a band around it (or even a piece of copper binding wire), so that the joint is only 1/32in. open. They are now all three placed on a face-plate, which has been faced up quite flat and true, and clipped by means of bolts and plates by their edges in such a position that when turned up outside they will be of the exact dimensions given in Fig. 15. When set so as to hold up to size, the clips should be tightened down as much as possible, when the bands or binding wire can be removed. The outsides are now turned exactly 4in. diameter, and should be quite smooth. Turning all the rings at once insures their being all the same size. When the outside of the rings are turned take them off the face-plate, and make a chuck from a piece of cast-iron or brass, turning it out inside to 4in. diameter by ¼in. deep. Place the rings in this one at a time, springing them in, a small screw projecting into the joint serving to prevent them rotating, and locating the joint in the same place every time. This chuck, which should be bolted to the face-plate, is used 1/16in. out of centre, so that the rings are eccentric, as seen in Fig. 15. Note

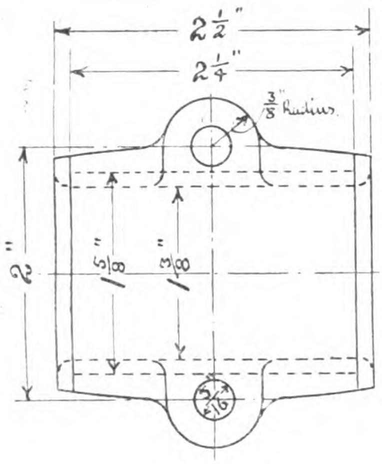


FIG. 17.

that the thinner side of the rings occurs at the joint. Therefore, this part of the chuck where the screw is will be 1/16in. nearer the centre of the face-plate than the opposite side. The insides are now turned to 3 1/16in. diameter.

The connecting-rod (Fig. 16) is cast in malleable iron. The pattern is exactly as its casting plus shrinkage and machining. The hole in the little end can be left solid or cored out as desired. Note that the edges of the rod form part of a circle, which enables one to turn it up if the casting should be very rough, or if high finish is required.

Fig. 17 is an end view of the big end, giving dimensions and shape of the lugs for the bolts, which are omitted in this view. The little end of the rod has a phosphor-bronze bush ⅛in. thick (see section), driven in tightly, and secured by a ⅛in. pin, screwed half into end of bush and half into rod. An oil-hole, ⅛in. diameter, is drilled through rod end and bush, and well countersunk on the outside. This hole will be on the top side of rod when in the motor, so that the oil splashed about by the crank may find its way into it, and thus lubricate the gudgeon pin. Oil-grooves are to be cut in the interior of bush so as to lead the oil well over the bearing. They need not be more than 1/32in. full in depth. The cap is first fitted to the big end, and the bolts made a good fit to the holes. The bolts should be turned and the holes reamered. The rod is now secured to the face-plate of the lathe, and the big end bored out for the brasses to 1⅝in. diameter. A gap-bed lathe will be required for this job. The holes bored in both big and little ends must be absolutely parallel with each other, and out of winding. Should they be in winding, if not to any great extent, the rod can be set; but it must be done cold, as malleable cast iron is hot short, and apt to fly.

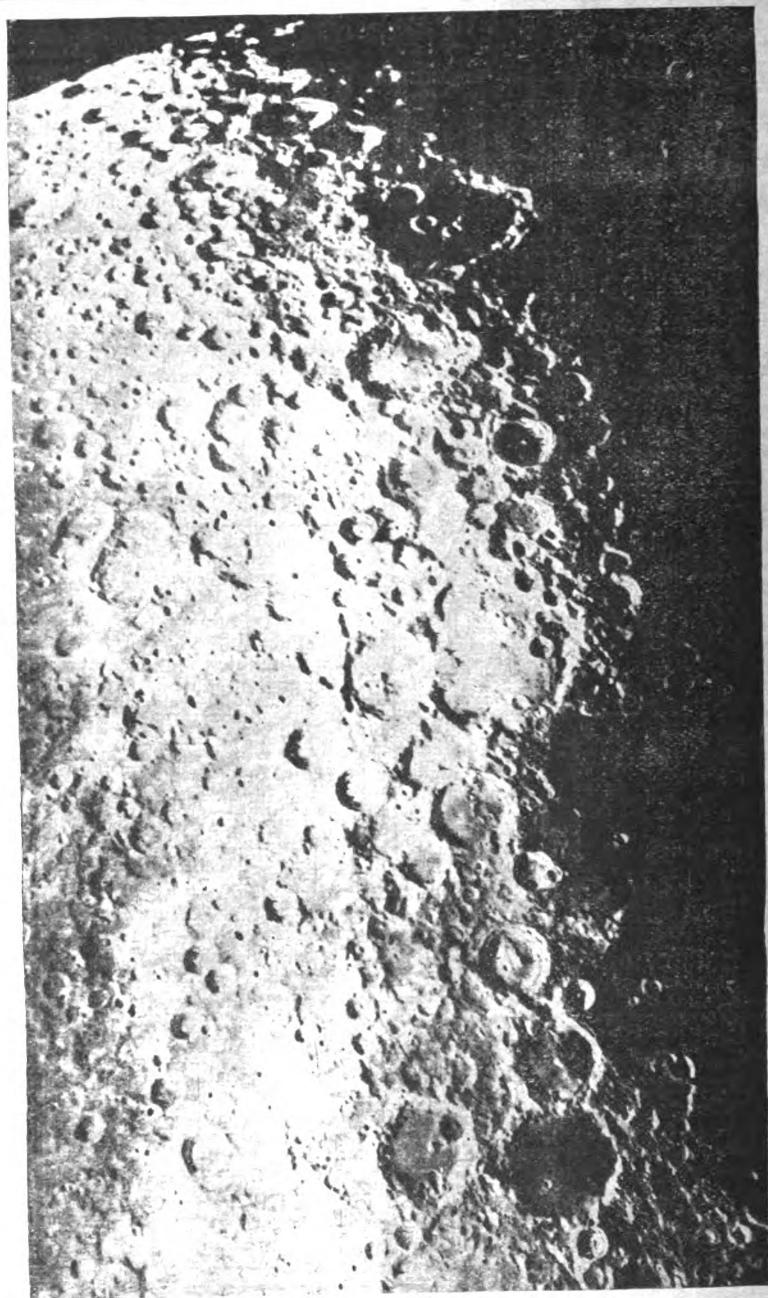


FIG. 1.—Maginus, Tycho, Arzachel, Alphonsus, and Ptolemaus. Moon's Age, 8½ days.

THROUGH A SMALL TELESCOPE.—VII.

By NORMAN LATTEY.

WE will now proceed to examine what is, perhaps, the most attractive meridional zone of the visible portion of the moon—that occupied by the terminator about the time of first quarter. In the last article a general view of the illuminated semi-disc was given, together with a key-map thereto, in order to facilitate the identification of its chief features, including those beginning to struggle out of the darkness along the broken edge. The latter formations, on account of their grandeur, extent, and many intricacies, need at least two papers in which to attempt their description. They might well be accorded several, and yet leave many interesting objects unnoticed.

Referring to Fig. 1 (an enlargement of a photograph with as many details filled in at the telescope as it was possible to insert) a pair of deep crater cups, the rim of the lower right-hand one almost encroaching on its companion, will be seen close to the South Pole at the top of the picture. These are Moretus and Gruemberger, two magnificent walled plains of great apparent ellipticity owing to their positions near the foreshortened limb of the moon. We are now in a wonderful region of closely-crowded craters with lofty borders and deeply-sunk floors, on several of which no ray of light ever falls; for neither the sun nor the earth can be even glimpsed from their gloomy recesses. This is, however, not the case with either Moretus or Gruemberger, although their finely-terraced walls overlook their interiors to heights reaching, in the latter instance, to 20,000ft. Moretus, the larger and most southerly of the two, has a magnificent central mountain nearly 7,000ft. in height. It can be well seen in the slightly later view given in Fig. 2; as also the beautiful and extensive inclosure, Clavius, with its vast encircling mountains, and two conspicuous ring-plains perched up on the north and south ramparts. The diameter of Clavius is, roughly speaking, 150 miles, and it embraces an area of 16,000 square miles, or rather over that of Denmark. The two striking ring-plains on the walls are scarcely more than 25 miles across, but their little central hills are easily observable at this period. The floor of Clavius is almost completely traversed from west to east by a chain of five craters, diminishing in size from the largest at the western end (lying almost midway between the two ring-plains already referred to) to the smallest under the eastern wall. All around are scattered innumerable craterlets, depressions, and other details. The broad, massive border affords almost unlimited field for

exploration with its steep broken sides, transverse valleys, clefts, ridges, and many other features. Under a low sun, the long shadows cast by the loftier peaks are exceedingly striking, particularly when they stretch completely across the slightly convex interior.

Returning now to Fig. 1 (in which Clavius is plainly outlined in threads of tangled light against the inky background), we find Maginus, an inclosure of nearly equal extent to Clavius (and immediately below it). But Maginus is obviously an older formation, for many of its once sharply-defined features have become almost obliterated. Fragments of a lofty border, however, still remain, and in one place attain an altitude of 14,000ft.

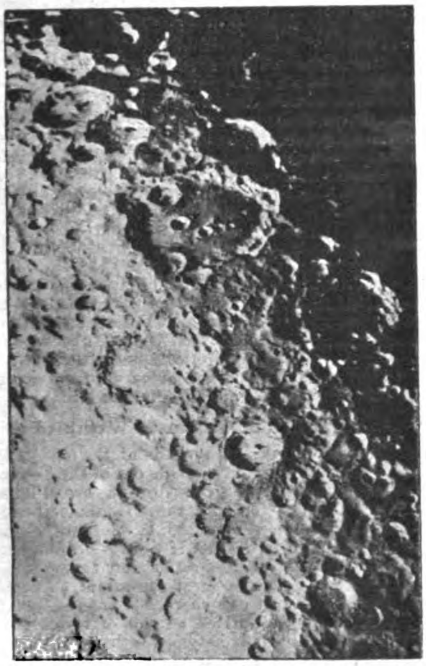


FIG. 2.—Tycho, Clavius, and Moretus. Moon's Age, 9 days 11 hours.

On the floor lie a group of little hills, and the eastern wall is occupied by several good-sized ring plains; but these, in keeping with the other remnants, wear the same appearance of demolition, their encircling walls being much broken, and here and there completely effaced. Curiously enough, Maginus is most difficult to detect under a high sun. The expression, "The full moon knows no Maginus," though not strictly accurate, has at times much justification.

Still further down towards the north stands Tycho, aptly styled the Lunar Metropolis. From this noble ring-mountain radiate those mysterious bright rays which at full moon are so plainly visible even to the naked eye, stretching like meridians of longitude far beyond the equatorial regions. Although but 54 miles in diameter, Tycho is a most conspicuous object, even amidst the scores of its almost equally striking compeers. Except under noonday illumination, the well defined terracing of its steep inner sides may be distinctly seen with so small an aperture as two inches. Along its towering ridges bristle innumerable peaks, and the massive border is everywhere traversed by valleys and depressions. Except for the fine central mountain, however, little has been noticed on the floor. Beneath the noonday sun Tycho exhibits the appearance of a deep saucer of purest chalk, shedding a snowy radiance all around, and shooting forth long streamers of silvery luminosity in every direction. But even the largest instruments are unable to discover the nature of these radiating rays.

Exactly beneath Tycho, though as far to the north as Clavius is to the south, will be noticed the comparatively small but conspicuous crater Hell, the principal irregularity on a vast low-walled ring-plain. It has a central mountain and many well-marked ridges. Abutting against the western section of the ridge surrounding the great circular plain will be observed another immense inclosure, Walter, 100 miles in diameter. Its floor is considerably depressed, and its borders much pitted. The central mountain throws a fine spire-like shadow at sunrise—which, by the way, is the best time to observe this interesting feature. Against the north west wall lies Regiomontanus; and encroaching on the northern rim of the latter, Purbach, with Thebit hard by, the two last forming together a well marked figure-of-eight. All of these are noteworthy objects with high surrounding walls, and contain much detail which space will not permit an elaborate description of.

We must hasten on to the striking trio of immense formations below, rendered more conspicuous by their contiguity and alignment. The smallest, Arzachel, just below Thebit, is a prominent ring plain some 66 miles in diameter, and encircled by a finely-terraced rampart completely surrounding the bright interior. In the centre stands a large central mountain with a deep crater slightly to the west of it (the latter can be plainly seen in the photograph). In Alpetragius, that well-defined object to the north-east of Arzachel, we have a formation which, though barely 30 miles in diameter, rears itself up in peaks 12,000ft. above the floor. It also possesses a central mountain, and the massive walls dividing it from its immediate neighbour to the north, Alphonsus, is well worth attention, especially under a low sun. But Alphonsus cannot boast of walls higher than 7,000ft. Its bright central peak and three dark patches on the floor deserve scrutiny, besides other interesting features in the way of clefts, ridges, and craterlets, most of which have unfortunately disappeared in the process of reproduction.

Abutting against Alphonsus is Ptolemaus, the most perfect example of the moon's walled plains. With it terminates the great meridional chain of lunar formations stretching in an almost unbroken line from the Equator to the South Pole. Ptolemaus could very nearly hold the whole of the north of England; but its border is much intersected by gaps and passes. On the floor of this extensive area can be discerned, under a low sun, a number of large saucer-shaped hollows with low rims. On the north-west side of the inclosure stands a bright crater, a few miles in diameter, and there are a few others which can be just detected in the photograph.

Close under the somewhat shattered northern wall of Alphonsus can be seen Herschel, a fine ring-plain with a lofty rim and prominent central mountain. Its inner slopes are splendidly terraced, and on the outside may be noticed irregular depressions. Many craters and valleys bestrew the rather dusky floor, and to the north lies the elevated plateau Herschel A, a region presenting many features for critical study.

With this *résumé* of the great ring-plains lying along the southern portion of the terminator at first quarter, our survey must come to a close. Next week we shall examine several of those magnificent formations which possess such startling terrestrial resemblances—viz., the vast chains of rugged mountains encircling the trackless wastes of the Mare Imbrium on the western side; likewise, a few of the great isolated ring-plains which, as regards their areas, and heights to which their borders rise, easily rival some of the noble circumvallations we have just been investigating.

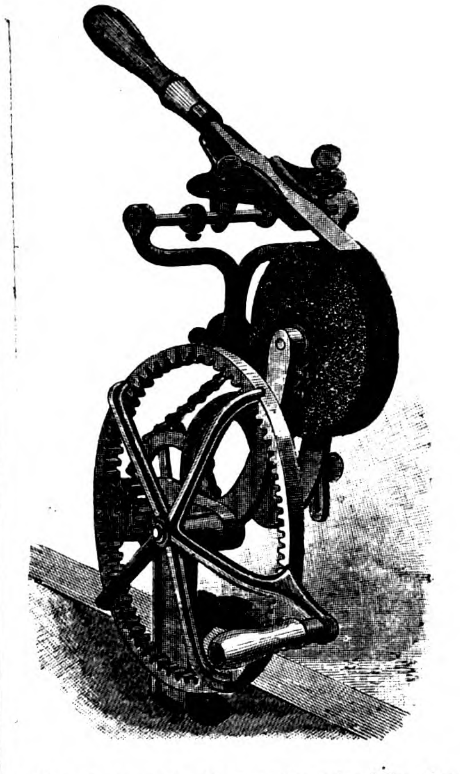
As before, the instrument in use was a 4in. Cooke refractor stopped down to 3in. It may be here mentioned that the stopping-down—which is accomplished by a piece of black cardboard (with a hole in it 3in. in diameter) placed over the object-glass—is done solely for the benefit of observers with small apertures. The light-grasp and separating power of the whole 4in. would, of course, reveal many details beyond the scope of the present series.

DILLENBECK'S TOOL-GRINDING MACHINE.

THE following description of a patent granted to Mr. Arie Van Dillenbeck, of 261, Hamilton-street, Albany, N.Y., for a tool-grinding machine, the novel features of which are found in the means provided for adjusting the table so that tools of various kinds can be sharpened with any desired bevel, is given in the *Scientific American*.

The machine is supported by a standard, the base of which is clamped to a shelf or bench. The standard has an arch at its upper end, and is provided with a rearwardly-extending horizontal arm at one side, and with forwardly and upwardly projecting arms at the other side. A stone is mounted in the fork formed by forwardly and upwardly projecting arms, and is connected by a chain and sprocket gear with a shaft mounted in the rearwardly-projecting arm at the upper end of the standard, and turned by an internal pinion meshing with a driving-wheel journalled in the horizontal arm at the base of the fork. By turning the driving-wheel the stone will be rapidly rotated.

The tool-holding table slides on a rod held between the arms of a fork, the shank of which is connected by a universal joint with a bar which is pivoted to one side of the arch, and which can be swung to raise or lower its outer end (and hence the table), and can be locked in adjusted position. Upon the table tool-holding clamps with under-cut bodies are mounted; these clamps can be adjusted to receive tools having short or long cutting edges, such as chisels, drawknives, and the like. In sharpening a tool the table is moved back and forth



on its rod, so as to sharpen all parts of the edge uniformly, collars being provided which limit the movement of the table, and prevent the tool from leaving the stone. By reason of the pivoted bar and the universal mounting of the table fork, the table can be raised or lowered to accommodate thick and thin tools, or moved to or from the stone to bring more or less edge of the tool on the grinding-surface, to produce a greater or lesser bevel. The machine can be driven with one hand, and the table manipulated with the other. As soon as the hand is removed from the table the weight of tool-handle will cause the table to drop back and carry the tool away from the stone.

LOCOMOTIVE ENGINE BOILERS.

A GLANCE at the past history of locomotive development shows that the increase in power has been mainly sought in enlarged cylinder capacity. Thus, cylinders 18in. by 26in., and even larger, have been fitted to boilers with 1,100ft. or 1,200ft. of heating surface, which at one time was considered none too much for 17in. by 24in. cylinders. The result has always been unsatisfactory. In more than one case it has been found necessary to line up the cylinders to much smaller dimensions before the engines could be got to keep time. Wiser counsels now prevail. Instead of seeking for shadowy economies by working with an early cut-off in a big cylinder, the designers of locomotives recognise the great truth that the first thing to be done is to cope with the traffic. That done, economy may be studied, but not before. There is a good excuse available for past policy and practice. It is that the designing of a narrow-gauge boiler with much more than 1,200sq. ft. of surface is full of difficulties, and that a big cylinder will take an engine up an incline which cannot be surmounted with a small one; but the latter theory is delusive. It has been fostered and supported by the great skill of a few exceptionally clever drivers, who understand precisely how to jockey an engine. In the hands of the great body of drivers the engine with big cylinders and a small boiler is a failure, and we believe that the larger number of locomotive superintendents in this country will now admit the truth of a statement long accepted as an axiom in

the United States and on the Continent—namely, that "a big boiler means going." No doubt we have fared better than our neighbours would have done, because of the generally excellent quality of our locomotive coal; but the limit has long since been reached, and more boiler power is being provided for heavier and yet heavier traffic demands.

It may be taken as proved that certain relations exist between the dimensions of a good locomotive and the work it has to do. These relations are lax, rough-and-ready, but still they do exist; and we venture to think that much might be gained if they were reduced to some approach to regularity of form and embodied in uniformity of practice. The resistance of a train weighing, say 100 tons, is about the same, under the same conditions of weather and gradient, on all the principal railways of the kingdom. It ought to be possible to say approximately how many square feet of heating surface ought to be provided to move 100 tons of train at, say, 50 miles an hour. We take this, of course, as the average speed on a fairly long run. We do not think that less than 700sq.ft. can be trusted to do this work with Midland coal, or perhaps 600ft. with Welsh coal. There is a theory that a big engine can do more work per foot of surface than a small one; so for 200-ton trains we find 1,400ft. regarded as too much for any coal. It seems to be forgotten that although it is possible—which we much doubt—that the big engine may be more efficient than the small foot for foot, that it weighs a great deal more. The weight increases in a very rapid proportion with the augmentation of the heating surface. Thus, the whole weight to be moved becomes more considerable. For example, while a 1,500-gallon tender would be quite enough for an engine with 600sq.ft. of heating-surface, a 3,000-gallon tender is provided to supply a boiler with 1,200ft. There is, then, we take it, every reason to believe that a fairly fixed relation exists between train loads and heating surface; and we shall find that this runs roughly at 600sq.ft. to the 100 tons. Thus, 300-ton trains ought not to be hauled by engines with less than 1,800sq.ft. of surface; as a rule now, they are hauled by two engines with 2,400 to 2,600sq.ft. between them. The wastefulness of piloting is so obvious that we shall not waste space by saying anything more about it.

When we come to consider the engine, another factor is introduced. We find, again, that practice gives us roughly a general relation between the size of driving-wheels and speeds. Thus, forty miles an hour are run with drivers anywhere between 5ft. and 6ft. in diameter; fifty miles an hour, with drivers between 6ft. and 7ft.; and sixty miles an hour and over, with 7ft. to 8ft. wheels. Again, very roughly, we have ten miles an hour for every foot in diameter of the driving-wheels. Given the speed in miles per hour, and the load, it is easy enough to settle for existing practice what the diameter of the cylinder should be. As a rule, we think the tendency of late years has been to give engines cylinders with too great a diameter. An engine with 18in. cylinders, 26in. stroke, 1,400sq.ft. of heating surface, 21sq.ft. of grate, and four coupled wheels 6ft. in diameter for a hilly road, and 6ft. 6in. for a level, would, it will be admitted, most thoroughly represent excellent proportions. Such an engine ought to be competent to deal with the very fastest and heaviest traffic handled in this country, some assistance being provided on steep inclines, such, for example, as Shap. But 1,400ft. of surface is the least that the boiler ought to have, and this should be good surface, or the result will be disappointing.

Now, this word "good" brings us to the very essence and point of this article. The efficiency of heating-surface varies through an enormous range. Let us take the case of an engine with 1,000ft. of heating-surface in tubes 10ft. long. Each foot in length of tube represents 100sq.ft. of surface. It is clear that by lengthening the boiler barrel 2ft. we can increase the heating-surface to 1,400sq.ft. But can it be argued that the extra 200ft. thus obtained will give aught but a small fraction more steam? Heating-surface in the smoke-box end of the boiler is not one-tenth as efficient as it is at the fire-box end, which brings us to the deduction that the right way to augment surface lies in increasing the diameter of the boiler barrel; and this is made admissible by keeping down the diameter of the driving-wheels to 6ft. or 6ft. 6in., without pitching the centre of gravity too high—no one ever yet heard of a locomotive upsetting so long as the rails did not sink, and it kept them? Thus more tubes—not longer tubes—are got into the boiler. But beyond all question it is in the enlargement of the firebox that increased steaming power should be sought. The firebox makes more steam than all the rest of the heating-surface put together; 1ft. in it is worth 10ft. and more elsewhere; and it is in the improvement of fireboxes that we must look for the development of locomotive power, rather than to anything else. Mr. Drummond, of the South-Western, has carried out a most successful experiment by putting in water tubes. These tubes, exposed to the full fury of the furnace gas, have been found, as we have already stated, to give no trouble whatever, while they greatly improve the steam-making power of the boiler. His success confirms the accuracy of statements made some time since in our pages in a series of papers on "The Marine Boiler of the Future." We therein said that if a water tube is not more than 24 diameters long it will give no trouble by bending or choking. Mr. Drummond's tubes are only about 16 diameters long. No doubt their success depends to some extent on the violent shaking which the water in a locomotive boiler undergoes. This rapidly disengages steam, and goes a good way to explain why locomotive boilers which do not prime when running, will if used for stationary purposes. A simple experiment will show what we mean. Nearly fill a bottle with boiling water, and cork it lightly. Then shake the bottle, and steam will be liberated and the cork blown out. A large grate should go with a large box. It is quite possible to get on with a small great provided the coal is very good. But it usually means a small blast pipe and heavy back pressure. Notwithstanding that a great deal of air is admitted nowadays though the fire-door, much has still to be pulled in through the grate, and a small grate always means a very heavy fire, through which the air rises with difficulty. Various forms of grate can be tried which give more air space than the normal flat English grate. Thus, there are step grates; then there is the basket grate; the grate with an air space of raised bars in the middle of its length; and so on. If we are content to set the grate on a considerable incline, it would seem that almost any length of bar can be fired, the motion of the engine shifting the coal down from the fire-door forward. Hitherto with hind-coupled engines it has been held that a long fire-box is impossible, because, in the first place, side rods are dangerous at high speeds; and because, in the second, coupled wheels will not run safely round small curves. Mr. Drummond, however, has the courage of his opinion, and he made an engine with side rods 10ft. long, which so far has refuted the accuracy of all prognostications of evil.—*The Engineer.*

CRUST-CREEP.

Geology and Its Practical Utility.

PROF. LAPWORTH'S opening address to the afternoon class in advanced geology, at Mason's University College, was devoted to the subject of the scientific and economic aspect of earth-crust movements in Southern Britain. After a reference to the course of lectures delivered last term, in which the mountain areas of Britain and Europe were treated of, he said that all the central parts of England were in reality an extension of the great so-called plain of Central Europe, not only as respects their geographical features, but also as respects their geological formations, and their geological history. Two great regions or systems of crust-creep,

The Scandinavian and the Armorican,

move in great wrinkles, or solid crust-waves, inwards upon it on its borders: the former from the north-west, the latter from the south and south-east. The Scandinavian creep ridges up into mountains and hills the western parts of our islands, as far as the eastern borders of wales; the Armoricain creep domes up the Weald of Surrey and Kent, forms the hills of Cornwall and Devon, &c., and meets the Scandinavian creep in South Wales to the north of the Bristol Channel. North of the English Midlands the long Pennine arch comes down from the Scottish border to Derby, forming the backbone of England. Wrapping round it follow in regular order the successive newer geological formations—the black sheet of the coal measures, and the red sheet of the Permian and Trias. As we proceed to the south follow the succeeding sheets of the Jura and the chalk, and the series is completed by the soft Tertiary rocks of the Valley of the Thames, which meet the Armoricain creep on the flanks of the weald. All these Midland rock-sheets are closed in rapidly to the west towards the borders of Wales, but they flatten and broaden out to the east as they sweep bulow the waters of the shallow North Sea to form the floor of the great plain of Central Europe. But while these Midland rock formations lie as a rule very gently inclined, and their study appeared to the geologist of fifty years ago to be comparatively simple, the mapping of the country in detail, and the discoveries of miners and geologists have brought to light hosts of unexpected difficulties, and at the same time have revealed wonders all unexpected by the earlier workers in the science. It might very naturally be supposed that as these Midland formations are so gently inclined, so, also, would be the rock formations which deeply underlie them; but of late years it has become clearly evident that these rest upon

A Wonderfully Rugged Subterranean Floor

of steep hill ranges and broad valleys. Now and again a peak or ridge shows through the flat-lying formations, as in Charnwood Forest and the Lickeys, or the old land is reached unexpectedly in boring for coal, as in the Eastern Counties. Not only so, but some old hill ranges have disappeared altogether, and nothing remains of them but the loose screes that were washed down their flanks. Again, long strain lines and bands of crust deformations sweep through our country. Along some of these bands the rocks have been warped and ridged up, along others they have been shattered and flung down hundreds, and it may be thousands, of feet, along others pushed for long distances over thrust plains, as in mountain regions. To one set of strain lines belong the great boundary faults of our South Staffordshire coalfield—the ranges of Dudley and the lower Lickey Hills. Another set is that which sweeps down from the western edge of the Pennine Chain, past the Wrekin and Caer Caradoc, Horderley, and Old Radnor, probably to the Bristol Channel. Twenty years ago the geologist saw few or no suggestions of law or rule in complexities such as these; but year by year, as the evidences accumulate, we find that the facts begin to arrange themselves. We have passed the day when we were content to name the ridges and the fracture lines after every individual place where we find them, or to speak of them as if their direction in space and the period of time of their formation were one and the same. We find that in space our great lines of warping and folding in Britain, as all the world over, can ultimately be all referred, like the lines on a geographical map, to four different axial trends or directions: One (like the Malverns) parallel to the lines of longitude; one (like the Wealden) parallel to the lines of latitude; one diagonal (like the Caledonian ridge of the Scottish Highlands) trending to the north-east; and another diagonal (like the so-called Charnian Rocks of Charnwood Forest) trending to the north-west. We see that the great systems of crust-creep—like the Armoricain and Caledonian—which sweep in long bow-like curves from one of these trends to another, wrinkle up the land,

As the Skin of Cream is Wrinkled

up in front of the skimming-ladle of the milkmaid. Nor is there any sign that a single one of the ancient crust movements, or the creep on the strain lines, has come to rest; for both the Scandinavian and the Charnian creep seem to have been almost equally concerned in the last Hereford-Birmingham earthquake. All the discoveries and theories, old and new, have also a most important economic bearing, for here, as elsewhere, the pure science of to-day becomes the applied science of to-morrow. To an ancient struggle between a then weakening Scandinavian and a growing Armoricain crust movement we owe our rich coalfields and coal seams, which were laid down largely in the shallow seas, the lagoons, and the lakes that were formed as the struggle progressed. The slowly-sinking hollows formed broad and quiet receptacles for deposition, and the rising lands afforded space for the abundant growth of vegetation to be swept into the quiet waters by rain and by rivers, while from the more rapidly-rising ridges came the thick wash of sand and clay, in which the coal seams were effectually sealed up and preserved for the use of mankind. As our knowledge is added to day by day by every new coalshaft and every new geological discovery, the phenomena of the crust-creep in coal measure times become clearer, and we infer, with closer and closer approximation to the truth, the ground where rich coal seams now lie below the red rocks of the country, and learn to avoid the ground where they have always been absent, or have been washed away by the elements. As our store of facts accumulates respecting the laws of crust movement, we approach nearer and nearer to that day when the land-owners, the mine-owners, and the speculators shall be freed from their present well-justified dread of proving the boundary faults of our coalfields, and will pierce confidently through them at the safest and the cheapest spots, and open up for working the now-hidden coalfields outside them, thus furnishing employment, comfort, and it may be riches, to the coming generations.

A COMPREHENSIVE REFORM.

ACCORDING to *Engineering*, Mr. George Westinghouse has written a letter to a New York paper which is big with promise of better things for the dwellers in cities. As is well known, the extension of electric traction in New York, as in so many other cities of the United States, is leading to the erection of vast power-houses, in which steam-engines of enormous capacity are the prime movers. Mr. Westinghouse warns his brother engineers that this procedure is a mistake, and ought to be, if it is not, obsolete. By one blow he promises to demolish the difficulties that beset the path of the municipal engineer, and, whilst disposing of refuse, will solve the water problem, abolish smoke, and supply power for rapid transit. His plan is as follows:—"There are," he says, "created daily in New York about 500 tons of garbage, or at the rate of about ½lb. *per capita*. Such garbage is about 20 per cent. carbon and 80 per cent. water. By a process well demonstrated on a small scale, which is being

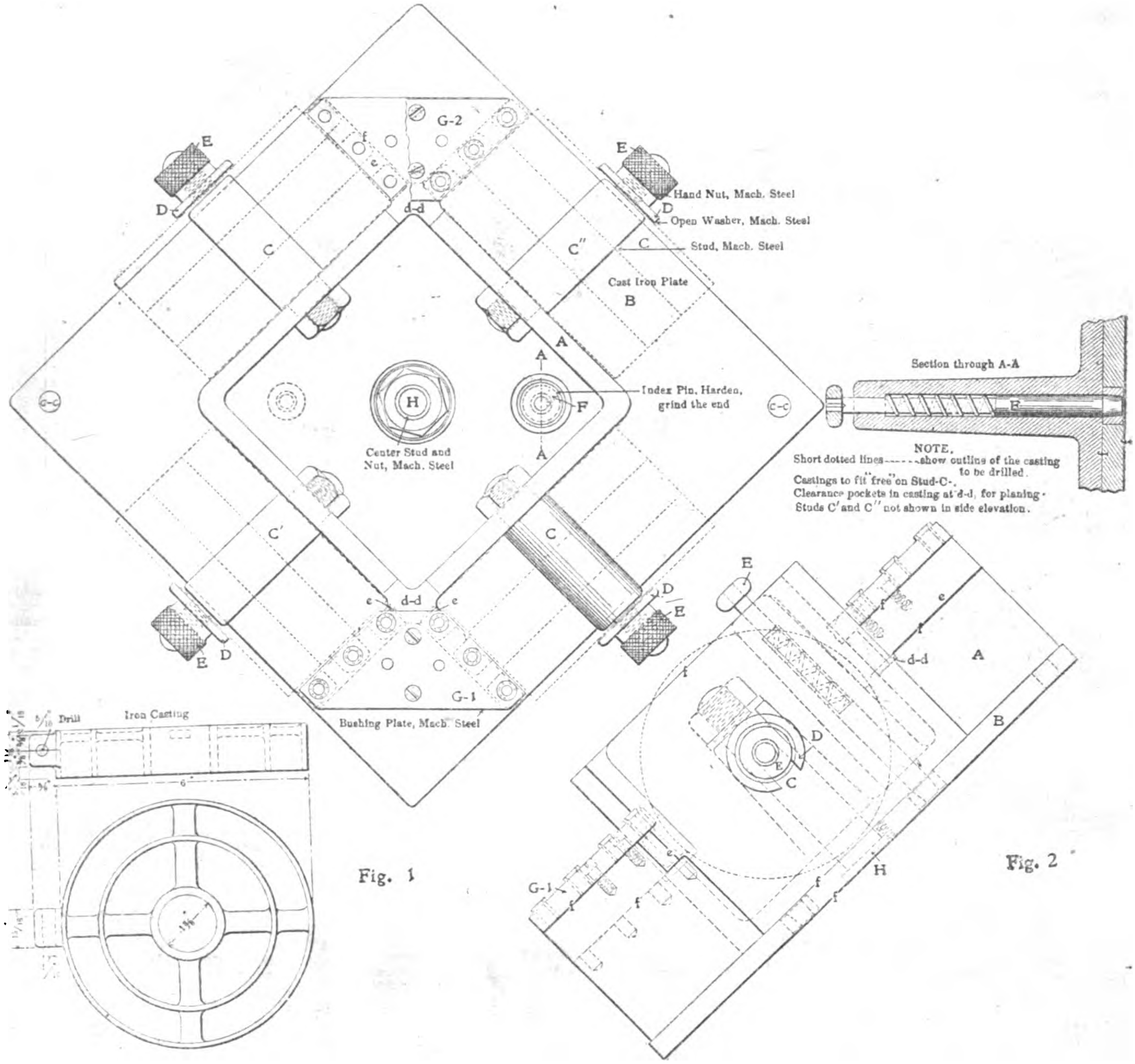


Fig. 1

Fig. 2

rapidly brought to a commercial basis, all of this garbage can be economically, and without offensive odour, converted into a fuel gas of great value. In the same apparatus, and by the same process, soft coal can be made into a gas suitable for power and heating purposes." The gas thus produced is to be used for operating gas-engines, which in turn will drive electric generators, the current produced being used for lighting or power purposes. Refrigerating water for the gas-engines will be taken from and returned to the river. This will relieve the town water of the duty of feeding boilers, and as it is estimated 20 per cent. of the water supply is used for generating steam, the growing difficulty of water service in New York will be pushed into the background. The name of Westinghouse is one to conjure with. More than once already the great American engineer has shown the way to higher planes of engineering enterprise, and, whilst at first derided, has at last proved himself triumphantly right. His present suggestions are fascinating from their boldness and heroic proportions. He bids the chief engineering authorities in his own country, the chosen land of progress, pause in their titanic scheme of laying down 375,000H.P. in steam-engines. "The plans," he says, "are based upon an imperfect knowledge of the subject;" they are "as far from the best as are the old cable systems for the propulsion of cars." Statements so positive, coming from an authority so high, cannot but cause any engineer to reconsider his position. We know already that by burning town's refuse steam can be raised, and it will be interesting to learn from Mr. Westinghouse quantitatively what the economic value of garbage is, used in the manner he proposes; what proportion of the one-fifth constituent of carbon in the garbage will be needed for the evaporation or dissociation, as the case may be, of the four-fifts of water; and also what percentage of soft coal is consumed in the apparatus. We have no doubt Mr. Westinghouse can give thoroughly convincing figures on the whole problem.

A DUPLEX DRILL JIG FOR A MULTIPLE-SPINDLE DRILLER.*

The accompanying drawing illustrates a tool recently designed by the writer, which may contain some points of interest to your readers.

Multiple-spindle drilling is usually confined to work of drilling several holes in each casting. The demand for many thousands of such castings as are shown in Fig. 1 brought forth the idea of drilling single holes in several castings at one time.

Fig. 2 is a top plan, shown in the position which it occupies on the drill-table, and an end view.

The cast-iron plate B is made 14in. square by ½in. thick, secured to the drill-table by two ½in. bolts at *c c*, and holds a centre-stud H, on which the jig casting B swings, and is held in two positions by the index-pin F. The casting B carries the studs C C C C, and the bushing-plates G_1 and G_2, and is not as complicated or difficult a piece to machine as may be inferred by a first glance at the sketch. The top and bottom surfaces were finished in the lathe centres in an arbour through the centre hub. *d d* are pockets for clearance of the planer tool in finishing the steps *e e e e*. The piece to be drilled is a light iron casting used in electrical work, and has no finish on the outside. Referring to the drawing Fig. 2, the pieces are slipped over the studs C C C C, and under the bushing-plates, resting on the steps of jig casting, as shown by short dotted lines, being held in place by the washer D and knurled nut E; the drill spindles are set for the six bushings at the back of the fixture G_2, the power-feed turned on, when the drilling commences, feeding through the 1⅝ths of metal in 55 seconds, during which time the operator places six more castings. The drill-feed releases automatically, the workman swings the fixture a half-turn, again snaps in his feed-gear, and proceeds to remove the six drilled castings, replacing them by others, and using 40 seconds, giving him a rest of 15 seconds before the feed again releases. The nut E, being made smaller than the stud C, leaves only the open washer to be slipped off before removing the castings. The time required by the operator to swing and index the fixture for each lot of six castings is five seconds, leaving the reader a little problem in multiplication to give the working capacity of the tool. In actual operation we have handled 3,250 castings per day, allowing one hour out of the ten for drill-grinding, and the rest for the operator.

A few words may be added here relating to the construction of jigs and fixtures for use in multiple-spindle drilling.

Jig castings may be made very light, and require but little to hold them in place on the machine, owing to the fact that more than one drill cutting at one time forms a brace to keep the work firm. Again, where a piece is to be drilled with several holes, and the jig can be so constructed, the piece may be slipped into the jig against a fixed pin or block held by the hand until the drill starts to cut, when it is then held as securely as if clamped with straps and bolts.

* By D. E. MacCarthy, in the *American Machinist.*

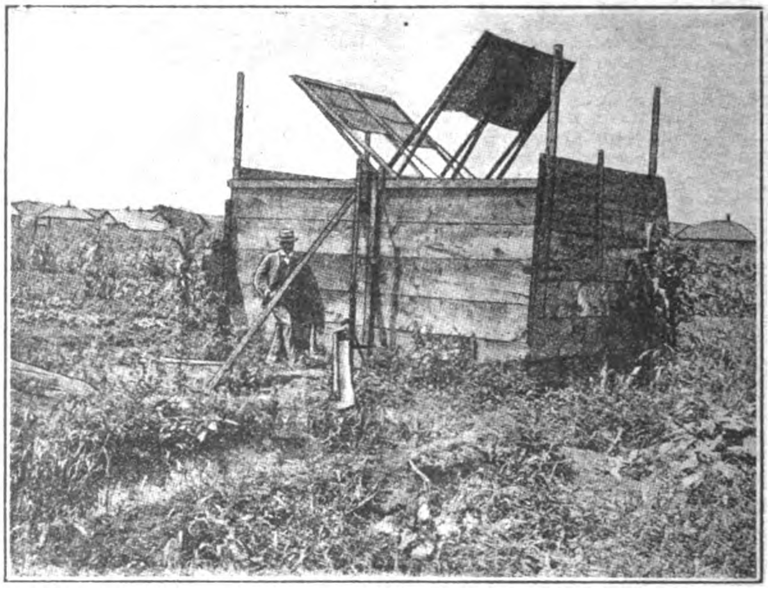
MOTIVE POWER, HIGH SPEED, AND STEAM TURBINES.

The Friday evening discourse at the Royal Institution last week was by the Hon. C. A. Parsons, and dealt with steam turbines, the coming method of propelling steam vessels. After a brief historical reference to the steam turbines described by Hero of Alexandria, and much later by Bianca, Mr. Parsons said that with the introduction of the dynamo the desirability of a high-speed engine was perceived, and the problem became to produce an ideal rotary engine. In 1884 experiments were begun for the construction of a steam turbine which was designed to run as slow, while the dynamo

went as fast, as possible in order to admit of direct coupling. Special bearings were devised for keeping down the vibration, and the turbine itself, which was 10H.P., making 18,000 revolutions a minute, consisted of 15 successive turbine wheels gradually increasing in size, to allow for the expansion of the steam. Defects were noticed, one being a tendency to whip in the spindle with accompanying loss of efficiency, but it was seen that these would decrease with increase in size, and therefore efforts were made to construct bigger engines. In 1888 several turbo-alternators were applied of 120H.P., non-condensing, running at nine or ten thousand revolutions a minute, and taking about 35lb. of steam per electrical horse-power, while in 1892 the adaptation of turbines of the radial flow type to work with condensers marked an epoch as regards economy in steam-power. Turbines of 2,000H.P. were now being constructed, still bigger ones being contemplated, and a large turbo-alternator recently tested was found at full load to consume only 18 8lb. of steam, 10° superheated, per kilowatt hour. Mr. Parsons said there seemed to be an important field for turbines to propel ships, as in such work lightness, careful balancing, and economy were required, and the 1892 turbines appeared capable of fulfilling these conditions. Their high speed, however, was a drawback, since it rendered direct coupling with an ordinary screw impossible. Experiments were, therefore, begun, and, economy suggesting a small boat, the *Turbinia* was built and fitted with engines of 2,000 actual horse-power. Many trials were made with various propellors, but the speed attained was disappointing owing to the excessive slip and inefficiency of the forms used. Mr. Parsons explained the "cavitation" phenomena which wasted the power, giving an ingenious experimental demonstration of the vortices formed in the water by the revolving screw, and pointing out that the best way to avoid them was to have a coarse pitch on the screw and a large blade area. The *Turbinia* was radically altered and fitted with new turbines. The alterations had a marvellous effect. The speed was doubled and 32¾ knots authenticated on the measured mile, while when the vessel was at the Naval Review it was estimated that 34½ were attained. There was but little vibration, and the engines worked very economically. After this success larger works were constructed at Wallsend-on-Tyne, and contracts entered into with the Admiralty for building a torpedo-boat destroyer with a displacement of 350 tons to have a speed of 31 knots. The engines were similar to those of the *Turbinia*, but there were two distinct sets working four screw-shafts, each of which carried two propellers. The two low-pressure turbines acted on the two inner shafts, which also carried the reversing turbines that enabled the vessel to go backwards. The boilers and auxiliary engines were as usual on such ships, and the destroyer, which was named the *Viper*, could be manœuvred like an ordinary twin-screw vessel. On her second trial trip, she attained a mean speed of 34·8 knots, her fastest trial being over 35 knots, or about 41 statute miles per hour, with an indicated horse-power of 11,000; the *Viper* was thus the fastest vessel afloat. After commenting on the great ratio of her steam expansion, the steam entering her high-pressure engines through an 8in. inlet, while it left the low-pressure turbines through an outlet 4ft. square, Mr. Parsons concluded by sketching a few types of vessel in which his turbines might be used. One was a cross-Channel boat, with a length of 270ft., a beam of 33ft., and a tonnage of 1,000. She would carry 600 passengers, and with engines of 18,000H P. attain a sea speed of 30 knots, against the 19 22 now reached. Another was a small unarmoured cruiser, with a length of 420ft., and a displacement of 2,800 tons. Provided with eight propellers and engines giving 80,000H P., she would be able, if necessary, to maintain a speed of 44 knots for eight hours.

HOME-MADE WINDMILLS.

THE illustrations annexed show two windmills, examples of those found in Nebraska, which are published by the *Scientific American* as specimens from a series of articles which are to appear, from the pen of Mr. E H Barbour, entitled "The Home-Made Windmills of Nebraska," in the Supplement. To those who may be unfamiliar with these windmills, says the *Scientific American*, they will be a revelation, and the importance of this movement, inaugurated by the inventive farmers of Nebraska, is made manifest, in that many acres of garden truck, fruit land, and even farm land, are irrigated at a trifling expense. Stock is supplied with water, ranchmen and sheep-herders are benefited, dairy products are increased and improved, and the comfort of the village and the rural home is often enhanced. The merits of these home-made mills have enjoyed such prompt recognition that they are going up daily, not to the detriment, however, of windmills which are made by regular manufacturers, but in addition to them. In a given community the man who puts up the first mill generally furnishes the model for the rest of the neighbourhood, hence it seems desirable that good models should be used, as illustrated in Mr. Barbour's paper. All of the leading types, are shown, and they may serve as models, and, with the aid of a few types, almost anyone can construct windmills which will prove of substantial benefit to their constructors. The author has visited a large number of mills in various parts of the State of Nebraska, and in other States, and his writings on the subject give proof of an intimate acquaintance with the subject.

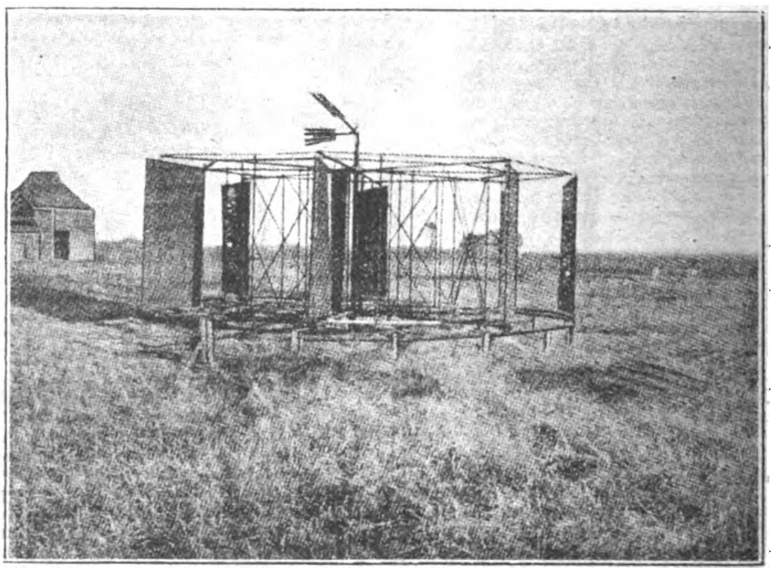


Home-Made "Jumbo" Windmill.

The builders of home-made mills in Nebraska are generally the wealthy and more progressive among the older and well-established farmers, or else younger men just making a start, and not the roving, unsettled, or shiftless class. Some of the beginners use the home-made mill for the irrigation of the garden and for supplying the house, and others make luxuries of them rather than necessities. They put them to work in various ways so save hand labour, such as running a grindstone, churning, working a feed-grinder, corn-sheller, the wood-saw, and other farm machinery. The cost of these windmills is not great. In dollars and cents the average mill will not fall far from four or five dollars, not including the labour. Such mills are usually put up at odd times, and made out of material at hand, such as old lumber, poles, and hardware common to every farm. Some builders, by a display of superior management, erect excellent mills at a nominal extra expense of one or two dollars for labour and hardware. Some mills will be found doing good service which cost but 1dol. 50c., and from this there is every gradation in the price of mills up to 150dol., which gives an efficiency of 8H P., and is capable of grinding food for the stock at the rate of 200 to 300 bushels of grain per day, according to the wind.

Mr. Barbour divides the mills into "Jumbos," "Merry-go-Rounds," "Battle-Ax," "Holland," and "Mock Turbines." This includes all of the main types of the home-made mills known at present.

The "Jumbo," or "Go-devil," as some call it, is very like an old-fashioned overshot wheel. They lend themselves readily to construction, being very simple in design, and they are very economical, owing to the fact that old lumber, laths, shingles, split rails, tin from old roofs, &c., can be pressed into service in the construction of these mills, and even the useful tin can unsoldered can be utilised for nailing on the loose sides of the Jumbo box. The efficiency of the Jumbo mills is low; but this is compensated for by the fact that they are comparatively inexpensive to build, for a good mill of this type can be built for 3dol., and a better one for 8dol. Some have been built large enough to irrigate 10 acres of orchard. The smaller Jumbos, termed "Baby Jumbos," are very small mills. They are generally mounted on abandoned towers or upon buildings, while the larger mills of the same class are set upon the ground and securely anchored there. They are all set so as to catch to best advantage the prevailing wind of the place, which is north and south in Nebraska.



A "Merry-Go-Round" Windmill.

The construction of the Jumbo mill will be understood by reference to our first engraving, which shows one which was made at an expense of 8dol. The sails are made of old coffee-sacks, and the cut-offs or wind-guards may be seen at either side. They are raised and lowered by pulley and rope. The dimensions are 13ft. long, 9ft. wide, and 13ft.

high. This mill successfully irrigates a five-acre garden. The reservoir supplied by this mill is 150ft. long by 4ft. wide, and 2ft. or 3ft. deep. The sliding doors may be raised or lowered, so as to cut off more or less of the force of the wind from the fans, as is rendered necessary by winds of varying velocities. Sometimes these Jumbo windmills are built one north and south and the other east and west, so as to insure service, whatever the direction of the wind.

In the "Merry-go-round" mill is found another attempt at the construction of mills of unlimited size. These mills are rather complex in construction, and are not put up by the farmer, but by a carpenter, and at a considerable expense. Mounted upon towers, like ordinary turbine mills of the manufacturer, they soon reach a size at which the wind can upset them, however well anchored. This has led to the towerless mills which stand low upon the ground, and consequently are capable of a greater circumference. These mills consist of a number of fans revolving about a central axis. About the same axis usually revolves a semicircular hood, thus exposing half of the fans, and shielding the other half, the shield running upon friction rollers. When the mills are to be thrown into gear the cord simply revolves until it covers all the fans on the windward side. Small and medium sized mills may be constructed in this way. A larger Merry-go-round is that built by S. S. Videtto on a ranch near Lincoln, Neb.; it is shown in our engraving. This mill has a diameter of 40ft., and the fans are 12ft. to 14ft. high. The whole structure is carefully designed and well made, being solidly braced, and runs upon a circular steel rail. This is an experimental mill, and it is hoped that this, or some other equally powerful mill, may yet be perfected.

Mr. Barbour then goes on to describe turbines or open-faced mills, which include the "Battle Ax" mills, the "Holland," which resembles the well-known type used in Holland, and the "Mock Turbines," which resemble the manufactured article so closely as to be scarcely distinguishable at times. The subject is a most interesting one, with which all our great agricultural class should be acquainted.

A SIMPLE METHOD FOR PREPARING SALTED PAPER.

In the current number of the *Camera Obscura*, Franz Hofbauer describes the following simple method of preparing a matt-surface plain paper, which differs from most methods in that plain, and not boiled, arrowroot is used for the salting solution. Strong white paper is coated by means of a badger's-hair brush with a mixture of arrowroot (finely powdered) 10 grammes, salt 0·66 gramme, distilled water 33c.c., carbolic acid (pure) 6 drops. This mixture should be well shaken before use till the whole of the precipitate is suspended. The brush should be kept about half full of the mixture, and the paper brushed over in all directions, so as to obtain as even a coating as possible, and, finally, all marks evened out with the damp brush. Any streaks faintly visible after drying will not matter, as the important thing is not so much an even coating as an even damping of the paper. The paper should now be allowed to dry spontaneously, without heat, in a place protected from dust; it should be left to lie flat for 24 hours.

In order to sensitise this paper, the following solutions should be prepared:—(A) Silver nitrate 5 grammes, distilled water 25c.c.; (B) citric acid 5 grammes, distilled water 25c.c., carbolic acid (pure) 6 drops. Mix immediately before use just enough of these solutions by pouring one part of solution B into two parts of solution A. The paper should be supported at an angle of 45°, and fastened down at the corners by sealing-wax, and the sensitising solutions painted across it from left to right without pressure, so that the streaks of the liquid shall run into one another. Metal pins must not be used, nor should the brush be fastened with metal.

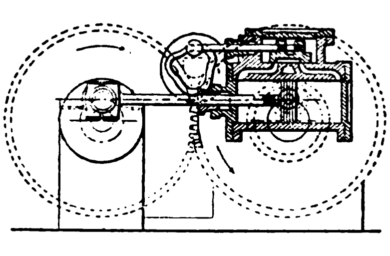
The sensitising solution will gradually become cloudy from the chloride and arrowroot taken up from the surface of the paper by the brush, but this is of no moment, if the brush be not dipped too far into the liquid so as to disturb any precipitate. Thick, rough papers as a rule require more coatings than thin, smooth ones, though a good deal depends upon the kind of paper. The sensitised paper should be allowed to dry spontaneously in a place free from dust, and, as a rule, paper sensitised at night will be ready for use the next day; it will keep longer, but better results are always obtained if it is used at once, and the freshly prepared paper is always slightly damp, which is in favour of the prints.

The finest prints are obtained from tolerably plucky negatives with the following platinum bath. The paper should not be much over-printed, and then washed for about half an hour in three changes of water and then treated with the following:—Potassium chloro-platinite, 1 gramme; distilled water, 300c.c.; nitric acid (pure), 20 drops. The prints will turn first reddish-brown, then violet-black, and finally black. Toning should only be carried to the violet-black stage, then washed and fixed in a 10 per cent. solution of hyposulphite of soda for a quarter of an hour, and then well washed and dried. Greyish-black tones are thus obtained. If toning is carried on too long, the whites become yellow.

If, when dry, the prints do not show a fine grey and the whites are yellow, they may be toned in the following bath: Ammonium sulphocyanide, 10 grammes; sodium phosphate, 12 grammes; distilled water, 250c.c.; solution chloride of gold (1 per cent.), 30c.c.—*British Journal of Photography.*

GAMBLE'S NOVEL ENGINE.

The following description of a novel engine which has been patented in the United States by Mr. H. E. Gamble, of Hoboken, Belgium, is given in the *American Machinist.* It is a "very novel engine, in which the crosshead and connecting-rod are done away with, and yet the engine is not of the oscillating type. The sketch shows the



arrangement, by which it will be seen that the cylinder, with its connected parts, revolves in the opposite direction from the crank-pin, and it is evident that if the cylinder and valve-chest could be made of the same weight as the piston and connecting-rod, the engine as a whole would be exactly balanced horizontally."

Minima of Algol.—Erratum.—We regret that, through an inadvertence, the times of Minima of Algol given on pp. 439 and 527 are exactly 12 hours too late. The reader is requested to subtract 12 hours from each of them in both cases.

USEFUL AND SCIENTIFIC NOTES.

Steel, as a shipbuilding material, was used in the United Kingdom during the past year to the extent of 93.8 per cent. The amount of iron used was only 1·2 per cent.

There is an outcry in Paris against the behaviour of the drivers of motor-carriages, who appear from all accounts to have a supreme disregard for all rules of the road. Some time ago officials were appointed to "keep an eye" on automobilists, but they do not seem to have met with much success, probably because they have to depend upon their limbs to catch the offenders. It seems likely that more rigorous steps will shortly be taken to limit the legal speed of these vehicles.

The beneficial effect of water filtration upon the typhoid death-rate of a community afflicted with polluted water is strikingly shown by figures given in the report of the Massachusetts State Board of Health for 1898. From 1887 to 1892, inclusive, the number of deaths from typhoid in the City of Lawrence ranged from 47 to 60 per annum, a rate per 10,000 of population of 11·44 to 13·44. The filter plant was put in operation in the latter part of 1893, and the typhoid deaths for that year fell to a total of 39 and a rate of 7·96 per 10,000. In 1894, the first full year the filter was in service, the deaths were 24, and the rate 4·75 per 10,000. There has been a steady diminution since, until in 1898 there were but eight deaths from typhoid fever in the city, giving a rate of 1·39 per 10,000 population.

Aerial Navigation.—In the current issue of *Feilden's Magazine*, some attention is given to the subject of aviation, which, it would appear, has retired to some extent from the prominent position which it occupied a few years ago. The great difficulty of assailing the Boers in their rocky strongholds has called attention again to the great desirability of some means, and which should be sufficiently effective, to enable the attacking party to reconnoitre the enemy's position. Ten years ago, the Americans, the Russians, the French, the Germans, and ourselves were experimenting with war balloons. No great success, however, attended these expensive experiments. Major Renard, a French engineer, was the only one who succeeded in navigating a balloon at all. On one occasion he succeeded in making the balloon travel about for a few miles, and then return to the starting point, but this was in a dead calm. After that no success was achieved.

SCIENTIFIC NEWS.

It appears that the solar haloes and parhelia observed from various parts in the southern counties on Jan. 11 were also seen from many parts of western France. M. de Fonvielle, in *Cosmos*, publishes a description. The "brilliant meteor in sunshine" of Jan. 9 is the subject of a note, accompanied by many reports, by "W. F. D." in *Nature* for Jan. 25. The meteor appears to have been observed in the southern counties only, and the writer of the article (evidently Mr. W. F. Denning) says that "the radiant point was probably at a rather low altitude in the S.W. sky."

Sir William Huggins has in the press a volume on the results obtained at the Tulse Hill Observatory, principally consisting of an atlas of star-spectra, with a rather full discussion of the evolutional order of the stars as indicated by laboratory examination of their spectra.

The density of close double stars is considered to be low as compared with that of the sun. There are two papers in the *Astrophysical Journal* by respectively Mr. A. Roberts, of Lovedale, South Africa, and Mr. H. N. Russel, of Princeton, U.S.A., in which the subject is examined mathematically. The authors obtain independently results which lead to the conclusion that variables of the Algol type are probably more than five or six times less dense than the sun.

The report of the Meteorological Council for the year ending March 31, 1899, has been issued. Forecasts are prepared three times a day, those at 8.40 p.m. being for the newspapers of the next morning. For the whole area of these islands 55 per cent. of the forecasts are classed as a complete success, and 28 per cent. as a partial success. The highest percentage of success was 88 in the south of England, the lowest, 78, in the west of Scotland and in the south of Ireland. During the last ten years the only year with a higher percentage of success (complete and partial) was 1893, with 84 per cent. over the entire area of the United Kingdom. Hay harvest forecasts are sent free of charge to recipients selected by the various agricultural bodies. The telegrams were sent daily for a period of about five weeks, and 89 per cent. of the forecasts were useful. Storm signals are hoisted at 234 stations, of which 121 are in England and Wales, 70 in Scotland, 31 in Ireland, four in the Isle of Man, and three in the Channel Islands. The report shows that 87 per cent. were justified by subsequent gales of high winds, but there were five gales for which no storm warnings were issued.

The new wing of the engineering laboratory at Cambridge, erected by his widow in honour of Dr. John Hopkinson, is to be opened by Lord Kelvin to-day (Friday, Feb. 2).

On Friday next week Prof. J. Reynolds Green, Sc.D., is to give a discourse at the Royal Institution on "Symbiosis and Symbiotic Fermentation." The lectures on "Modern Astronomy," by Prof. H. H. Turner, Savilian Professor of Astronomy at Oxford, will be delivered on Thursdays, Feb. 8, 15, 22.

Dr. G. K. Gilbert, of the U.S. Geological Survey, has been elected president of the American Association for the Advancement of Science. Dr. G. M. Dawson, director of the Geological Survey of Canada, has been elected president of the Geological Society of America.

The death is announced of M. Marion, curator of the Natural History Museum at Versailles, who some years ago superintended scientific sea-dredging expeditions.

Mineralogists and geologists will regret to hear of the death of Mr. James R. Gregory, at the age of 68. He started life as an expert in gems; but subsequently devoted his time to mineralogy and geology. So long ago as 1867 he went to South Africa prospecting for minerals, and was remarkably successful. Mr. Gregory had a fine collection of meteorites.

At the annual meeting of the Bristol Naturalists' Society, the president, Prof. Lloyd Morgan, F.R.S., gave an address, in the course of which he referred to some experiments in protective mimicry—i.e., one organism resembling another escapes danger on account of its resemblance. He had kept young birds, and they found from painful experience that bees were unpleasant food, and, in consequence, they avoided the drone fly, which somewhat resembles the bee. Both these insects are banded with black and orange, an

ornamentation rather common in deleterious forms. On a slip of glass he placed some meal, the young chicks ran to it and enjoyed the food; on another slip of glass, ornamented on the under side with bands of orange and black, he placed some meal mixed with quinine, the chicks ran to it, but on tasting the mixture it was received with much shaking of heads, and not a bird would go near food on the orange and black slip of glass again, even after it was washed and pure meal placed upon it. He tried young birds with cinnabar caterpillars and wasps. Those which had experienced that the caterpillars were unpleasant, avoided the wasps. Other experiments proved young chicks 24 hours old could swim as well as young ducks; it was a regular hand-over-hand swimming, not only excitement. Even a young duck, on first entering the water, would probably experience, in the words of Wordsworth "A pleasant shock of mild surprise." If this experiment was tried before the down on the chick was dry, it was not a success, neither was it with a moor-hen.

In a memoir presented to the Paris Academy of Sciences, M. P. Villard describes his experiments connected with the discharge of electrified bodies and the formation of ozone. In ordinary air incandescent bodies may emit cathode rays comparable to the Lénard rays, but of very low voltage, which explains the power of discharging electrified bodies that is possessed by flames, incandescent bodies, and phosphorus, the production of ozone by flames, and sundry other phenomena.

In a communication on the "Birds of Bute and Arran," read before the Edinburgh Field Naturalists and Microscopical Society, Mr. Craig said that the smaller fauna were fairly well represented, but the only important discovery made was that of the "grasshopper warbler" (Acrocephalus nævius) in Bute. There does not seem to be any recorded instance of its previous occurrence in that island, but as it has been identified several times in Argyleshire, probably its presence has merely been overlooked. Another warbler of irregular distribution in Scotland is the Chiff-chaff (Phylloscopus collybita), which was heard in both islands.

In New York Zoological Park a gigantic cage is being erected in which birds will have an opportunity of flying about practically free. The structure is built of steel tubing, and is covered with wire netting. It is 152ft. long, 72ft. wide, and 55ft. high. It incloses three forest trees of considerable size, a pool of water 100ft. long, and plenty of shrubbery.

The Forum at Rome has been coverted into an open-air museum, as, besides the archæological objects, so many plants have been introduced that the botanist can also find something of interest.

M. Moissan has shown definitely that fluorine when free from hydrofluoric acid and moisture is incapable of acting upon perfectly clean and dry glass even after weeks of contact. If, however, the glass contains the merest trace of any organic matter, the fluorine will attack that, and, forming hydrofluoric acid, the glass is speedily corroded.

A great snowslip is reported from the Grampian mountain known as Craigmegachidh, near Kincraig railway-station in Badenoch. The hill attains an elevation of some 2,000ft., and for about 1,500ft. from its base is almost perpendicular. At the top of the sheer acclivity, in one of the scaurs formed by water torrents and snowslips, are precipitous rocks, from which other seams branch off before the slope recedes to the summit. At this point an immense mass of snow was drifted in by south-westerly gales during the late storm, and the base having become insecure in consequence of a strong thaw, the prodigious pile was projected over the precipices. Acquiring terrific momentum downwards, it carried everything to the bottom of the hill—fir-trees, rocks, and huge boulders, some of these latter believed to be nearly a ton weight, being propelled as much as 200 yards beyond the bottom of the hill, destroying in their progress some 40 yards of a deer fence running at right angles. The carcases of two deer have been discovered in the mass of wreckage. Enormous herds of deer were to be observed daily on the summit of the hill during the storm, and, as a favourite pass with the animals is contiguous to the edge of the precipices, it is probable that their movements gave the impulse to the avalanche. About forty years ago a heavy snowslip occurred at the same spot, and hundreds of old pine and other trees were swept down, with immense quantities of rock. The track is still visible, as new trees have not grown.

The experimental trials with an electrical train on the District Railway are reported to have, so far, given satisfaction. The portion of the line selected for the experiments is that between Earl's Court and High-street, Kensington—about a mile, with a steeper gradient than is found on any other part of the Inner Circle. The current, supplied by Belliss-Siemens motors at 500 volts, is conveyed in channel iron rails in which metal shoes slide, the running rails being quite independent, as, for a long time to come, both steam and electrical trains will be used. The experimental train has coaches slightly wider than the present rolling stock, with compartments and doors at the sides, except in the case of the two motor coaches, which, having large wheels, the floor-level is so raised that a gangway is adopted. These motor coaches weigh 50 tons, and the train being a "shuttle," there is a motor at each end. When the train goes round the "circle," only one motor-coach will be needed.

The main line of the West Jersey and Seashore Railway—the portion between Philadelphia and Atlantic City—is to be fitted with electro-pneumatic automatic block signals. It is about 59 miles in length, and at present is worked by the manual telegraph block system. The work is to be completed before heavy summer traffic begins. It will be remembered that it is on that portion of the Pennsylvania system which extends from Atlantic City to Camden that the fastest train in the world runs during the summer season (see p. 38, No. 1744, or p. 401, No. 1708.)

The ice-breaker placed on Lake Baikal recently forced her way through ice 18½in. in thickness for a distance of over 30 versts, at a speed of 14 versts an hour. A verst is 5·2 furlongs.

USEFUL AND SCIENTIFIC NOTES.

The metric system of weights and measures is allowed to be used in Russia now with the system at present in use.

Acetylene gas for railway-carriage lighting has been in use for some time in the United States on the Cornwall and Lebanon Railroad. The gas is compressed, and is carried in the tanks formerly used on the same cars for ordinary illuminating gas.

From the returns compiled by Lloyd's Register of Shipping, it appears that, excluding warships, there were 538 vessels of 1,306,751 tons gross, under construction in the United Kingdom at the close of the quarter ended Dec. 31 last. This total shows a reduction of 95,000 tons, compared with the same date in 1898. But during 1899, 726 vessels of 1,416,791 tons gross—viz., 714 steamers of 1,414,774 tons, and 12 sailing vessels of 2,017 tons, were launched in the United Kingdom. The warships launched at both Government and private yards amount to 35 of 168,590 tons displacement. The total output of the United Kingdom for the year was, therefore, 761 vessels of 1,585,381 tons.

A swing bridge operated by electricity has been erected across the River Charles in the United States and connects Boston and Charlestown. The bridge, with approaches, is 1,920ft. long and the width 100ft. The revolving central section is 240ft. long, and weighs 1,200 tons. When turning it is supported on 70 steel wheels, 26in. in diameter, which run on a track 54ft. diameter. The plant for operating this portion of the bridge is contained in a chamber below, and the motive mechanism consists of two 28H.P. motors placed outside the power-house, one on each side and above the circular track. They are connected to this by means of bevel gearing and vertical shafts, so as to equalise the moving power.

Insect Life.—The distribution of insects is affected by that of plants. In the semi-tropical parts of New South Wales there is a semi-tropical insect fauna, but where the semi-tropical vegetation has become extended beyond semi-tropical geographical limits, there are found also the usual semi-tropical insects. In several places insects found associated with some particular kind of plant in one locality will be met with upon some kindred form of vegetation in another. Thus the peculiar beetles living on the leaves of the Queensland bottle tree are found feeding on the currajong at Wagga Wagga, in New South Wales. The Australian insect fauna is estimated at 10,000 species, but it is believed that the actual number is considerably greater. Of these the greatest variety is to be found in New South Wales, the scientific collections formed in Sydney and elsewhere being of singular attractiveness and interest.

LETTERS TO THE EDITOR

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

⁂ In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

THE CIVIL AND ASTRONOMICAL DAY.

[43262.]—The "curious mistake" to which the "Fellow of the Royal Astronomical Society" alludes (p. 534) certainly requires some explanation, because it has been made in all sorts of papers from the *Times* downwards, and even in the scientific papers. I suspect that a "news agency" has sent round a paragraph based on the fact announced in the second paragraph of the "Scientific News" (p. 490), and there has been some confusion. As everyone knows, however, the *Nautical Almanac* is, of necessity, prepared several years in advance. I suppose that for 1904 is now in preparation or going to press—and it may be that an alteration is being made. There certainly was some proposal for assimilating the astronomical and civil time, and if I recollect the date suggested was the beginning of the next century—Jan. 1, 1901. Is not the *Annuaire* of the Bureau des Longitudes the equivalent of our *Nautical Almanac*? That, it appears, now uses civil time. It would be of use if this matter were set forth in a definite manner by authority. Is civil time to be adopted, or are we to stand "As you were"? The newspapers are now so fully occupied with "war news" that there is little room for anything else, or some questions might have been printed; but may I ask why there should be any distinction between civil and astronomical time? For all ordinary purposes 12 midnight and 12 noon seem suitable divisions. Cannot it suit the astronomers to reckon midnight as the finish of a "day," or must it be noon? P. M.

THE LUNAR RAY SYSTEM.

[43263.]—Adverting to the suggestion of "Silverplume" (letter 43219, p. 511), that the theory which I have submitted is not new, I should be very glad if he can refer me to any book in which such a theory has been put forward. For thirty years past I have taken a great interest in lunar study, and have read everything on the subject that I could get hold of; but I have never come across a suggestion that the lunar rays may have been caused by deposition of the lunar atmosphere. The nearest approach to that idea seems to be the theory of Prof. Pickering, which is discussed in Elger's work on the "Moon." His theory, like mine, suggests the action of wind currents; but the deposited matter is assumed to be volcanic dust (pumice) ejected from small craters. All the conditions he mentions, such as the commencement of the streaks from numerous small craters on the rims of mountain rings, the spreading out of the streaks as they recede from the craters, their reinforcement when a new crater is reached, and the passage of the rays over ridges and plains alike, seem to apply with even greater force if we substitute atmospheric for volcanic deposit, and the suggestion that the bright streaks are formed between the lines of wind currents removes many of the objections that have been urged against the professor's theory.

But volcanic dust seems hardly sufficient to account for what we see. The rays are generally assumed to be the latest of the lunar formations; but I think it is very doubtful if the emission of dust from the craters was the last act of all on the lunar surface. The deposition of the atmosphere might have been. Moreover, the deposit is much more universal than is likely to have occurred from volcanic dust.

Inspection of a good photograph will show that the deposited matter extends in many cases far beyond each side of the rays, but that it is not so bright as on the rays. On each side of the rays there is a plainly-defined dark lane, which, I think, is the line of the main wind current which swept aside the depositing matter. The rays, I suggest, were formed by the concentration of the matter *between* the currents, and in many cases they are subdivided into narrow streaks by fainter dark lanes caused by weaker wind currents. Again, when the actual currents meet an obstruction, such as a crater or mountain, one would expect to find a heaping up and spreading out of the deposit, similar to drifted snow, and such drifting is very

plainly visible around craters, mountains, &c., on lunar photographs.

As regards the suggestion that during the long lunar days the sun's heat would melt the deposits all over the moon—this would doubtless be the case if anything like a terrestrial atmosphere still existed on the moon. But Prof. Langley, in dealing with this very question of heat on the moon, gives a graphic account of his own experiences on the high regions of the Sierra Nevadas, where any part of his person exposed to the sun was severely burned, yet at the same time he was shivering with cold, and everything around him was freezing, owing to the rarefied atmosphere and rapid radiation. If such is the case on the earth, it is very improbable that, in the almost airless condition of the moon, the heat would have any appreciable melting effect, except near the equator, or in some sheltered places where, as I have suggested, it *may* occur, and thus produce the slight atmospheric effects which some observers have noted.

Besides, it must be remembered that Very's 206° is an estimate only, and I think, having regard to the difficulty of securing any accurate result, Very would be the last person to claim that such an estimate should be used as a basis for an argument as if it were a proved fact.

"F.R.A.S." (No. 43244, p. 534) deals very tenderly with my omission to mention pressure as an essential in liquefying the terrestrial atmosphere, and I fancy I can see the humorous twinkle in his eye as he penned that paragraph. The exigencies of space compelled me to condense my remarks—perhaps at the cost of lucidity. What I meant to convey was, that intense cold alone, such as is assumed to prevail during the long lunar night, might be sufficient to cause precipitation of the lunar atmosphere;—not that we have to assume exactly the same conditions and results as in a laboratory experiment when liquefying our own atmospheric air.

In conclusion, I can only say that, in putting forward this theory, I have been animated solely by a sincere desire to assist in the solution of one of the most puzzling mysteries of the moon. **Mark.**

THE NUMBER OF STARS NOT INFINITE.

[43264.]—WITH reference to previous correspondence on this subject (see letter 42994, Nov. 10), the following extracts from Dr. Isaac Roberts's recently-published book of celestial photographs may be of interest to your readers.

Dr. Roberts asks the question: "Are the millions of stars and the numerous nebulosities which are now known to exist, limited in number and extent, and do they consequently indicate that the universe, of which the Solar System constitutes a part, is only one member of a greater stellar universe?" He then records the following remarkable facts:—

"(*a*) Eleven years ago, photographs of the great nebula in Andromeda were taken with the 20in. reflector, and exposures of the plates during intervals up to four hours, and upon some of them were depicted stars to the faintness of 17th and 18th magnitude, and nebulosity to an equal degree of faintness. The films of the plates obtainable in those days were less sensitive than those that have been available during the last five years, and during this period photographs of the nebula with exposures up to four hours have been taken with the 20in. reflector. No extensions of the nebulosity, however, nor increase in the number of stars can be seen on the later rapid plates than were depicted on the earlier slower ones, though the star images and the nebulosity have greater density on the later plates.

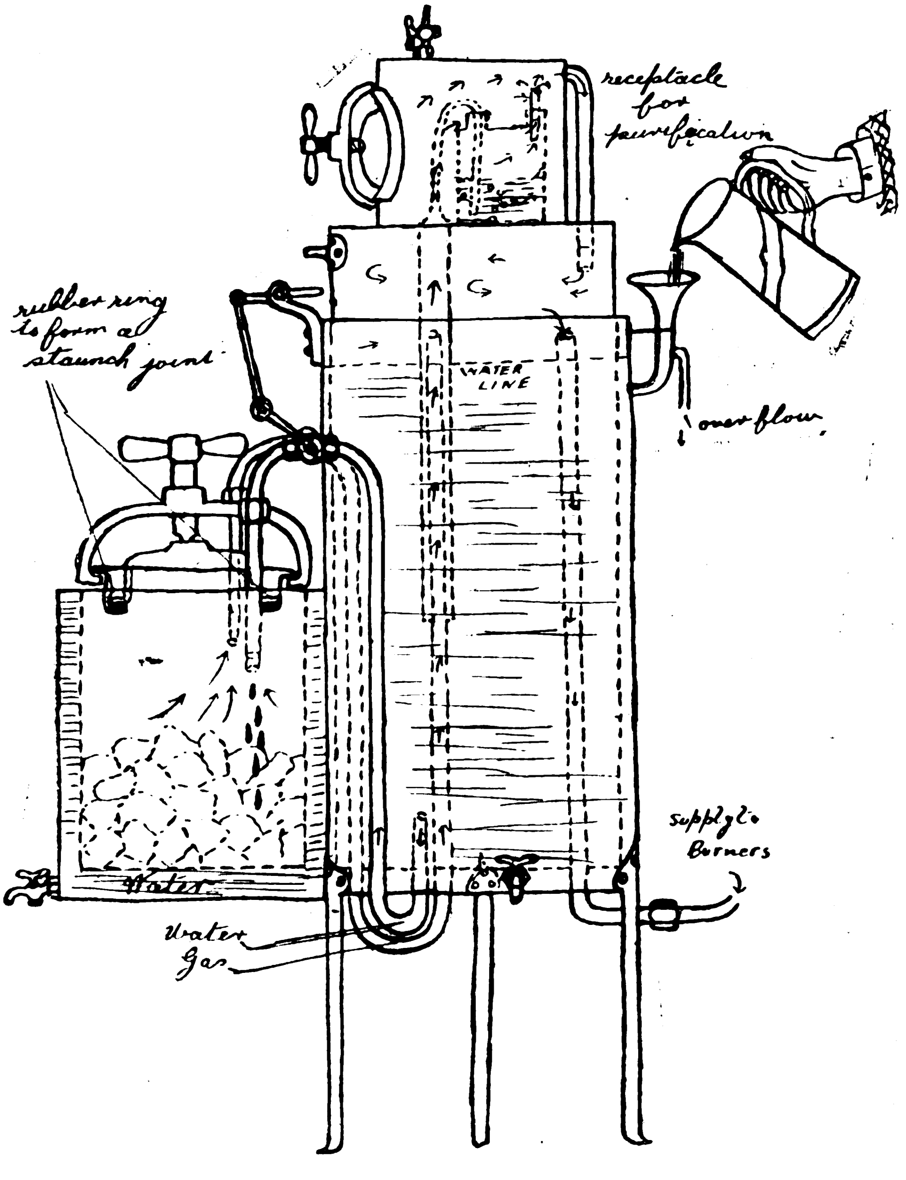
"(*b*) The great nebula in Orion has been photographed with the 20in. reflector at frequent intervals between the years 1886 and 1898, with exposures varying between one minute of time and 7h. 35m.; yet the stars are not more numerous, or the extensions of the nebulosity greater on the latter than are shown on a plate of like sensitiveness which had been exposed during 90 minutes only; the difference exhibited is that of density.

"(*c*) The group of the Pleiades has been photographed with the 20in. reflector at frequent intervals between 1886 and 1898, with exposures of between one minute and twelve hours. The results are that only the same faint stars and nebulosity seen upon plates, which have had an exposure of 1½ hours, are depicted upon those which have been exposed during ten to twelve hours.

"(*d*) Several photographs of the region of the Milky Way in Cygnus have been taken with the 20in. reflector between the years 1886 and 1898, and on comparing two of them (one with an exposure of 60m., and the other with 2h. 35m.) no fainter stars could be found on one than on the other.

Dr. Roberts thinks his evidence "may be accepted as demonstrations of the accuracy of the surmises of astronomers in the past, that the part of the starry universe visible from the earth is limited in extent."

The only remark I have to make on the above is that there appears to be no evidence whatever of the existence of the "greater stellar universe" to which Dr. Roberts refers. **Gavin J. Burns, B.Sc.**



JESSE'S ACETYLENE GENERATOR.

[43265.]—FOR the past few years I have taken great interest in the numerous designs of acetylene generators put upon the market by various firms, and of those made by amateurs which have been illustrated in this journal. I have made numbers of generators from these designs, and have come to the conclusion, after a lengthy trial, that my last effort has been most successful in every manner, and as I thought readers of this journal who are interested in this subject might be on the look-out for a generator perfectly safe and without a deal of complication, I have requested the editor to insert the following drawing, which readers may copy. The body of the gasometer and the generator itself are made of 20-g. zinc, which material acts admirably for this purpose. The series of levers at the side of gasometer actuate the water-feed as the floating portion of gasometer rises and falls.

Portsmouth. **S. Jesse.**

IS THE THEORY OF GRAVITATION A FINALITY?

[43266.]—MR. MUNRO (letter 43216) asks me for an authority for saying that it is not true that the theory of gravitation explains *all* the celestial motions. His next sentence, "True, we cannot explain by gravitation the rotation of the sun upon its axis, and that of the earth and the planets," supplies me with an authority. It surely cannot be the correct thing to say that a theory which explains a part explains the whole of the phenomena of the celestial movements. Would Mr. Munro have me say that because it explains some it explains them all? If so, then my ideas of logic and his are of a very different character. My critic does not appear to be aware that the moon's velocity varies in such a way as to attain its greatest speed when she is in syzygy (in opposition and conjunction), and her least speed when she is midway between these two points in her orbit (in quadrature). Nor does he seem acquainted with the fact that our great mathematicians are divided in opinion on so fundamental a point in the theory of the tides as the place which high water would occupy supposing the ocean to be vibrating with ideal tides. Newton, Laplace, and Airy held that low water should be represented under the moon and at the Antipodes, instead of high water as in modern textbooks.

So far from the tides having been thoroughly explained by the theory of gravitation, as Mr. Munro says, it is well known that the most conflicting accounts have been given by undoubted authorities respecting the *modus operandi* whereby this phenomenon is produced. (See remarks on the subject by "F.R.A.S." in the ENGLISH MECHANIC Aug. 3, 1894.) I am unable to follow Mr. Munro in what he says respecting the calculations of the eclipses and tides. The fact that these phenomena were calculated accurately by astronomers long before the theory of gravitation was invented ought to satisfy every reasonable person that the theory of gravitation can have nothing to do with these calculations. I am not aware that I said anything about the physical appearances of the heavenly bodies. I did, however, draw attention in my letter to their different physical constitutions, and to the fact that the sun acts upon the earth mechanically by means of his heat, and that in this respect there is a marked difference between the sun and the moon, since the latter is a source of no heat whatever to our earth.

I also said (and I challenge anyone to deny it) *that the theory of gravitation does not take into account these notable differences, but is based upon similarity only.* Surely everyone who knows anything of the subject must be aware that, according to gravitational philosophy, matter in general and heavenly bodies in particular are supposed to be inert, and the latter are said to act and react upon each other in a precisely similar manner by means of a precisely similar force called gravity. Now do the facts, viewed from the standpoint of observation and experience, strictly coincide with this theory? Is the sun inert in the same sense as the moon? Do the two bodies act upon the earth in an absolutely similar manner by means of an absolutely similar species of force or energy? These

are plain and simple questions which admit of the simplest answers possible.

The definition given of "attraction" by Mr. Munro as a movement of two bodies towards each other, is no doubt perfectly correct in the primary and ordinary sense of the term; but attraction in philosophy possesses another signification, for it not only denotes a movement of two bodies towards each other, but a movement of the same bodies away from one another. The sun is, in this sense, supposed to be constantly attracting the earth, notwithstanding the fact that the latter from perihelion to aphelion recedes from the sun. If the sun really attracted the earth in the ordinary sense of the word, it would continuously approach the sun in a spiral manner, instead of alternately approaching and receding from it. Sophistry in philosophy is not yet extinct. If it were, the science of logic would scarcely be required.

I am unable to endorse Mr. Munro's conclusion, "that if the theory of gravitation is not a finality it is not even an initiality." Many imperfect theories—the Ptolemaic, for example—have been extremely valuable in their time, although they have had to give way to more perfect theories. We are apt to underrate views that are obsolete, and to overrate established views in speculative science. The reformers of science have, in all ages, had to contend against those who think that they have attained to finality, and have, on that very account, been subjected to the unjust opprobrium of others who cannot appreciate the truly philosophical proverb of Solomon, "The wise will hear, and will increase in learning." I regard the theory of gravitation in much the same light as the Ptolemaic system—as a most valuable attempt to solve the problem of the causation of the celestial motions. But, at the same time, I do not regard it as a finality, because it does not embrace and explain the whole of the phenomena, and because it neglects to take into account the motor effects in the cosmos of those great natural agents of motion known as the correlated forces — viz., heat, magnetism, and electricity.

I believe that it will be a matter of surprise to a future generation that a theory of celestial dynamics which excluded the agency of heat, magnetism, and electricity from a share in the causation of the celestial motions, and which attributes these movements entirely to a unique force called gravity, should have retained its vitality throughout the 19th century. I hope "R. L." (43239) will pardon me for saying that I fail to see that his letter throws any light upon the subject.

It may serve to amuse the leisure time of lovers of romance to speculate about what may have happened "in the beginning," or about "the origin of motion," but such speculation can have nothing to do with things as they are. It would be as vain to speculate about the origin of matter itself, or of energy, both of which are held by modern physicists to be indestructible. I trust that any of your correspondents that may think fit to enter into the discussion will adhere to the main points. A decisive answer should be given first of all to the question, Is the theory of gravitation a full and final explanation of the mechanical and physical cause of the known movements of the Solar System? And if the answer is in the negative, the queries obviously follow, What is the nature of the defect in the current theory?—Have any new facts come to light in astronomy and general physics since the theory was formulated? Until these questions are definitely answered, it would be useless to discuss any novel theory.

Hugh Alexander.

PROPORTIONS OF TELESCOPES.

[43267.]—THE reply of "F.R.A.S.," that the focal length of a lens should be about fourteen times its diameter, scarcely touches the real question. This well-known proportion, it seems to me, is merely the limit prescribed by the difficulty of working lenses of shorter focus with sufficient accuracy to prevent the imperfectly-corrected aberrations becoming obtrusive.

Optically there seems no such limit as this 14-to-1 proportion. On the other hand, I believe it is generally admitted that, *cæteris paribus*, of two telescopes, the shorter will give the more brilliant image. Herschel long ago suggested that perhaps in seeking improvement by lengthening the focus, we in reality might be going in the wrong direction, owing to other conditions interfering with the results.

In a Gregorian or Cassegrain we get an equivalent focus of, say, 250in., though the actual length of the ray-paths may not exceed one-sixth of this distance. Is there, then, any "real best" proportion, so as to combine a maximum of brilliancy with a maximum of focal length, assuming that the question of imperfect workmanship is ignored?

A. S. L.

CUTTING WHEELS WITH PRIME NUMBERS OF TEETH.

[43268.]—REQUIRING a number of small toothed wheels for a geometric curve arrangement, it was necessary to find some means for cutting those which had numbers of teeth only divisible by unity—prime numbers—the others presenting no particular difficulty. It must be admitted in the beginning that there is no way of cutting a wheel, say, of 37 teeth with precise theoretical accuracy; but the method I am about to describe will be so near, that all practical purposes are answered.

My lathe, which is by Cooke and Sons, of York,

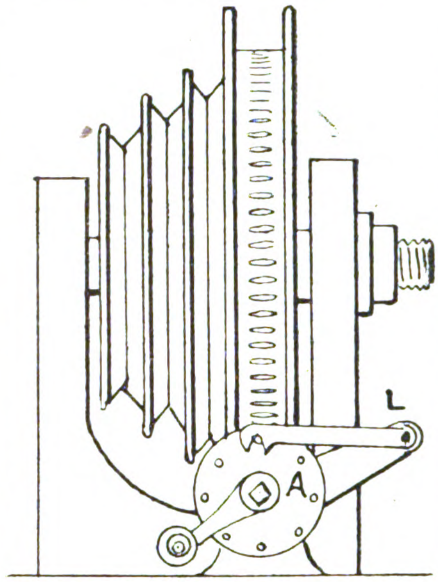


FIG. 1.

has a worm-wheel and tangent-screw attached to the headstock in the usual way. The worm-wheel has 180 teeth, and the spindle of the tangent-screw can be fitted with discs divided in any desired way, and perforated with holes for the reception of a pin which is held in place by a notched lever coming down on it, as shown in Fig. 1, L.

The essential parts for the purpose of cutting prime wheels are shown in Fig. 2, where A represents a gunmetal wheel fixed on the end of the tangent screw, and perforated with 100 equidistant holes. B is a piece of metal fitted with two pins C and D, which are exactly the distance of 10 holes apart. Any other number might be taken, as these pins are only to hold the piece B to the division-plate A. It may be mentioned that the pin C projects outwards so as to form a handle, and it is also longer on the other side, so as to facilitate adjustment, the long tapered end being placed in the desired hole, when the shorter pin D easily slips into its own place.

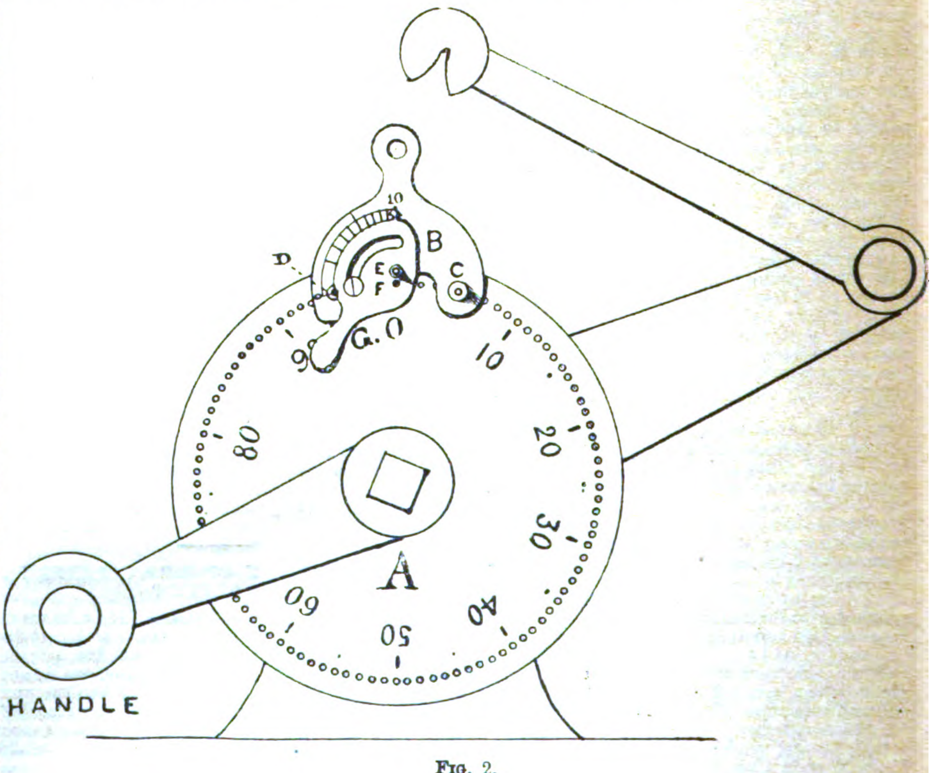


FIG. 2.

G is a quadrant piece, slotted as shown, and capable of being fixed in any position by the screw which passes through it. This quadrant piece rotates on F, which is a small pin attached to the piece B, but not projecting beyond the front of G. It falls exactly over the middle hole between C and D. E is a pin projecting outwards from the face of the attachment, and this pin engages in the notch of the lever L when the latter is let down on it.

The distance between E and F is exactly one division of the row of dots, so that when the pointer on G stands at 10 it is practically over one hole; but when the pointer stands at 0 on the scale, it is over the one before. At intermediate points on the scale it corresponds to tenths of a division, and as it moves eccentrically round F, it practically divides the space between two adjacent holes into ten equal parts.

The scale, which is made without difficulty, is so divided that it corresponds to equal steps of E, as measured on the line of holes. These steps correspond to $\frac{1}{1000}$th of the circle of holes on A, and as the worm-wheel of the lathe has 180 divisions, each step, as measured on the scale of the quadrant piece, corresponds to $\frac{1}{18000}$th of the circumference of a wheel fixed in the usual way for cutting between the centres of the lathe. In cutting a wheel of 6in. diameter, the greatest error which could occur in the setting would not amount to the $\frac{1}{10000}$th of an inch—a quantity probably less than the unadvoidable errors caused by wear of tools, temperature, and other causes.

The management of this apparatus requires the undivided attention of the operator, and a table for each wheel to be cut has to be calculated. For instance, in cutting a wheel of 37 teeth, the first cut will, of course, be at zero, the second will be at 4·864—a number obtained by dividing 180—the teeth in the worm-wheel by 37, the teeth in the wheel to be cut.

The whole number, 4, means four turns of the tangent-screw handle. The next two figures 86, means that the pin, C, is to be set in hole No. 86 on A; and the last figure, 4, is to be set on the small quadrant scale. But in dividing 180 by 37 there was a remainder of 32. This has to be distributed as equally as possible over the 37 teeth—i.e., ·001 is added to each number of the table except five, which five are to be separated as equally as possible.

If still greater accuracy is required, make the piece G large enough to admit of 20 divisions instead of 10. I have cut many prime-number wheels by this method, and they run as smoothly as those with more tractable divisions.

I may mention that, with this arrangement for subdividing the disc on the end of the tangent screw, the whole lathe-head is converted into a micrometer of great accuracy, and with the addition of a screw-piece attached to the lathe-nose, and of, say, 20 threads to the inch, working in a nut properly restrained from going round, a quantity so small as a half-millionth of an inch could be theoretically measured. For such ultra-refinement the piece L must be supplanted by a detent moving radially to A.

Richard Inwards.

20, Bartholomew-villas, N.W.

AN X-RAY CURIOSITY.

[43269.]—IN reference to letter 43238, I would suggest that the greater transparency is only apparent, and that the real cause is fluorescence of the glass, which is probably coloured with uranium, some of the compounds of which are capable of considerable fluorescence under the influence of the X-rays, notably the oxy-fluoride of uranium and ammonium. William G. Collins.

ORNAMENTAL TURNING.

[43270.]—IN answer to "Spherical Rest" (43232) I am extremely glad of the opinion therein expressed. With regard to the procuring of the necessary material, either in ivory or black wood, I am sorry to have to admit the difficulty in both cases, when so large a diameter is required. If our correspondent could favour me with a call, I will do my best to put him in the way of getting the best to be had. Also, shall be pleased to show him the best way of sharpening the step tools, with the aid of small strips of brass, charged with a cutting powder. I think the step tool will be found, when correctly sharpened, a great saving of time. I can probably suggest to "Spherical Slide-Rest" how the expense may be modified by putting together certain parts, which, if well done, will not interfere with the perfection of the work when finished.

J. H. Evans.

DOUBLE-ENGINE RUNNING ON RAILWAYS.

[43271.]—THERE is much to be said in connection with what "Large Boiler" (p. 540) notes, with reference to two engines drawing one train; but he surely does not mean to say that it is a common practice to put two engines on for the through journey. Surely it would be better work to make two trains, for, however skilful the drivers, the two locomotives can scarcely do their full duty always. I see it is mentioned that the water-tubes in the fireboxes of Mr. Drummond's latest locomotives have enabled those engines to do rather remarkable work, and it would seem that every possible inch of heating surface should be utilised. It is not so much a question of the size of boiler, it seems, as the ability of the boiler to supply the required quantity of steam. L. T.

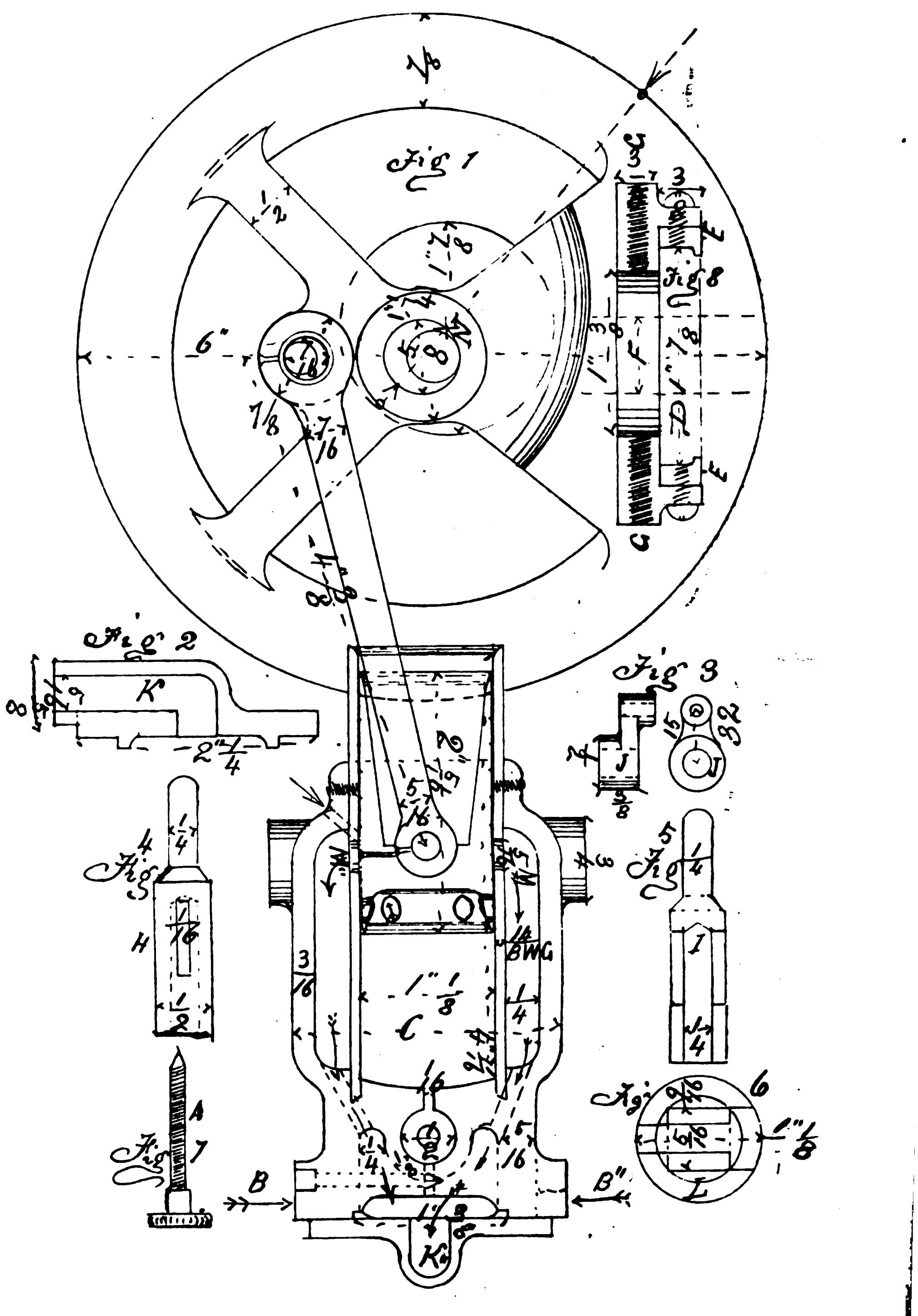
STEAM-ENGINES.

[43272.]—I WOULD like to warn amateur engineering readers of "Ours" against making small *steam*-engines for the purpose of driving a lathe, &c., whether on the lines laid down by "Jack of All Trades" or anyone else. Make *gas* or *oil* engines if you want a bit of power, but *not* steam. Now for the reason why: Some years ago I came into possession of my first lathe, and could not rest till I had made an engine to drive it. Thinking I might wish to add another lathe or an emery-grinder to my stock, I built an engine (steam) of sufficient size to drive all I might require. I then bought a boiler, and my troubles began. I burned coal, and the neighbours complained about the smoke, and I had to use coke. Then came the worst rub of all. Little boilers want attention, and just as you are doing a nice bit of turning you discover that the fire is low, or the pressure is running down, or, worst of all, the water is only just visible in the glass. After altering that, you go on turning, and presently your speed begins to get less and less. Then you remember that you forgot to put any tallow in the cylinder, and you have to do that. In short, you cannot be in two places at once. I have said nothing about pump or injector failures, boiler cleaning, or space occupied, but they must be taken note of. Then, again, it does not pay to wait, say, half an hour while you get up steam, just to do, perhaps, an hour's turning. The above letter is not written to discourage model steam-engine makers, but only to show that steam-engines are not of much use unless you can give the whole, or nearly whole, of your time and attention to them.

E. W. Fraser.

HOW TO BUILD A LIGHT ENGINE FOR VARIOUS PURPOSES.—V.

[43273.]—I HAVE shown you how to utilise the first cylinder for a bracket or wall-engine. Now that is not bound to be positively fastened to and bolted to or through the wall, but could be mounted upon a floor-board, the which I will show further on. This sketch will show you how to construct an engine single-acting, and as I am restricted to space in one sense, and to make it easy to work out details, I make all to the same scale, and give dimensions, and if any of you think of augmenting your power—i.e., substituting an inch and a quarter or larger cylinder, make the jacket mountings larger. All other things will be the same, excepting, of course, the base to which the cylinder stands upon. Fig. 1 is an elevated section of of engine; Fig. 2 is the bonnet for the bottom of the cylinder, and is to be put in that position, as the exhaust will be led through holes at bottom of steam-jacket. See the arrows for path of same. Fig. 3 are two views of bell-crank for working the valve made fast upon the valve spindle, as a matter of course. Fig. 4 is one view of valve, which is rotary. I confine myself to that, as it is the oldest known, and we have ocular demonstrations of its utility in engines of the present day, and it cannot be beaten for effect and simplicity. Fig. 5 is the transverse view; the hole up the centre is the steam-way, and may be carried up to the end of the port, as shown, which will make the said ports much easier to get out. Carry this port right across in every instance. In this instance you will see that it is used to drain the cylinder, from the screw valve at B, where the same discharges itself into the exhaust chamber and out at the bonnet K. Fig. 6 is a section through the trunk-piston pin and joint of the connecting rod. Fig. 7 is the screw for valve for draining the cylinders, and Fig. 8 upon the face of flywheel rim—i.e., not the usual place for it, but when the paper is upon the board and an open space presents itself. I cannot help crowding some more information in the same space as it is only a question of very little trouble on one side while the things are under my eye, and on the other, no more space but a little more ink upon the other side.



This is a somewhat queer sketch, as there is no visible support for the mechanism—like Mohammed's coffin; but it saves confusion, and nuts and bolts I have dispensed with, as there is no need to put them upon paper, and if holes are given for the fixing, there can be no mistake, and it leaves the ground clear. And I suppose I am getting lazy, for I do not see getting things out on a scale of one inch to the foot, and after the trouble they are not readable. However, in the next view of the same, I will make amends as regards the support, as you will have two entablatures for the one engine—i.e., the edge with engine mounted and a plan; so you see it is only a question of time. Jack of all Trades.

MOTOR TRICYCLES.

[43274.]—"MONTY'S" method (letter 43256) of using two motors on a tricycle is ingenious; but I fail to see object of intermediate pinion on back engine, nor that this arrangement balances at all. The pistons both go up and down synchronously. While one is firing, the other is taking a charge and offering comparatively no resistance; on the next up-stroke one is exhausting, and the other compressing—both power-absorbing operations, and I am sure the result would be greater vibration than with single motor. I have a twin-engine tricycle, in which the engines are placed side by side—one in the usual place, the other on the other side of the large gear-wheel. The pistons travel together, but fire alternately. When they work properly, the machine is very powerful; but the difficulties of ignition are great. To save correspondence, I may say I do not intend to carry two coils or two batteries; but if some reader can suggest a method of firing these engines regularly without complication, I shall be glad to hear from him. I have tried

tube-ignition; brush commutator for secondary, with electric ignition; two plugs in parallel, two plugs in series. Now I have a cam current-shifter on the lay shaft for secondary, but cannot insulate sufficiently for a wet day. The machine devours petrol by the bucketful, and runs batteries down in a day. It makes more noise than a Maxim gun, and is perilously prone to tip up.

To revert to "Monty's" letter. What has "even divisible number of teeth" to do with it? The engine-pinion must go tooth for tooth with the axle gear-wheel, and if both engines have same size pinions they *must* synchronise. If I were to adopt "Monty's" position for my engines, I should run both engines in the same direction, but one piston up and one down; this gives a bad torque, but does balance a little, and is, in my opinion, worth trying. It is done in the Decauville car. Will "Monty" say what he thinks about this device? **H. Scott Russell.**

MOTOR-CARS.

[43275.]—I HAVE heard it objected to a jockey-pulley that, as usually applied, it causes an injurious reverse bend in the belt. If this be so, might it not answer better to apply the jockey at the place where the driven pulley is first touched by the belt, which would thus be pinched between the two pulleys. In this position there would be no effort of the belt to straighten itself against the pressure of the jockey, as in the ordinary method, and, therefore, the jockey might be applied with greater power.

As to the guide-pulleys in "our" motor-car (if I may call it so), which have been so much objected to, could not the one (or, rather, the two) to the left of H be dispensed with—with very little loss of brake surface—by connecting the brake-rods directly with the short cranks on centre, U, these being rotated clockwise into the same line as the long handle?

I should certainly prefer a bell-crank in lieu of the other pulley (above Z), especially as the turn is a sharp one; and the joints in this linkage need not be elaborate ones *if* the spring that takes off the brake be next it, not next the pedal. Indeed, I believe simple hooks and eyes would answer perfectly, for I have had two tricycles in which the five joints between the hand-lever and the hand-brake were of this type, and they were quite satisfactory, for they were cheap, gave great freedom of movement, and required no oil.

All rods were in tension, and therefore light, one having a turn-buckle for adjustment, which, when properly done, rendered the linkage quite free from rattle. Of course, the pedal must be pulled up against a stop.

Seeing that the connecting-rod is always in compression, and that, therefore, the outer half of its big-end bearing is merely a cup to keep things in place, would it answer (and get rid of the need for adjustment) to put on the studs, in place of nuts, short, stiff spiral springs, secured by cotters? It seems to me extraordinary that, so far as I know, no maker fits efficient gear-cases to the driving-chains of his motor-car. How can an elaborate and costly piece of mechanism like the modern pitch-chain be expected to work and wear well when exposed to continual showers of mud or dust?

Most small cars depend for varying their pace upon altering the ignition. Is not this a mistake? For if a given speed of the engine should be associated with a definite timing of the spark, it would seem better that this timing should be regulated by a governor, not by hand, and that the pace should be altered by adjusting the throttle-valve. This valve ought, it seems to me, to be coupled with the air-valve, so that both should move together, yet so that the air-valve could also be adjusted by hand when necessary. **Faber.**

[43276.]—THE majority of those criticising my design of motor and car have missed the main points—simplicity and cheapness; and I would ask that future critics would bear these in mind. There are many details I could, and should like to, alter and improve, but for the cost they would involve.

I am pleased to see Mr. J. W. Riding (43230, p. 513) has constructed a car with such complete control as his letter describes.

Mr. A. Jacks (43231, p. 513) complains of the short wheel-base; but I fail to see the disadvantages in this for a car which is not intended for racing. I have allowed ample room for anyone to mount or dismount, and consider the short wheel-base to help considerably in steering the car in traffic. Its width is ample to prevent any tendency to overturning. As to the frame, I must repeat what I said in the first article. It may be made of any material the builder may prefer. The same sizes (width and length) will, of course, be required; and if readers are capable of working angle, channel, or H-bars, or steel tubes, very little else in the way of dimensions will be required by them. I will give the sizes of angle or channel-bars and tubing suitable in the chapter dealing with the frame. When I stated that I did not know of a car on the market with belt driving, in which the action of putting on the brake also disengaged the engine, I was not thinking of cars fitted with friction clutches, as I regard this type as being midway between belt and gear-driven—not purely belt-driven.

The question of using a greater-powered motor is fully answered by consideration of the cost. The horizontal valves to which "Dragoon" (43254, p. 539) objects work quite well. I have used them on several motors, and have no fault to find with them. Moreover, disposing them in this way simplifies the valve-gear somewhat. Let "Dragoon" make a full-sized horizontal section of the cylinder and the valve-box on separate pieces of tracing-paper. The valve-box to be drawn as it would be if the valves were vertical. On placing these one over the other he will find that two of the studs will come far in the rear of the cylinder end if the same compression space is to be maintained. That unfortunate bell-crank lever was put in for an object. I stated in the first article I would show later how a governor could be fitted. The governing will be effected by a "hit or miss" arrangement between the push-rod and bell-crank lever. Hence its *raison d'être*. I am fully aware that it could have been dispensed with, as perhaps will be evident on referring to my drawings in the articles on "Motor Cycles." The next paragraph of "Dragoon's" letter seems somewhat vague; but if I read it rightly I take it he would have the combustion chamber connected by pipes to the water-jacket. I would point out that I am describing a petrol and not a hydraulic motor. If a water-joint is a nuisance it is evidence of bad or careless workmanship. Properly made, they will stand for a very long period, and should be no more a "weak point" than any other part of the motor. As the cylinder is to be of cast iron and the crank chamber of aluminium, I am afraid technical difficulties would stand in the way of casting them in one piece. A cast-iron crank-chamber is, of course, possible, but would be inconveniently heavy. The difficulties in machining would alone be sufficient to condemn this one-piece idea from an amateur's point of view. In a well-equipped engineering works such an objection would not count.

Built-up cranks are not so good as a solid forging, and little, if anything, would be saved in the cost, wherefore I do not describe one. Re putting valve gear-wheel inside crank-chamber: I have adopted the most simple and easy construction. I most heartily agree with the last paragraph of "Dragoon's" letter.

"R. W. B." (43255) also falls foul of the bell-crank lever. This I refer to above, so need not explain again. I would add, however, that by its use a more easy movement of the gear is obtained, there being no side strain and friction on the push-rod. I notice that some of the best French makers are abandoning the use of the straight push-rod in favour of a lever and roller, notably in the "Sphinx" cycle motor.

The Daimler Motor Co. do not fit perch-bars to their front axles; but, if desired, they can be fitted to ours, and I will incorporate them as an addition. In this connection, I would remark that if I were to describe every addition suggested by various critics the cost of the car would be prohibitive. I agree in the matter of not using steel wire cord for band-brake. It is very unreliable and wears out quickly. I shall use a steel band leather-lined. Has "R. W. B." ever seen a Daimler motor of recent construction? If so, why does he refer to the arrangement I give for valve springs as "slipshod"? Has he also considered that for equal efficiency the less the number of parts the better? The Daimler Co. always hook the ends of valve-springs through the rods, and very neat it looks, besides working well. The same firm also use non-adjustable small ends to their connecting rods, and for a considerable time did not even bush them. They case-hardened the small end of rod, which is a mild steel stamping. The plain bushed small end works well, and, when needed, it is a small matter to put in a new bush.

Has "Monty" ever tried to synchronise two motors arranged as shown in his design for motor tricycle? If not, he will have enough experimenting to last him a twelvemonth or more.

The Writer of the Articles.

WEATHER.

[43277.]—IN a letter which appeared on p. 496, I mentioned that "many of those who work in London live, say, five miles north," &c., and they are convinced of the futility of predicting weather for even so small a place as England. For "England," I think I might now write London. On Sunday morning last, quite a heavy fall of snow was seen at Wimbledon, Chiswick, Camberwell, Clapham, Dalwich, Clapton, and Regent-street; but there was no sign of it at Forest-gate, Upton, or East Ham, places as far to the east of St. Paul's as Chiswick is to the west. At Bardett-road (about three miles east of St. Paul's) there was just a little snow, which melted almost directly; but further east there does not seem to have been more than a suspicion of a little sleet, which is understood to be partly-frozen rain. I suppose that the clouds deposited their snow on the west side of London, and, passing over the great city, became so warmed that the moisture could not freeze into snow. **S. R.**

THE TWENTIETH CENTURY—ERRATUM.

[43278.]—I REGRET that a confusing error has got into print in the last paragraph of my letter (43258) on the Twentieth Century. Anglo-Russian documents are dated thus:—

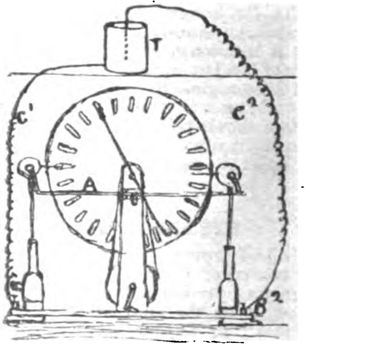
$$\text{Thursday, 1900, March } \frac{2 \text{ O.S.}}{15 \text{ N.S.}}$$

The day of the week is the same, and so, practically, is the course of the seasons in Moscow and London. But in 1752 our English Calendar was treated like a behind-time clock. It was "reformed" by being put on 11 days, and its clock-work was regulated so as to make it go faster in future, and keep up to date. In Russia the Julian Calendar has never been brought up to date, nor has its clockwork been revised, and in a few weeks now it will have drifted back a further two days. It therefore follows that in Russia, the seasons of the year, and the festival days based on those seasons, will not be indicated by the calendar until they are 13 days past. **James Edmunds.**

26, Manchester-square, W.

PECULIAR EFFECTS UPON SPARK DISCHARGES.

[43279.]—THE following account of a phenomenon I have observed may be of interest to some of your readers. The accompanying sketch illustrates the arrangement of apparatus:—



C^1 is a conductor connecting the tin T to the terminal B^1 of a Wimshurst machine. C^2 is a conductor from the terminal B^2, which hangs, reaching about 1¼in. from the bottom, and thoroughly insulated from the tin can. A is a double spark-gap arm. When the machine is working the sparks passing in the tin can (which produces a sharp hollow sound) are almost deadened by the sound produced by the sparks passing between the double spark-gap. But on placing the hand upon any part of the arm A, the discharges passing between the two spark-gaps are hardly audible. On the contrary, those inside the tin can are very plainly heard, even in an adjoining room with doors shut. I have performed this experiment a number of times, always obtaining the same results. I should very much like to know the cause of this phenomenon. Perhaps one of your readers may be able to explain this. **A. Stammwitz.**

THERE were 951 ships of 267,642 gross tons built in the United States last year. Of this number 421 were steamships of 160,132 tons gross.

CLEANING bridges by sand-blast has been tried on five structures on the Boston and Maine Railroad. The work is entirely satisfactory, being more thorough than hand cleaning. A pressure of 15lb. per square inch is employed, and the sand has to be perfectly dry.

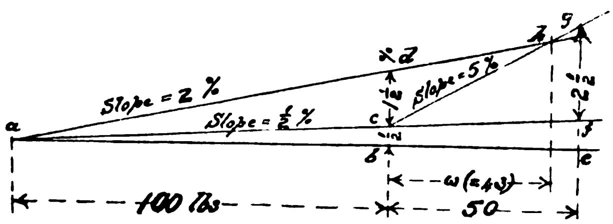
A SCHEME has been prepared for the construction of a system of underground electric railways in Berlin. The project, which has already been approved by the mayor and the traffic committee, will shortly be submitted to the municipal authorities, who will be asked to approve the carrying out of the works. It is proposed to construct two circle railways and two transverse lines from north to south and east and west respectively. The scheme provides for the building of the railways by private enterprise at the expense of the town; but whether they would be leased to a company or worked by the city authorities is a question for the future to determine. It is belived that the railways could be completed and opened to traffic in two years from the time of commencement, as was the case with the underground electric railway in Buda-Pesth.

REPLIES TO QUERIES.

**** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[96919.]—**Flying Lady.**—I saw this performance at Blackpool, and distinctly heard the squeaking of the machinery behind the black curtain at the back. At the time I believed that she was fastened behind to the end of a long lever. The system of bright lights and black background was arranged to prevent anything being seen. A hoop was certainly drawn in various ways around her; but they should certainly oil their machinery to make the trick complete. H. WADSWORTH.

[97069.]—**Formula (U.Q.)**—Perhaps a graphical solution will be of interest. Draw a horizontal line and mark off a length $a\,b$ to represent your 100lb. of ½ per cent. solution to any convenient scale. With the same or any other scale mark a perpendicular height $b\,c$ to represent ½ per cent., and $b\,d$ to represent 2 per cent. From a draw lines through c and d, as shown. Through c draw $c\,g$ at a slope corresponding to 5 per cent. To do this, measure



100 horizontally and 5 vertically from $a\,f$, or, as has been done in the figure, use other figures in the same proportion, such as $b\,e$ horizontally = 50, and $f\,g$ vertically = 2½. The intersection of $c\,g$ with $a\,d$ produced at h gives a length w (= nearly 43lb.), which is the weight of 5 per cent. solution which must be added to obtain a 2 per cent. solution. Mathematically: By the terms of your question it is evident that—

$$\left[(100 + w) \times \frac{0.5}{100}\right] + \left[w \times \frac{5}{100}\right] = (100 + w) \times \frac{2}{100}$$

Hence—

$$w \times \frac{5}{100} = \left[(100 + w) \times \frac{2}{100}\right] - \left[(100 + w) \times \frac{0{\cdot}5}{105}\right]$$

$$= (190 + w) \times \left(\frac{2}{100} - \frac{0.5}{100}\right)$$

$$\frac{\frac{5}{100}}{\frac{2}{100} - \frac{0{\cdot}5}{100}} = \frac{100 + w}{w} = \frac{100}{w} + 1$$

Hence—

$$\frac{5}{2 - 0.5} - 1 = \frac{100}{w}$$

$$w = \frac{100}{2{\cdot}33} = 42{\cdot}8\text{, or, say, 43lb.}$$

GLATTON.

[97180.]—**Marine Navigation.**—As a marine engineer of ten years' experience, I can fully substantiate the reply of "J. H. H." in "E.M." for Jan. 19. "G. S. N." appears to have a very hazy idea of modern marine-engine practice. He probably has not heard of the "Davey" motor, which is a steam-engine worked with barely one pound of steam. This is a surface-condensing engine. A partial vacuum is first obtained by means of a small pump worked by hand. Steam from the boiler (at, say, 1lb. pressure) is then admitted to cylinder, and after a few revolutions of engine, the air-pump worked by engine produces a vacuum of about 27in., which practically works the engine. When triple-expansion engines of a large steamer are working dead slow, there is really no more steam in low-pressure steam-chest than would be obtainable from the exhaust of all the auxiliary engines; but having once established a good vacuum in condenser, the main stop-valve could be almost or entirely closed if the exhaust from auxiliaries were turned into low-pressure receiver. "G. S. N." is puzzled to know what the boilers do with the evaporated water. Perhaps he is not aware that the boiler feed is not supplemented as in bygone days with water direct from the sea, but with condensed steam from evaporated sea-water, nearly all up-to-date high-pressure jobs being fitted with what are known as "evaporators." CHARLTON.

[97180.]—**Marine Navigation.**—I regret I am unable to refer "G. S. N." to any work on marine engineering which treats of the subject in question. There are but one or two such books in existence, and for a very good reason—viz., marine engineering practice advances with such rapid strides that any work dealing with it necessarily becomes practically obsolete in a very few years. But the reasons which lead to the utilisation of exhaust steam from auxiliary engines in the main engines are very apparent when the subject is looked into. Take, for instance, a liner with boilers working at, say, 150lb. above atmosphere. The auxiliary engines are mostly "simple" engines—that is to say, not compound. The cut-off in these engine cylinders will be at about ·6 or ·7 of their stroke, and the exhaust steam therefore leaves the cylinders at considerable pressure, even after making allowance for loss from various causes. To realise this, one has only to listen to a locomotive with a heavy load behind it. Now to discharge this high-pressure exhaust steam direct into the condenser would be to lose all the work still left in the steam. Therefore it (or some of it) is passed into the receivers of the i.p. or l.p. cylinders of the main engines, and some of its work extracted by the main pistons. Compound auxiliary engines are not possible for many purposes, chiefly on account of the variations in the load under which they are required to run. Otherwise, their use would obviate this waste of useful steam. The aim of using this exhaust steam in the main engines is then to avoid waste so far as is possible, and as every year sees more auxiliary engines added to our first-class ships, so the difficulty increases. As I pointed out in a former reply, this steam may be passed through evaporators, and so used to produce distilled water to supply loss of water from the boilers by reason of leaky joints, glands, safety-valves, whistle, &c., and which in the Navy is very great. No sea-water is allowed to be used in Naval boilers under any circumstances at the present time. A large quantity of distilled water is therefore required, and part of it is obtained in the above manner. Referring to the original query about driving the ship four knots with exhaust steam, it should be remembered that a very small pressure per square inch on the l.p. piston will turn the engines after a vacuum is once established, and a very small number of revolutions of the engines are necessary to maintain a speed of four knots. J. H. H.

[97196.]—**Science and Art Department Certificates.**—On p. 475 I mentioned that in replies on p. 409 I gave the price of the "Directory" as 6d., while "Clara" gave it as 1s. 6d. Being in the neighbourhood of the publishers the other day, I called in and found that the price is 6d. It appears that by an error the price on some copies was printed 1s. 11d., and that being altered by pen to 6d., appeared occasionally as 1s. 6d. If anyone has paid 1s. 6d., there is a shilling to come back. I have some recollection that, by one of the rules and regulations of the Department, or by an order of the House of Commons, the "Directory" of the Science and Art Department should never be more than 6d., no matter how many sheets it contains. It is probably in reckoning up the price per sheet that the mistake was made. M. T.

[97216.]—**Grammaphone (U.Q.)**—There are no larger records to be bought, as far as I know, than the 7in. ones. Of course, you could make them any size in reason if the dimensions of the machine were altered to suit.

R. A. R. BENNETT.

[97221.]—**Telectroscope.**—If "F. H. E." will refer to what I said on p. 518 (he strangely omits to give the reference), he will find that I was talking about being able to see round a corner by means of a wire—the telectroscope notion. Any schoolboy knows all about seeing by means of reflection: he has seen through a book or a brick by that means long ago. The query I noticed appeared on p. 388. I cannot deal with all the "red herrings" drawn across that trail. The real question is "seeing by wire"—not by reflection from mirrors. T. P.

[97231.]—**Moving Hearth-Rug (U.Q.)**—This reads like spiritualism, and has almost the effect desired by the Fat Boy in "Pickwick"; but I am inclined to attribute the phenomenon to more prosaic sources. We have an Axminster carpet, with an Axminster rug to match, which does the same thing; in fact, it insists on advancing in so forcible a manner that it actually opens the door before which it is placed if this is not very tightly shut. It is, I think, simply due to the pile of the carpet underneath, which moves it gradually forwards when the strands of the carpet are pushed forwards by people treading upon the carpet behind the rug. But why should the rug go forwards during the night? I do not think ours has ever done this. I suppose the querist means that no one had entered the room between the hours mentioned?

R. A. R. BENNETT.

[97286.]—**Specula.**—If this querist ("Astor," p. 432) will refer to the back volumes, he will find all the information he can require; but if he cannot find it in them, it is certain he will not find it anywhere. Surely Mr. Wassell's articles are sufficient, to say nothing of the many which preceded them, and of others which have followed. It is not even easy to understand what is "Astor's" difficulty. He has "tried ineffectually," he says; perhaps if he tries again, and yet again, he will succeed. One thing is certain—that he can obtain instructions from practical men, who will show him how to do the work. As no reference is given to the machine mentioned, it is scarcely likely that readers will wade through back volumes to find out.

GRINDER.

[97292.]—**Cycle Plating.**—If sufficient information cannot be found in back numbers (which is doubtful) the querist might consult Bonney's "Electroplater's Handbook," published by Whittaker and Co. The "cycle work" has nothing to do with the question—any plant capable of coppering and nickelling will do, according to the size of the parts to be plated. There is nothing special in "cycle work." I presume the querist knows that "coppering and plating" can be done with economy only on the large scale—a scale, at least, large enough to use a dynamo and the energy given out by, say, a small gas-engine. Batteries cannot compete. ESSAR.

[97294.]—**Acetylene Gas.**—If "Robbie Burns" cannot succeed in working with acetylene gas after studying the numerous schemes given in previous numbers, I am afraid it is useless to endeavour to help him. What sort of a 4in. reflector is it, and is the light properly placed with regard to the reflector? Possibly the condenser is wrong; but no particulars are given, and it is not worth while guessing what querists mean. Surely, when asking a question, it is only courtesy to give the data in the fullest possible way. I have no doubt that replies would be returned to every query that appears if only the querists would state definitely what it is they want. SABRAS.

[97306.]—**Thorite as an Explosive.**—Cannot find any mention of thorite being an explosive. Possibly the "thorite" of the query is some fancy name given to a trade article. The paragraph quoted seems to me to be a hoax perpetrated on the news-agencies, and so has been circulated during a period of "excitement." The querist should inquire of the editor of the paper in which he found the statement. N. F. J.

[97308.]—**Salicylate of Soda and Uric Acid.**—With all due deference to "D. W. A.," I must adhere to my opinion *re* uric acid, which is founded on facts that "D. W. A." may possibly, or may not possibly, know. Salicylate of soda does not dissolve out uric acid, and the clue to "D. W. A.'s" headaches is furnished by implications from his statement that he has chronic rheumatism. Uric acid is not increased as a result of rheumatism alone, either in the blood or in the urine, and "D. W. A." must beware of the "Post hoc, ergo propter hoc" fallacy. Sal. of soda is a well-known cure for rheumatoid headaches. Possibly it may interest "D. W. A." to know (1) that uric acid in itself is not the cause of the symptoms referred commonly to it, but certain tissue-poisons formed under like conditions, which may cause the evil when there is no increase of uric acid; (2) that alkalies, to which he ascribes his relapses, are given to *cure* the uric acid diathesis; (3) that the condemnation of salt (sodium chloride), which one of his authorities so fiercely reiterated, is exactly contrary to experience, so that sailors, who eat a lot of salt, hardly ever suffer from gout or stone, while stone and gravel are exceedingly common among the natives of India, who live almost wholly on rice.

Galway. M. B.

[97316.]—**Zinc Printing - Blocks.**—The "simplest" process is to draw the lines on the zinc plates with a "resist" ink, and then eat away the surrounding metal to so much that the lines would remain as a sufficient printing surface. Obviously, if there are many lines to be drawn, it would be more economical to make a drawing, photograph that, and transfer to the zinc. There are plenty of manuals on the subject nowadays, and, I suppose, all the processes have been described in these pages. If patented, a full account can be found in the specifications. T. L.

[97345.]—**Wax Phonograph Records.**—To clean phonograph cylinders, rub them with a fine cloth wet with spirits of turpentine; after the grinding noise ceases, do the same with a cloth wet with wood alcohol; and after this operation polish

with a dry cloth. Of course, in all these operations the cylinder must be rotated at a good speed in the phonograph itself or in a lathe; the last operation, if a very high polish is required, necessitates the highest speed. With this method three records can be cleaned in the time it takes to shave one, and a surface obtained far superior to any obtained by the shaving process alone. It is, of course, vital to have high speed, as a slow one will make record untrue.

WM. F. RIGBY.

[97361.]—**Clock-Weight.**—Thanks again to Mr. F. M. Mann. I said nothing about the actual (only the comparative) weight. As a matter of fact, it is nearer 15lb. than 5lb. I will find out the arc of swing of my pendulum. I should say it was 6° or 8°. C. D.

[97382.]—**Rats.**—Every winter I have a renewed warfare with the rats that infest my farm buildings and house. I cannot entirely get rid of them once for all, as they have several old banks to retreat to, where they can restore their numbers in the summer. The most effective cure is poison. I always use Barton's, but you cannot safely use poison when there is food about, for instance. A resort must then be had to traps or ferrets. The easiest, as well as the most effective, way of trapping these artful creatures is as follows: Procure some good rat "gins," place these in shallow boxes, and cover entirely with bran to the depth of, say, ½in. over the gin; upon the bran just over the table of the gin place a few sunflower seeds. In my experience this is the most enticing bait for rats that can be used. It never fails to draw them over and over again. I saw this bait recommended in the *Bazaar and Mart* several years ago, and have often used it since. Do not use the naked hand in setting the gin, and pour the bran out of a bag. The scent of the hand deters the rats from trying the snare. The same remark applies also to the bait. Do not handle it. STELLA.

[97394.]—**New Moon.**—As this query is put I cannot see what "astronomical contributors" specially have to do with it. A series of almanacs will show when in recent years there was a February without a new moon or without a full moon, or without a first quarter, &c. A question as to why there is no new moon this year in February would be astronomical, but the short answer is: There are only 28 days in February, and the new moon just escapes—skipping from Jan. 31 to March 1. As to when the event will recur next, that would involve a rather long calculation; but probably it is already worked out at the *Nautical Almanac* office, and possibly one of the officials there may see this note and reply. A. F.

[97398.]—**Climate of China.**—Much obliged to correspondents who have kindly noticed my query; but they appear not to have observed the real point which is "Pekin, China, is frozen up for six months of the year." I don't think so—not quite so long. That's where the query comes in. F. F.

[97403.]—**Patent Accumulators of Woven Glass.**—I had occasion to test one of these—a 5 amp. 40 amp. hours accumulator. It had been in use some time on a motor-car for ignition, and wanted recharging at 5 amp. After doing this in seven hours I discharged it, going slowly up to 10 amps. I then discharged it at 10 amps., and discharged it at a high rate, drawing for several minutes as much as 40 amps. I quite expected to have completely destroyed the plates, but found on taking it to pieces that the plates were not buckled, and that the lead oxide had not dropped out. As a matter of fact, it is not easily done, because all the plates are packed tightly together, being separated by a sheet of spun glass. The woven grid seems to hold the active mass very firmly, and makes the plates look like solid lead. The space between the spun glass threads seems sufficient to allow the acid to circulate. Since the accumulator works well after recharging it at the given rate, I have no hesitation to recommend them to "Windmiller." The ebonite lining of the wooden box seems to me a good plan, as it prevents the rolling of the wood, and wood prevents the ebonite getting broken. I prefer them to other accumulators, as most of those I ever saw seem to go wrong very soon, and usually are losing the charge after having been at rest for some length of time. W. H.

[97406.] — **Ulcer of Stomach.** — "Tempus Fugit" is acting in a very reprehensible manner if he is going to tinker up such a serious and acute case of ulcer in the stomach himself. If he can afford it, call in a doctor; if not, send the patient to a hospital. But he is taking on himself a serious responsibility to let such an acute case drift without help.

Galway. M. B.

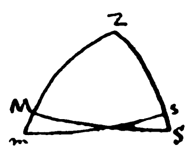
[97416.]—**Leclanche Cells**—Sealed cells are never a success; the more air that gets to the carbon the better. If you want a large current for a very short time, increase the zincs from rods to plates. If, though, for continuous working, keep the zincs small and the carbon surface large. Always amalgamate the zincs once: any crystals adhering are then easily removed, but it is rarely they form on amalgamated zincs. Put nothing at all in the way of paints on the outsides of the zinc cylinders: it is more nuisance than good. Wrapping the carbons in canvas has nothing to do with the polarisation: the canvas is merely to prevent the particles that fall off the carbons touching the zincs, and thus reducing the power of the cell by short circuiting the carbons and zincs.

L. A. I., Electrical Engineer.

[97431.]—**Gas-Engine Valves.**—Your valves did not ought to want grinding in, and your seat, i.e., cone, did not ought to be above $\frac{1}{32}$ less if anything. Drill a small hole up into your valves and tap them, then screw a piece of wire and screw in tight; take a cut off the face of seat or off the valve to reduce cone, and use powdered pumice-stone or silver sand for grinding—no emery.

JACK OF ALL TRADES.

[97434.] — **Spherical Triangle with Side > 90°.**—To find log. sin. 101° 14′ 3″, we should subtract from 180°, and look up in the tables for log. sin. 78° 45′ 57″, which is equal in value. Or, we might subtract 90°, and look for cos. 11° 14′ 3″, which is the same thing. As a general rule, when a trigonometrical function of an angle greater than 90° is required, either subtract from 180° and look for the same function of the angle thus obtained, or look for the co-function of the excess of the angle over 90°. For log. sin. ($\frac{1}{2}$ Σ − M S), we should subtract M S from the true value of $\frac{1}{2}$ Σ—e.g., 99° 44′ 49″ from 101° 14′ 3″ in the example quoted. I do not quite understand how "Fleur-



de-Lys" solves the lunar distance problem. The second of his formulæ requires the angles at M and S (true positions of moon and star) to be known, while his first formula could only find the angle Z; and the angles at *m* and *s* (apparent positions of moon and star). The finding of Z from the triangle Z *m s*, in which the three sides are known, is, of course, part of the problem. We then know, in the triangle Z M S, the angle Z, and the sides Z M, Z S, and could finish by finding M S from the fundamental formula—

$$\cos. MS = \cos. ZM \cos. ZS + \sin. ZM \sin. ZS \cos. Z,$$

but as this, containing a +, is not adapted for logarithmic computation, it is better to use the following:—Find subsidiary angle θ from—

$$\tan. \theta = \tan. ZM \cos. Z.$$

Then—

$$\cos. MS = \cos. ZM \,.\, \cos. (ZS - \theta) \,.\, \sec. \theta.$$

Here it must be noted that if Z > 90°, cos. Z will be negative, and hence also tan. θ. Therefore θ is negative, and we must remember to add its numerical value to Z S in finding Z S − θ.

ARCTURUS.

[97435.]—**Electrical Power.**—Electric-lighting stations are commercial undertakings, and the querist may rest assured that there is no considerable amount of power allowed to run to waste in the one he speaks of. Every unit generated is accounted for, and leakage anywhere on the system is immediately discovered. His misunderstanding has probably arisen from having heard that the machines are "earthed"; but this is done merely for convenience or safety, and no loss of power is occasioned. R. H. PARSONS.

[97435.] — **Electrical Power.** — We should imagine you are wrong in supposing that any portion of the 5,000H.P. is allowed to run to waste. Even if 1,000H.P. were running to waste, it would not be possible for you to recover any portion through tapping the ground.

Dudley. WEBSTER MICHELSON AND CO.

[97439.] — **Gauge Sticking.** — See that the pointer is not in contact with either the dial or the glass. If not, remove the case and examine the motion inside, which has probably become clogged with dirt. If you find it necessary to take the gauge to pieces, test it at all pressures by comparing it with a standard gauge before using it again.

R. H. PARSONS.

[97440.]—**Governing Engine.**—As neither the type of governor nor the manner in which it is fixed is specified, it is rather difficult to advise. The governor is presumably one of the old slow-speed pendulum pattern, and, if so, will never govern satisfactorily with a fluctuating load. A governor should run at three or four times the speed of the engine, so that an increase in the engine's speed is multiplied on the governor. I should advise you to fix a high-speed governor of the "Acme" or "Pickering" type, with an equilibrium throttle-valve if the conditions admit. R. H. PARSONS.

[97436.]—**Stamping Notepaper.**—The ink is applied to the die by means of a stencil-brush, Fig. 1. It should be well rubbed in until every letter appears filled. The superfluous ink is removed by rubbing the face of the die across a paper pad in the manner indicated by Fig. 2. This operation, though apparently simple, requires some practice before satisfactory results are obtained, but if it is done with despatch the surface should be left perfectly clean, whilst the ink remains in the letters.

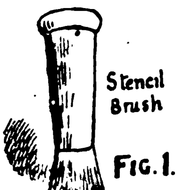


FIG. 1.

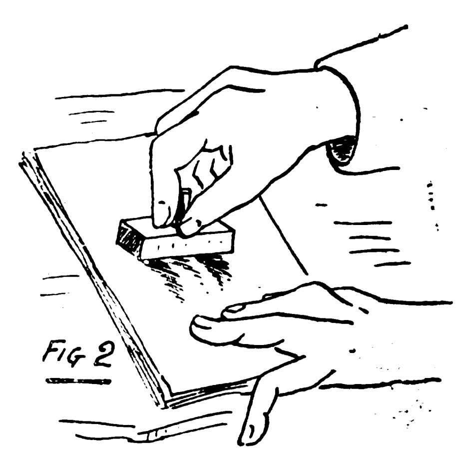


FIG 2

When a hand-press is employed, the reverse is made of cardboard backed up with a composition capable of being squeegeed into the indentations of the die. This reverse should be cut away except where the lettering comes in contact. When the die is not in use, it should be coated over with white beeswax; this will prevent rust, and keep the die ready for use on future occasions.

THEODORE BROWN.

[97441.]—**Enlarged Tonsils.**—If the "growth in the throat" means enlarged tonsils, then the question whether operation is necessary could only be settled by a doctor for some time in charge of the child. If the tonsils are subject to chronic inflammation, which spreads to the throat and soft palate, if they are hardened and enlarged, threatening to fill up the back of the mouth and obstruct swallowing and breathing, then they are better out. The operation, with modern instruments and skill, will not take a minute by the watch, the child merely standing up and opening its mouth. With proper skill there is no danger, though sometimes the hæmorrhage may be hard to stop. Good fresh milk, butter, and eggs, and emulsion of cod-liver oil will help to sustain the strength of the patient.

Galway. M. B.

[97443.]—**Face-Plate.**—Unless your lathe has a tool steel mandrel it will probably bend, or at least get a set on it, in turning such a heavy plate. My experience with excessively heavy face-plates is that they absorb too much power to drive them, and require very much larger mandrels than usually fitted to carry them satisfactorily. I have a 9in. lathe with a 30in. plate, weighing upwards of 3cwt. The tremor set up by the revolving of such a weight is such as to make turning on it impossible.

Bromley, Kent. A. F. SHAKESPEAR.

[97443.]—**Face-Plate.**—It all depends upon what diameter your front bearing is; but, if made properly, it ought not to weigh more than 70lb., or 75lb. at most. Why should you bend your saddle in turning it up any more than turning up one of 12in.? If you use a Scotch tool as shown in the Number for Dec. 15th, 1899, p. 407, you will be able to do the job like the paring of cheese, i.e., if your metal is good. Of course, you must not run your lathe at the highest speed with that chuck on, or you will come to grief. I once saw a 3ft. chuck with an eccentric strap mounted on it. It was mounted upon a 12in. centre-lathe. The gaffer who was doing the job was very fond of finishing his job with emery and a stick. He did not seem capable of finishing a job otherwise, so he slips out the back gear and locks the spindle, and starts for polishing, when snap! and the spindle seized and was fast; off goes the plate and the job on it, right over a fitting bench, where two men were only

half a minute before at work. Had they been there I don't know how things would have ended; but the thing went right over to the other side of the shop, over everything, a distance of 40ft. No one stood in its path as luck would have it.

JACK OF ALL TRADES

[97444.]—**Tank-Sinking.**—During the time the tank is filling, the difference between the water inside and outside will be approximately constant and equal to 4ft. Thus the water will enter with a velocity due to a head of 4ft.—i.e., $\sqrt{2gh}$, or 16ft. per sec. The volume of water which flows in is therefore $16 \times \cdot 6 = 9 \cdot 6$c.ft. per second. The tank will not sink until it contains $20 \times 30 \times 5 = 3{,}000$c.ft. of water, which will evidently require $\frac{3{,}000\text{sec.}}{9 \cdot 6}$ to enter. The answer is therefore 312·5sec., or nearly $5\frac{1}{4}$min.

R. H. PARSONS.

[97446.]—**Deflection of Oak Beam.**—D = deflection, W = force of the blow, l = length of span, b = breadth of beam, d = depth, I = moment of inertia, E = modulus of elasticity. Then the work done in deflecting the beam $= \frac{W}{2} \times D$ = the kinetic energy of the body. Therefore—

$$\tfrac{1}{64} M V^2 = \frac{W}{2} \times D$$

But for a beam fixed at the ends and loaded in the centre, the deflection is given by $\frac{W l^3}{192 E . I}$. Therefore—

$$\tfrac{1}{64} M V^2 = \frac{W l^3}{192 E I} \times \frac{W}{2}$$

$$140\text{ft.-lb.} = \frac{W \times 192^3}{192 E . \frac{6 \times 8^3}{12}} \times \frac{W}{2}$$

$$1680\text{in.-lb.} = \frac{W^2 \times 192^2 \times 12}{2 \times 6 \times 8^4 \times E}$$

$$W^2 = \tfrac{140}{3} \times E = 46 \cdot 6 \times E$$

$$W = 6 \cdot 85 \sqrt{E} = 6 \cdot 85 \sqrt{1{,}700{,}000} = 2{,}870\text{lb.}$$

Therefore force of the blow is equal to a dead weight of 2,870lb.

$$D = \frac{W l^3}{192 E I} = \frac{2{,}870 \times 192 \times 192 \times 12}{1{,}700{,}000 \times 6 \times 8^4}$$

Deflection = ·243in.

Lasswade. J. WIGHT.

[97448.]—**Soap.**—Clarify your fat by beating it up one or two or three times. All smell will be gone.

G. A. HAIG.

[97454.]—**Overtype Dynamo.**—Drum armature, 7in. diameter 9in. long; C.I.F. magnets, 8in. by 9in. section; winding spaces 9in., wound with 50lb. No. 18 for shunt, 25lb. $\frac{7}{16}$ cable for series. Armature to have one layer 150 wires, No. 13. Speed about 1,200 per minute.

WEBSTER MICHELSON AND CO.
Eve Hill Works, Dudley.

[97456.]—**Launch.**—Many thanks to Mr. W. J. Shaw for his reply to my query. Would he, or someone else who knows, kindly inform me whether the method suggested of bringing the propeller-shaft out by the side of the stern-post, instead of through it, is a practical one, and would the screw act as efficiently (seeing how very slightly it would be out of the centre) as it would if it were placed in the centre of the stern-post? Having the boat, I wish to avoid altering her after-body, if possible. Hints as to method of fixing the shaft and tube, so as to make a watertight job, would be greatly appreciated. I observe that one maker advertises an engine (oil), ½H.P. for £10, while another asks £30 for one of similar power, the cheaper make being advertised by presumably a reliable firm. Wherein lies the difference to account for the great difference in price? I should also like details of jointed screw-shaft.

NAVIGATOR.

[97464.]—**Shortest Day in Trinidad.**—In Trinidad, as everywhere in N. latitudes, the shortest day is at Winter Solstice (generally Dec. 21). The length of the day (sunrise to sunset) in Trinidad on June 21 is 12h. 40m., on March 20 and Sept. 22 12h. 5m., and on Dec. 21 11h. 30m. Measuring from the beginning of dawn to end of twilight, the length of day is: June 21 15h. 18m., March 20 and Sept. 22 14h. 26m., Dec. 21 14h. 3m. When sun's declination is 20° S. (i.e., about Nov. 21 and Jan. 21), the length of day is 11h. 36m., or, including twilight, 14h. 5m. Thus including twilight does not make the day shorter in latter half of November than at Winter Solstice, although the difference is very small. In computing the above I have allowed for refraction, and considered twilight to end when the sun has sunk 18° below horizon.

ARCTURUS.

[97465.]—**Carbon Transmitter.**—Deal is a kind of pine, and except in not being generally quite so even in the grain, will serve just as well as Swiss pine. Choose a piece free from knots, with the veins running straight, and you will get good results. But you should have no difficulty in getting a bit of pine from any carpenter or builder. Remember it must be planed very thin.

S. BOTTONE.

[97465.]—**Carbon Transmitter.**—Deal will do quite as well for this form of transmitter.

S. ELLIMAN.

[97466.]—**Torpedo Boat Destroyer.**—There is generally a model on view at the United Service Museum in Whitehall. Admission 6d., except on Wednesday, when closed to public.

RUSHLIGHT.

[97467.]—**Rook Rifles.**—Neither the "·22 long" nor "·22 short" are satisfactory. The first is inaccurate and the second has a very high trajectory. The "·22 long rifle" of Union Metallic Co. is the most accurate, but its trajectory is too high. I prefer the Winchester ·22-7-45, which has a lower trajectory that the above. The stopping power is sufficient, particularly if hollow-pointed bullets are used, if the aim is reasonably good. I seldom fire at a rabbit beyond 80 yards, but have no claim to be considered a crack shot. With all the ·22 cartridges the trouble of keeping the rifle clean and free from rust is so great that I would be inclined to recommend the ·250 c.f., unless the querist has considerable capacity for taking pains. A repeater is not to be recommended if rabbits are to be stalked. With a rifle that can be loaded silently one may, if well hidden, frequently fire three or four shots in succession before they take the alarm, but the clank of the magazine sets them off at once. If a repeater is decided on, the Winchester is a good one, though probably no better than the Colt or Marlin. Have the "take down" model in any case. For rooks I prefer the ·300, not that any of the ·22 cartridges will not kill a rook if well placed, but many shots have to be taken through leaves and twigs which deflect the light bullet, and various causes, such as swaying branches, constrained position in aiming, and fatigue consequent on firing a large number of shots, militate against accuracy. Any of the ·22 cartridges will send their bullet clean through a rabbit, and, excepting perhaps the "·22 long," will shoot closer than any one who is not an expert can hold.

S. F. W.

[97467.]—**Rook Rifles.**—In my opinion, the ·22 rifle is not of much use for sporting purposes, as the hole it makes is not large enough to kill quickly, unless the game is struck in a vital place, and rabbits and rooks will go away merrily when drilled through the body to die afterwards. I have not found much difference between the long and short ·22 cartridge, and think that the former shoots quite as well as the latter, and ejects more easily. All these very small bore rifles foul badly after a dozen or two shots, and want much care in keeping clean. They also are much influenced by windage. The effective range is about 60yd. to 80yd., although I have hit tin pots several times running at 100yd. with good ones in calm weather. For practical purposes I prefer the Winchester ·320, which has a flat trajectory, and will kill nicely at 300yd. Next to this comes the ·295, a good rifle, but with a high trajectory, which makes it difficult to hit anything over 100yd. unless the range is known nicely. It stops nicely if it strikes anywhere near the head or shoulders of rabbits. Both these latter rifles are dangerous if used in populous places, as, indeed, are any rifles when used near places in which human beings are wandering around. I once put a bullet into a man at 500yd. with a ·22.

A. C. PEMBERTON.

[97468.]—**Protecting Steel Surfaces.**—I do not know the oxidising process; but could not "F. L. H." get his rods and pins nickel-plated.

JEFF.

[97470.]—**Motor-Cycles.**—Ball-bearings for the back axle of tricycle can be obtained from Wm. Bown, Ltd., Birmingham, or the Southern Motor-Car Co., 59, Brixton-road, London.

THE WRITER OF THE ARTICLES.

[97473.]—**Pocket Accumulators.**—Pitch is generally used for sealing in the tops.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97473.]—**Pocket Accumulators**—Pitch, or Prout's elastic glue.

S. BOTTONE.

[97474.]—**Knocking in Gas-Engine.**—You had better heat the tube further from the cylinder. The new rings are not yet worn to the cylinder—they will be all right in time.

Dudley. WEBSTER MICHELSON AND CO.

[97474.]—**Knocking in Gas-Engine.**—The symptoms seem to point either to too early firing or too rich a mixture of oils, gas, with air. Try sliding the ignition chimney up a little, and decreasing the oil supply. Of course, I presume that all the bearings are tight—no back-lash. When running, the piston should be tight enough to prevent any visible escape of the products of combustion.

A. C. PEMBERTON.

[97474.]—**Knocking in Gas-Engine.**—If "Country Parson" will fit a longer ignition-tube in his engine, or heat the present one higher up with his Bunsen flame, that would cause the charge in cylinder to be fired later. Apparently the charge is fired or ignited before the crank has just turned the back centre, thereby causing a great shock and consequent strain on the working parts. The best results in this direction are obtained by a little experimenting, a good deal depending on the speed the engine has to run, &c. Another cause of a thumping noise in a gas-engine is that sometimes the flywheel key becomes a little loose from the strain put upon it by every impulse. This defect alone would soon ruin the finest engine made.

H. WILSON.

[97474.]—**Knocking in Gas-Engine.**—Is your ignition right? Try the burner higher, but not so high as to make engine miss fire. The explosion getting past the piston-rings would probably cause some noise.

SENLAC.

[97474.]—**Knocking in Gas-Engine.**—Gas-engines will sometimes make a knocking noise if the air and gas are in wrong proportion. It should be 1 to 8; also, if the tube is heated too low or too high. It must be red-hot, not white-hot. See that your valves are properly timed with the crank; exhaust should start opening at the commencement of the last half of the second revolution, and shut almost at the end of second revolution.

IGNITION TUBE.

[97474.]—**Knocking in Gas-Engine.**—This arises from the rings not fitting. Probably they are too loose in the grooves, or the grooves may have worn unequally—holding the rings tight at one side and allowing them to rattle at the other. In which case, the grooves will have to be tried up in the lathe and wider rings fitted.

Bromley, Kent. A. F. SHAKESPEAR.

[97474.]—**Knocking in Gas-Engine.**—If "A Country Parson" will take the rod out of the piston, and give the cogwheel which regulates the gunmetal bearings a slight turn (one cog will be sufficient), at same time cleaning all lubricating holes, he will doubtless find that the knocking will cease. The bearings wear out and require occasional tightening, especially if the lubricating holes are clogged.

C. J. L.

[97475.]—**Telephones.**—The fault is probably due to the fact that your microphones are lying horizontally, so that the carbon grains sometimes do not touch both diaphragms. Suspend them horizontally; preferably by twin flexible cords, so that they can be shaken up from time to time. This will probably remedy matters.

S. BOTTONE.

[97476.]—**Soldering Carbons.**—Make up a cell of a porous pot in an outer containing jar. In the porous pot place water acidulated with sulphuric acid, in the outer jar a saturated solution of copper sulphate. Place a rod or strip of zinc in the porous pot and attach the carbon thereto by a short length of wire. Allow about ¼in. of the carbon to dip into the copper sulphate, and in a short time it will become coated with a skin of copper, and may then be readily soldered. Or make a little mould, and having cut a few nicks in the carbon, cast a lead cap on. A little antimony added to the lead will tend to give it a better grip.

W. J. G. FORMAN.

[97476.]—**Soldering Carbons.**—Carbon is coppered first. Immerse in a strong solution of sulphate of copper to the depth that is required coppered; make the carbon the cathode, and insert a copper plate in the solution to form the anode. Pass current through this cell at a voltage of about 3 or 4 volts, and when a good deposit has been obtained take out the carbon, rinse, apply a flux, and tin thoroughly in the usual way, taking care to have everything ready and close at hand, as the pure deposit of copper tarnishes so quickly if exposed to the air.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97476.]—**Soldering Carbons.**—The usual method of connecting brass terminals to carbon plates is to run molten lead about the ends of the plates and the terminals in a mould, not by soldering.

JEFF.

[97476.]—**Soldering Carbons.**—Carbon must be copper-plated. This may be done by placing carbons and copper-plate in saturated solutions of copper sulphate, join positive lead of Daniell or Bunsen cell or battery to copper-plate, and negative lead to carbons. Place copper-plate close, but not touching carbons in solution.

A. BOTTING.

[97476.]—**Soldering Carbons.**—The carbon block, plate, or stick must be copper-plated before you can solder it. This can be done easily as follows:—Make about 1 pint of solution of sulphate of copper, and add about 1oz. sulphuric acid. In this place a zinc rod or plate, the wire from which twist round the end of carbon plate. If the other end of carbon is now dipped in the solution, it will be covered with a film of copper in a few minutes, which can be soldered in the usual way.

SENLAC.

[97476.]—**Soldering Carbons.**—To do this a coat of copper is first electro-deposited on the carbon.

It is then quite easy to solder any wire, &c., to it. A single cell arrangement will do.
West Didsbury. M. COLE.

[97476.]—**Soldering Carbons.**—You cannot tin carbons without previously coating the ends with copper, deposited from its solution as sulphate, by means of a Daniell or other suitable battery, as frequently described in these pages. S. BOTTONE.

[97477.]—**Brasswork.**—You can clean brass and copper beaten work by lightly rubbing with soft towel dipped in a weak solution of oxalic acid (poison), then drying with fresh dry waste, and polishing with chamois and finest rouge. To preserve from tarnishing, the work must be lacquered, with lacquer of suitable colour, or varnished with a clear varnish of celluloid, in benzole or amyl-acetate—preferably in benzole. S. BOTTONE.

[97478.] — **Electric Light and Gas.** — Gas at 3s. 8d. per 1,000. A standard gas-jet consumes 8ft. per hour, hence 1,000ft. supplies same for 125 hours at a cost of 3s. 8d. A unit of electricity equals 1,000 watts. A 16 c.p. lamp requires 60 watts per hour, hence such a lamp takes 7,500 watts, or 7½ units, in 125 hours, and, at a cost of 5·9d. per unit, equals the cost of gas. I have been running a 5½ unit dynamo, compound-wound, for the past 18 months with a 6H.P. gas-engine—gas at 1s. 9d. per thousand—and my estimate from careful observation is that the actual cost per unit (gas consumption only) is a shade under 1½d. per unit.
Plymouth. E. H. MICKLEWOOD.

[97478.] — **Electric Light and Gas.** — The answer is 3⅞d. A. H. AVERY, A.Inst.E.E.
Folmen Works, Tunbridge Wells.

[97478.]—**Electric Light and Gas.**—Since it must be very good gas that will give 12 candle-power light for every 5c.ft. of gas consumed per hour, it follows that 1,000c.ft. = 2,400 candle-power per hour, at a cost of 3s. 8d. Now, 1 unit of electricity = 1,000 watt-hours, and each candle-power requires 3·5 watts per hour to maintain it. Hence 1,000 watts = 285 candle-power, and 285 into 2,400 go 8·45 times. Therefore about 8½ units of electricity would be wanted to give the same light as 1,000c.ft. of gas. At 5d. a unit the price would be slightly in favour of electricity, since 8·45 × 5 = 42·25, or, say, 3s. 6¼d. In many places electricity is supplied at a lower rate than this.
S. BOTTONE.

[97478.] — **Electric Light and Gas.**—Electricity at 3½d. or 4d. per unit would be equivalent to gas at 3s. 6d. to 4s. per 1,000c.f., if the gas is of the usual 16c.p. quality. See last page of our new catalogue.
Dudley. WEBSTER MICHELSON AND CO.

[97479.] — **Induction Coil.** — (1) Yes, with a properly-wound Tesla, proportioned so as to increase the voltage six times. Of course, the spark loses density in like proportion, and becomes very thin and wiredrawn. (2) No, there is nothing new about these coils; some are still made, and I believe Watson's, of Holborn, still stock them. (3) A "tank" coil, immersed bodily in a tank of linseed-oil, works very well. Paraffin-oil is not so good; but the heavy petroleum-oil used for vaseline is excellent. S. BOTTONE.

[97480.]—**Chlorine and Fluorine.**—1. Fluorine has been obtained by the action of dry iodine upon dry silver fluoride. It is a transparent colourless gas, which, when dry, does not act on glass. It is absorbed by caustic potash, with the formation of potassium fluoride and hydrogen dioxide thus—

$$2KHO + F_2 = 2KF + H_2O_2.$$

2. Chlorine has been liquefied at a pressure of four atmospheres. I believe it has not yet been solidified, but should imagine liquid air would do it.
S. BOTTONE.

[97483.] — **Stains for Gun-Barrels.** — To "MECHANIC."—**Browning**: Solution of spirits of nitre ¾oz., black brimstone ¼oz., blue vitriol ¼oz., corrosive sublimate ¼oz., nitric acid 1dr., copperas ¼oz., rain-water 1½ pint. Mix and bottle for use. Clean bright with finest emery paper; then apply solution with clean white cloth. Set away for 24 hours. Then scratch-brush rust off formed, and rub off with woollen cloth. If not brown enough, repeat. If colour suits, wash off with wet cloth, rub thoroughly dry, finish by rubbing with linseed oil to prevent further rusting. Or sulphate copper 1oz., sweet spirits of nitre 1oz., water 1 pint; mix. In a few days ready for use. Two out of thirteen for browning. Bluing: Clean with emery paper, and quickly go over them with nitric acid. When desired colours are obtained, wash off with linseed-oil. See Stelle and Harrison's "Gunsmith's Manual," published by J. Haney and Co., New York. REGENT'S PARK.

[97484.]—**Lens Problem.**—With an iris diaphragm opening gradually the light passed at any given moment is of course dependent on the area of the opening at that moment. These openings could be graphically represented by slices (sections) taken off a solid cone at equal distances. The openings, when the lens was open all the time, could in a similar way be represented by slices from a solid cylinder of equal height and diameter of the cone. Now a solid cone has one-third the cubic contents of a solid cylinder the same height and diameter, therefore, provided the motion of the inner edge of the diaphragm were uniform, the exposure during the time an iris opens from nothing to full opening is one-third that given if the iris were open all the time. It will be a nice little task for "Iris" to ascertain whether the edge of the diaphragm moves uniformly when the iris ring is revolved uniformly. I do not think there is a great deal of difference, and therefore that the one-third exposure is approximately correct. ALFRED WATKINS.

[97485.]—**Sparking Coil for Motor-Car.**—Primary, 1lb. No. 16 d.c.c.; secondary, 1lb. No. 34 double silk-covered. S. BOTTONE.

[97488.]—**Soap.**—Add such ingredients as lanolin, vaseline, spermaceti, in about 5 to 10 per cent. of weight of soap. Brown Windsor proportions: 75lb. of soap or tallow and palm oil, 2lb. palm oil, 1lb. mirbane, 1oz. Bismarck brown. White kind: 75lb. of white soap of tallow and cokernut oil, 3lb. cokernut oil, 1lb. citronelle. See G. H. Hurst, F.C.S., on "Soaps" (Scott and Co., Trade Journal Publishers, Ludgate Hill.) REGENT'S PARK.

[97490.] — **Motor - Car Carburettor.** — "F. W. B." will find a carburettor, such as he requires, fully described in the Motor-Car articles now appearing, in its proper sequence.
THE WRITER OF THE ARTICLES.

[97494.]—**Shanks Patent Bath.**—The way to lift the porcelain soap-dish is to take off the water handles. Have you not omitted to loosen the little jamming screws at the side of the handles? The two water-handles should be unscrewed, and the flanges below them which hold the dish down, when the dish will be found to lift away, bringing with it the combined overflow pipe and waste plug. Beware of shortening the wire of the waste plug overmuch. My experience is that unless the pipe is allowed to cant a little the valve will not be tight. When you get the dish off you will understand what I mean. W. J. G. FORMAN.

[97496.]—**Silicate of Alumina.**—There are a great number of silicates of aluminium—many of them being common and well-known minerals. Clay is silicate of aluminium. Kaolin or porcelain clay has the formula $Al_2O_3 2SiO_2 2H_2O$. This clay results from the decomposition of orthoclase, another silicate of aluminium $K_2OAl_2O_3 6S.O_2$. Staurolite, often known as slate crystals, and often of great beauty, is a silicate of aluminium, frequently combined with iron and magnesia. Andalusite, kyanite, and allophane are also silicates of aluminium. Flint is practically pure silica, so that any of the above might be correctly described as a combination of aluminium and flint.
W. J. G. FORMAN.

[97496.]—**Silicate of Alumina.** — Occurs in nature in the following minerals and earths, some of which you can get cheaply:—Allophane, alumstone, collyrite, wörthite, miloschine, porcelain clay from Passau, cimolite, or Ellenbogen kaolin, agalmatolite, bucholzite, xenolite, ordinary porcelain clay, andalusite, chiassolite, cyanite, or kyanite, fibrolite, sillimanite, razoumaffskin, and malthacite Even the darker-coloured clays are nearly pure silicates of alumina, with small admixtures of iron and calcium. In fact, the aluminic silicates constitute the greater part of the earth's crust.
S. BOTTONE.

[97497.]—**Carburator.**—See reply 97490 above.
THE WRITER OF THE ARTICLES.

[97498.]—**Gas-Engine.**—Presuming that you can't *start* your engine on account of its firing back, then a probable reason is that the bearings and working parts are so tight that you can't get up a decent speed before admitting the charge. I always notice on turning my engine slowly that it invariably fires back if the compression be good. Should ignition still take place before the end of stroke, try heating tube a little higher, say ½in., and if unsuccessful, try a longer tube. To prevent exhaust being drawn back into cylinder, use a stronger spring. You say you have done so. Well, use a stronger one still. A very high compression is not necessary, but if piston and valves don't leak, then you can hardly avoid it, can you? You don't get too much gas and air into cylinder provided that they are in the correct proportions, for since they are sucked in automatically the pressure can't rise above the atmosphere, and it will probably be slightly below it at beginning of compression stroke. Two flywheels 8in. diam. are large enough.
W. EWART GIBSON.
103, Ferry-road, Leith, N.B.

[97498.]—**Gas-Engine.**—Engine fires its charge too soon, and so reverses. This is a very usual trouble with engines having no timing-valve, and in which the flywheels are so light that sufficient forward momentum cannot be got on them. There are several remedies. One is, fit a timing-valve by which the compressed explosive mixture is admitted to the firing-tube at a given position of the crank, and if this can be varied so as to fire earlier when once speed as been attained, so much the better. A simple plan is to heat the firing-tube higher up, as this will usually retard the time of firing the charge. Another plan is to fit a handle to end of shaft notched in such a way that when the engine fires it overruns the handle. By this means momentum sufficient to start it can be given. As to sucking back exhaust gases, these small engines usually exhaust right into the air, in which case the valve acting as a snifting valve is no detriment. Still, if the air-and-gas valve open soon enough, there should be little or no tendency for this to happen. High compression stops engine completely. It is impossible to have too good a compression in a gas-engine, and you cannot get in too much gas and air. The whole of the trouble arises from the lightness of the flywheels and consequent trouble in starting.
Plymouth. E. H. MICKLEWOOD.

[97498.]—**Gas-Engine.**—Without knowing the weight of the flywheels it is difficult to say if they are large enough. As a basis, I may say that one wheel 14in. diameter, weighing about 30lb. or 40lb., would do for this engine nicely. Of course, if the air-tap is turned off, the engine will suck back the exhaust. It should be left wide open, and the regulation done with the gas-cock alone—there is no need for an air-tap at all. The high compression is an advantage. All these small engines should fire early, and to start them they want a good spin, which is best given by pulling them round with the belt on the driving pulley. If they are timed to fire correctly when starting, they will lose much power when running at proper speed, say, some 500 revolutions per minute. The engine can be readily altered to fire later by sliding the chimney up a little.
A. C. PEMBERTON.

[97498.]—**Gas-Engine.**—Try heating the tube higher up—that is, away from cylinder. In such an engine as David Barratt describes, ⅛in. gas-pipe makes a good ignition tube, and lasts a long while. Are the valves set properly? Exhaust should open just before end of firing stroke, and remain open till piston reaches the top or end of cylinder again, but not later, or exhaust mixes with charge. If valves are right, stronger spring must do it. The piston can only suck 14·7lb. per square inch, so if area of exhaust-valve is known, you can easily find how strong your spring must be. If the engine is in London, I will gladly see and advise. You can have too much compression, but that is hardly likely to be your trouble. H. SCOTT RUSSELL.

[97498.] — **Gas-Engine.**—Your ignition-tube should be about 8in. long, made from a piece of ⅛in. gas-barrel. It should be bright red, about 2½in. from the bottom. If the tube is heated too low—not hot enough—the charge explodes too soon. If there is no explosion the tube is heated too high. The exhaust-valve should be pretty strong, as it is intended to be moved by gear from the crankshaft. It is a mistake to have the compression too high. Compression to 60lb. per square inch is high enough. The gas and air is 1 of gas to 8 of air. Your flywheels are much too small; use a pair of flywheels at least 12in. in diameter, weighing from 28lb. to 40lb. each; the crankshaft being ⅝in. in diameter. IGNITION TUBE.

[97498.]—**Gas-Engine.**—Your trouble is probably with ignition. Try a tube of ¼in. gaspipe, 5in. long, and heat about half-way up. If it still fires too soon, raise burner higher. The exact height will largely depend on the speed you run the engine at. If your exhaust valve is sound, try a stronger spring. You do not say weight of flywheels, so cannot advise; but they seem too small.
SENLAC.

[97499.]—**To Mr. Bottone.**—Since an impression on the retina lasts at least $\frac{1}{10}$th of a second, a succession of light-waves following each other at the rate of 44 waves per second would so overlap each other as to produce practically the same effect on the eye as one continuous light. But the alternating light is generally produced by much more rapid alternating, 80 to 110. S. BOTTONE.

[97500.]—**Cutter-Bar for Slide-Rest.**—C. W. Hull should get Smith and Coventry's tool list. Their holders for round tool steel are especially handy for general work. I have never known the steel to slip whilst taking even very heavy cuts.
JEFF.

[97500.]—**Cutter-Bar for Slide-Rest.**—I have recently purchased from the Pittler Company a tool-holder with tools for general slide-rest work of very novel and ingenious design. The cutters only require grinding on one face, and the movements are such that any clearance angle can be readily obtained. It is much more readily used on a lathe with adjustment for height of tool-post than on one where packing-pieces are required, and it can only be ground on an emery-wheel, which should not be more tha ¼in. thick. Given these conditions, it is a first-class idea for all sorts of outside turning.
Plymouth. E. H. MICKLEWOOD.

[97500.]—**Cutter-Bar for Slide-Rest.**—I have been using the Britannia Co.'s "Climax" bar for

the last eighteen months, and am very well satisfied with it, as it is suitable for both ordinary turning and screw-cutting. The other bars I have are not satisfactory; they may be all right for small lathes, but mine range from 7-centre upwards. The Haydon bar is very well for non-screw-cutting jobs, but wants to be very nicely made, or the cutter slips.

Bromley, Kent. A. F. Shakespear.

[97501.]—**Breech for Model Cannon.**—No simpler form than that used for cheap rook rifles, which may be seen in the windows of any gunsmith.

West Didsbury. M. Cole.

[97504.]—**Electrical.**—This query is a little ambiguous, as it is not stated whether one cell only is to be in circuit at a time, or one to be cut out and nine left in circuit. Supposing the former to be what is required, take a piece of dry board, say about 18in. long by 2in. wide. Attach to it ten little squares or circles of brass plate. Bore a hole in the centre of each plate, and provide a conical brass plug to fit the holes. Place two terminals about the centre of the board. To one of them attach the brass plug by a sufficient length of flexible wire. To the other terminal attach all the zincs of the ten cells and attach the carbon of each cell to one of the brass plates. The outer circuit will start from one terminal and end at the other, and by placing the plug in one or other of the brass plates, any given cell can be thrown alone into action. W. G. J. Forman.

[97504.]—**Electrical.**—Arrange your ten cells in a circle. Connect them in series, bring each pair of a connection out on the upper surface of a circular board, in the centre of which is pivoted a brass arm, which can be revolved so as to touch these connections. These connections should, for convenience of contact, be fastened electrically to brass studs arranged round the board so that the lever-arm can pass freely from one to the other. One terminal is fixed in permanent connection with one pole of the battery, the other is connected to the rotating brass arm. S. Bottone.

[97507.]—**Frame Food**—The following is the report of Mr. Alf. W. Stokes, the well-known analyst, on Frame Food, dated March 10, 1897: "I find it to contain in 100 parts by weight: albuminoids 16·30, sugar and dextrine 28·60, carbo-hydrates 53 00, mineral salts 1·55, moisture 0·55. The mineral matter consists principally of phosphate of potash, with compounds of lime and iron. The microscope showed that almost the whole of the starch granules were broken up, so that they are in condition to be immediately acted upon by the saliva and gastric juice. No fungus or other extraneous material could be detected. There was an entire absence of all preservatives. Having regard to these facts, I am of opinion that this is a prepared food of high dietetic value. Its richness in albuminoids and phosphates, and its readiness for easy assimilation, render it a valuable addition to our scanty stock of foods especially fitted for the use of children and invalids, and of infants of delicate digestion. Taken with milk, it would supply the whole of the nutritive ingredients required for the maintenance of vigorous life and health. It has been so prepared that about half of the material is soluble in cold water, and is, therefore, to that extent no tax whatever on the digestive organs. In the case of ordinary bread, as dry material, only about 10 per cent. is thus soluble. While bread contains usually some 40 per cent. of moisture, this 'Frame Food' Diet contains only half of one per cent. Hence, the latter is a more concentrated form of food." I believe your querist can obtain a free sample, if he mentions this paper and applies to the Frame Food Co., Battersea, S.W., and incloses three penny stamps for postage. I have found it palatable, digestible, and invigorating myself. Senex.

[97508.]—**Dead Batteries.**—Take off the terminals, make a hole through the pitch, near the carbon plate, with a hot stair-rod, pushing it down till you reach the paste inside. Now stand the cells in a wooden pail full of water for 24 hours. Remove, and stand upside down to drain a little. Prepare a saturated solution of permanganate of potash, and squirt as much of this in each cell as it will take up. Seal up the pitch again with a hot iron, clean up the terminals, and replace on the cells. S. Bottone.

[97511.]—**Radiometers.**—Rays of heat pass through the glass (without heating it) and impinge upon the blackened vanes. These are heated, and in turn also are heated the residual molecules of air left within the globe after exhaustion. The air-molecules fly from the hot vanes to the cold glass, where they are chilled and their velocity slowed down; thus a sort of bombardment is set up in front of the blackened vanes. There is a similar action going on at the back of the vanes, but in a lesser degree, as there is here less heat. The excess of bombardment on the heated or blackened side of the vane causes its retreat. Brandon T. Brierley.

[97512.]—**Manchester Dynamo.**—To Mr. Avery.—Armature 12 cog ring 4in. diam. by 2in. long, wound with 2lb. No. 22; field cores 1½sq.in. section by 4in. long, wound with 8lb. No. 22, connected in shunt. A. H. Avery, A.Inst.E.E.

Fulmen Works, Tunbridge Wells.

[97515.]—**Water Wheel.**—The theoretical horse-power given by the quantity and pressure of water stated would be about 2·1H.P. A turbine will return about 70 per cent. of this as effective horse-power—i.e., about 1½H.P. The velocity of the water at the pressure stated will be rather over 10,000ft. per minute. The velocity of the "circle of effort" of the turbine will be rather more than half this speed, say 6,000ft. per minute. To bring the dimensions of the wheel in line with this speed at 30,000 revolutions would mean a diameter of something like ½in., which is of course quite out of the question. Better keep the speed down to about 6,000 revolutions. This will give a wheel of about 3½in. diameter, inlet nozzle ¼in. diameter.

W. J. G. Forman.

[97516.]—**Edison-Lalande Battery.**—To Mr. Bottone.—As the chemical affinities of sodium are not so powerful as those of potassium, in the proportion of two to three nearly, so the battery will be weaker with the caustic soda as an excitant. The reaction consists in the formation of an akaline zincate, with the liberation of hydrogen, which in its turn absorbs oxygen from the copper dioxide plate, and is converted into water. Taken altogether, and for the special work you require, the Lalande is the better battery; but it is bulky, and has but little E.M.F. The accumulator is the best, if you have access to a charging station.

S. Bottone.

[97517.]—**Propellers.**—Sir W. A. White, in "Naval Architecture," gives pages on slip, both of paddle and screws. He gives, p. 607, (1) the mean effective angle of screw-blade, measured from an athwartship plane or pitch-angle, should be 45°, obtained when pitch is about twice extreme diameter. (2) Slip-angle varies directly as square root of coefficient of friction, and inversely as square root of coefficient of normal pressure, which gives a slip of about 12½ per cent. with the values of coefficients adopted. This is the real slip, apparent slip usually less, and varies to the amount and character of disturbance of water in which screw works. (3) Area of screw-blades may be expressed by formula—

$$\text{Area (in square feet)} = 8{\cdot}9 \times \frac{R}{v^2}$$

where R = resistance of vessel (in pounds) at her maximum speed v (in feet per second). (4) Since at moderate speed resistance varies as square of speed, same propeller should, within those limits of speed, drive ship with same percentage of slip; but above those limits of speed percentage of slip should increase. (5) For moderate speeds, if blade areas of screws of two similar ships have the ratio of squares of respective dimensions, the percentage of slip should be the same. (6) If two ships have same resistance at different speeds, area of screw-blades, which will overcome resistance, while maintaining given slip, will be less, in ratio of squares of speeds for ship which has higher speed; the last three deductions obtained from formula for blade area; or, suppose screw carried forward through undisturbed water at speed V feet per sec., mounted ahead of a suitably designed framework. As it advances let it be rotated N times per sec., if mean pitch be p feet. Speed of an advance of screw = V; speed of screw corresponding to revolutions and pitch $= V_1 = Np$; "slip ratio" screw $= \frac{V_1 - V}{V_1}$; slip of screw (per cent. of its speed) $= \frac{V_1 - V}{V_1} \times 100$. Example:—Screw making 72 revs. per minute, with pitch of 14ft., speed of advance being 8·2 knots. Speed of advance ft. $= V = 8{\cdot}2 \times 1{\cdot}688 = 13{\cdot}8$ per sec.; speed of screw $= V_1 = \frac{72 \times 14}{60} = 16{\cdot}8$; slip of screw $= V_1 - V = 3$; slip ratio of screw $= \frac{V_1 - V}{V_1} = \frac{3}{16{\cdot}8} = \frac{1}{5{\cdot}6}$; slip of screw (per cent.) $= \frac{3}{16{\cdot}8} \times 100 = 17{\cdot}85$ (1894 edition). Regent's Park.

[97518.]—**Clock-Weight.**—To "Antares."—I do not wonder at your surprise at the extraordinary information received from the two local clockmakers, for if the case was as stated by them, their own regulators ought to be swinging large arcs with a weight of an ounce or so. You will find, on reference to any work on escapements, that the dead-beat is, when properly constructed and the oil in fair state, very sensitive to any variation in the motive power, and that an increase of motive power is speedily followed by an increase of arc. This is remarked by Reid, page 189; by Sir Edmund Beckett, in any of his editions of "Clocks, Watches, and Bells"; by Charles Frodsham, in his masterly essay on the "Dead-Beat Escapement," printed in the *Horological Journal* for March and July, 1886; by Glasgow, in his "Watch and Clock-making"; and in Britten's "Watch and Clock-maker's Handbook." So if that is the experience of the best artists of the last hundred years or so, one must accept any statement to the contrary with a certain amount of reserve. I know my own Graham escapement regulator gives the following results:—With 3lb. it vibrates just over 1 degree, with 4lb. 1½ degree, with 6½lb. 2 degrees; and another clock with same escapement, going a month and driven by a weight of 12lb., will not go at all with only 6, the arc falls off until the clock fails to escape. But one can imagine it is possible that if the weight were excessive and the pendulum rather light, together with very thick and gritty oil on the resting faces of the pallets, that a reduction in weight might bring about an increase of arc. But such conditions would be quite abnormal. Of course, with escapements of a remontoire or spring pallet description the case is altered, for in that case so long as there is power enough to "arm the maintainer," as the expression is, any extra can only resist the unlocking, though in such an escapement as the Beckett gravity it is insensible. But Reid, on page 199, gives an example of one of his fine old spring-pallet clocks where an addition to the weight caused a decrease of arc, as might have been expected, the extra power giving nothing to the pendulum, whilst making the unlocking decidedly heavier. But experiments on that plan are quite extinct now, and only met with in old clocks; so if "Antares" will clean and oil his dead-beat, he will find that by doubling the weight that he will get a very decided increase of arc, though if the escapement is correctly planned, the alteration of rate will be slight. F. M. Mann.

[97520.]—**Cataloguing Books.**—You have not stated if the library is liable to increase or the class of persons who are to use the catalogue. A card catalogue is much the easiest to alter if the collection grows; but many people of disorderly habits cannot be intrusted with one, in which case a book must be used, and growth allowed for by leaving blanks between the entries, which are more or less of an eyesore when partially filled up. The first point in cataloguing is the arrangement of the books. A convenient arrangement for a public library consists in placing the books alphabetically under authors; but this is about the worst for a private library. The proper way is to group under subjects, the books in each subject being arranged alphabetically according to authors' surnames. The division into subjects is one of the most troublesome points in cataloguing, and it is very difficult, without actually seeing the books, to give advice on it. The division must not be carried very fine. Seven or eight sections ought to be ample for any collection containing only 1,500 volumes. A tolerable division for a general library would be: History, biography, travel, fiction, poetry, general literature, science, theology, and works of reference. It would break down, of course, in the case of any collection of a special nature. It is a current maxim, however, that a special student who cannot carry two thousand book-titles in his head is not worth his salt, and that all he really wants is some means of registering the borrowings of his friends. As regards the placing of the books, all works of reference, such as dictionaries and atlases, should stand on shelves between 2ft. and 3ft. above the floor, so as to be in the most convenient position for consultation by a sitter. The side of the fireplace will be best for them. Very high shelves and very low ones, should be given up to works on subjects of little interest. There is no reason why any important book in a library of only 1,500 volumes should require either uncomfortable stooping or the use of a ladder. The books on any subject of interest should stand on shelves not less than 2ft., or more than 6ft., above the floor; 5ft. 6in., in fact, is quite high enough, if ladies are to take down the books. The use of ladders or stools adds enormously to the fatigue of literary work. The books being grouped on the shelves, the next thing is to number them. A library which does not increase may be numbered from 1 up to 1,500, proceeding regularly along the shelves, preferably from left to right. Small suffix letters would be added to the numbers in marking the separate volumes of a large work. The only way of dealing with additions on this system is to put them at the tail-end of the series of numbers. A more adaptable way, however, is to assign a capital letter (or pair of letters after the 26th) to each shelf-compartment, and number the volumes in each compartment from 1 to the highest in it. Each volume would then be indicated by a capital letter and a number, with a small suffix letter following in the case of a work of several volumes. Thus, the indication for the third volume of Smiles's "Lives of the Engineers" might be "B B 24 c," meaning that it would be found in the 28th compartment at 24 places along it. Many people, however, cannot be got to understand this system of numbering, in which case there is nothing for it but to fall back on the plan of a running series. The next thing is the making of the catalogue. See that all the books are in; do not depend on your remembrance of those which are absent, for you will make some awkward omission that will spoil the appearance of a page of your work. If you are going to

make a card catalogue, use well-glazed cardboard, cut to a uniform size, and placed in a long drawer with about an inch of margin in the width, a steeply-inclined plane at the back giving the cards a slant of about 60°. A convenient size of card is about 4in. wide and 3in. high. The entry on each card should run thus:—Author's surname, Christian name or initial, number of volume (conspicuously written on upper right-hand corner, preferably in red ink), title of the book (exactly as it is given on the title-page), editor or translator (if any), and subject heading. Let us take two cases, one where running numbers are used, and one where shelf compartments are separately labelled.

Renan, Ernest. 783
"The Future of Science."
Transl. by Vandam and Pitman.

Lyell, Sir Charles. Y 17 a b
Life, Letters, and Journals.
Edited by Mrs. Lyell.

The backs of the cards can be utilised for noting borrowers' names, and the dates of issue. The card catalogue requires to be supplemented by divisional lists, one for each subject, in which the authors' names in alphabetical order and the reference numbers are alone given. The compiling of an ordinary catalogue in book-form should be preceded by the making of what is virtually a card catalogue. About 1,600 slips of paper will be required, on which the same details must be noted as in the case of the cards. These are then to be sorted, with the surnames of authors in an alphabetical series. The entries will be copied from the pile as they now stand; the reference numbers, however, being placed in a column on one side of the page. An entry in the catalogue would run like this:—

Carleton, Will., "Farm Ballads" (poetry)..121

This catalogue will also require supplementary divisional lists of the authors on particular subjects. The book form of catalogue is not at all suitable for recording borrowing transactions. A separate volume should be provided, arranged under borrowers' names, opposite each of which the reference number and the date of issue of a work can be entered. It is desirable to place a private identification mark in at least three places in the text of each volume. This may be a conspicuous one made with a rubber stamp, or a bare indication executed with a pen. The main point is to adhere to the same pages for the insertion of the marks. The owner of a good collection of works of fiction would do well to resort to the rubber stamp. Careful librarians provide a number of strips of stout card to mark the places where volumes are absent. Some even go so far as to assign a special card to each borrower, but this is perhaps an unnecessary refinement. P.

It is stated that elephants' skins are tanned to make carpets. They never wear out, but are expensive.

Field Experiments with Manures.—Mr. W. T. Wood, of the Cambridge University Department of Agriculture, gave the results of several field experiments at a meeting of the Cambridgeshire and Isle of Ely Chamber of Agriculture, at Cambridge, recently. He said that rotation experiments had now been carried out at Hatley and at Thriplow for the past three years, and several valuable lessons had been learnt. The artificials used in each experiment consisted of a mixture of superphosphate, sulphate of ammonia, and sulphate of potash in the proportions of 5cwt. of the former to 1cwt. of each of the latter. The first plot started with 7cwt. of artificials for swedes, and each succeeding year 2½cwt., and had produced a considerable increase in the roots and also in the barley—35 bushels, as compared with about 21 bushels on the no-manure plot. The plot which had paid best at Thriplow was treated according to the local method—namely, to grow the swedes with a small dressing of superphosphates, to eat the swedes on the land with sheep getting cake, and not to put on any manure either for barley or for swedes. The plots which paid next best were those which had received dressings of dung, and those which had paid the worst were those which had received nothing but artificials. The reason why dung was not suitable for heavy land appeared to be that wet land was so tenacious that it did not allow the air to get in, and prevented the dung from rotting. In potato experiments, by using 4cwt. of superphosphates they had an increased average yield of 1 ton 15¼cwt. By increasing the dressing to 8cwt. they had produced a distinct increase in the aggregate on peat soils, but on silt soil no further increase had been obtained. On one plot the 8cwt. of superphosphates had given an increase of 2 tons 5¼cwt. The addition of potash had not been at all profitable. Apparently on black soil the manuring of potatoes resolved itself into applying a considerable amount of some soluble, quick-acting artificial, such as superphosphates. Thirty-five charlock spraying demonstrations had taken place, which went to show that spraying should be done on a fine day when there was very little wind.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Glatton" has replied to 97069; R. A. R. Bennett, 97216, 97231.

97098. Adjustment of Newtonian Reflector, p. 345.
97112. Tin and Sheet Mills, 345.
97116. Tortoise, p. 346.

97285. Factory Clubs p. 432.
97282. Optics, 432.
97291. Handicrafts for Working Lads, 432.
97301. To Lanternists, p. 433.
97302. Refracting Telescope, 433.
97312. Stereoscopic Transparencies, 433.

QUERIES.

[97522.]—**Solution Wanted.**—Will some mathematical reader please give a general method for solving indeterminate equations like the following in positive integers?

$$16v + 13w + 9x + 21y + 5z = 17(v + w + x + y + z).$$

N.B.—This is *not* an examination question.—E. H. R.

[97523.]—**Curious Geometrical Figure.**—If a narrow strip of paper or other flexible material be taken and the ends joined, we have a cylindrical ring, with two distinct surfaces, an inner and an outer, and two distinct circular edges. If, however, before joining the ends we give the material a half-twist, we get instead a very curious figure, having only one surface and one continuous edge. What is the name of the figure so formed? And will some reader furnish a few particulars as to its properties, geometrical, mechanical, &c.?—E. H. R.

[97524.]—**Ancient Music.**—Can any reader of the English Mechanic inform me where I can obtain a copy of a piece of ancient Greek music, found in an excavation made to discover Greek antiquities some few years ago? It was, I believe, a "Hymn to Apollo," and was properly arranged and set for orchestral performance, and was actually performed in public at one of the large rooms in London.—Curious.

[97525.]—**Threshing.**—Kindly explain as concisely as possible the action of a modern grain-threshing machine, from the putting in of the straw and grain attached, to the finishing of the process, where the grain is taken away in sacks of different qualities. What I want to know is the different actions of the machinery. (1) The threshing. (2) Getting rid of the chaff and straw. (3) The separation of the qualities of grain. An answer to the above would greatly oblige.—Dutch Paul.

[97526.]—**Chalk Engraving Plate.**—I should be glad of any information as to the method of making chalk plates. The article in question is a thin sheet of steel, coated with a composition resembling French chalk. By means of a fine-pointed instrument a picture is drawn through the composition; the plate is then placed in a casting-box, and filled up with molten metal, which produces a printing block. The composition should crumble away under the point of the needle, but the intersecting portions between finely-drawn lines should remain standing. I have experimented with various substances, but failed to obtain anything like a satisfactory result.—W. H. S., Plymouth.

[97527.]—**Condenser.**—Will some expert steam-user inform me what form of condenser for a 250I.H.P. compound engine produces most economy in fuel, with a plentiful supply of cold water? Also, what is the best form in a similar case where water is scarce?—H. Jay.

[97528.]—**Power for Motor.**—I have two dynamos, shunt wound, 100 volts 40 ampères each. I want to use one as a motor for pumping. What H.P. shall I require to drive dynamo, and what H.P. shall I get on motor shaft?—Fitter.

[97529.]—**Enamelling.**—Will any reader inform me how to make enamelling oven to hold two or three bicycle frames, heated with paraffin oil, kind of sheet-iron to be used, and dimensions?—J. O'G.

[97530.]—**Acetate of Copper Solution.**—Will Mr. Bonney or any of "ours" kindly inform me how to make up an acetate solution of copper for electro-plating iron and steel? The solution I use at present is hardly satisfactory, being thin and bad colour.—W. K.

[97531.]—**To Mr. Avery.**—Will you kindly tell me the quantity and sizes of wire to put on a dynamo of your Avery-Lahmeyer design, as described in December *Model Engineer*, built same sizes as actual drawings? Will it not be necessary for so small a machine to alter design of armature? What will be probable output as a dynamo, and speed to run at? What H.P. as a motor?—C. H. W. Eccles.

[97532.]—**To Mr. Bottone.**—I have an undertype motor, with F.M. 2¾in. high, with cores ⅝in. by ⅞in. by ⅞in., wound with 16yds. of No. 22 B.W.G. Armature space 1¼in. diam. The present armature is a Siemens H-type, 1¼in. long, 1¼in. diam., wound with 4yds. No. 22. Can you advise me how to make this efficient, both as a self-starting motor and as a dynamo? Please state probable output of dynamo, and speed to run same. Also, current required as a motor. Full particulars of another armature would greatly oblige.—Pietre.

[97533.]—**Governor for Water-Motor.**—Can any reader kindly tell me how to make a governor for a water-motor with a wheel 4in. diameter? What H.P. will this motor give with the Manchester town's water, using a ⅛in. nozzle?—P.

[97534.]—**Turning Vulcanite.**—Please inform me the best way of turning vulcanite and ebonite, as I find that the ordinary turning tools will not stand? Any hints on polishing same will oblige.—Vulcanite.

[97535.]—**Ear Apparatus.**—Can anyone inform me if they have ever come across an apparatus for prevention of water entering the ears when bathing? Cotton-wool is apt to come out when swimming for any length of time.—Sidestroke.

[97536.]—**Lacquering Bedstead.**—I have a brass bedstead, the top rail and knobs of which are worn. Would it be possible for me to relacquer? If so, how should I set about it?—W. A. H.

[97537.]—**Induction Coil.**—To Mr. Bottone.—I am making a 4in. coil according to the instructions in your book "Radiography," with the change in the gauge of wire you were good enough to suggest some time ago. I find, however, that the vulcanised fibre circlets have warped, and I have been unable to flatten them, so I have made some discs consisting of five thicknesses of paraffined cardboard, the total thickness being $^3/_{16}$in. Would you be good enough to tell me if these will make an effective substitute?—A. H.

[97538.]—**Haidinger's Brushes.**—Will some reader who has had practical experience tell me how to see "Haidinger's Brushes"?—E. H. R.

[97539.]—**Wood Connecting-rods.**—Why are the Yankees so fond of fitting these on all their machinery? My experience is that they soon split, generally at a most inconvenient time.—A. F. Shakespear, Bromley, Kent.

[97540.]—**Quick-drying Black Paint.**—Will any subscriber to the English Mechanic give me a recipe for making a quick-drying black paint that will cover over white lead and other paints, so that it can be lettered upon with white lead in a few minutes afterwards?—A Constant Reader.

[97541.]—**Planing Machine.**—To "J. H."—Having had one example of a table that was too light, and that buckled when bolting down work on it, I should feel obliged if you would tell me if a table 3ft. 6in. long overall by 1ft. 6in. wide would be stiff enough if made ⅜in. thick. There would be five ⊥-slots down it about 1in. deep. I don't want to get it too heavy, as the beams are only 3in. wide, and the oil might get squeezed out when heavy jobs were put on the table. Also, should I gain anything by using double skew teeth in the rack, wheel, and pinion, the rest of the gear having ordinary teeth? I want to get a very smooth cut.—A. F. Shakespear, Bromley, Kent.

[97542.]—**Marble.**—I have been told that monumental masons save all chips and waste marble, which they use for making an artificial stone by mixing with some other substance. Can any correspondent say if this is so? And if so, what is the process?—T. W. Kenny.

[97543.]—**Indicated Horse-Power and Probable Brake Horse-Power of Compound Engines.**—Can anyone give this? Large cylinder 18in. diam., small cylinder 12in. diam., length of stroke 18in., revolutions per min. 190, cut-off at half-stroke, boiler pressure per square inch = 120lb.—Anxious.

[97544.]—**Welding Compound.**—Will some reader kindly tell me the best compound for welding cast steel? Also the best method of tempering cast-steel chisels for cutting iron, &c.?—Young Mechanic.

[97545.]—**Blowpipe.**—I should be very much obliged if one of "ours" would give me a few of the sizes for a 1in. gas-brazing blowpipe—namely, the size of gas-pipe, size of gas-nozzle, distance of nozzle from blowpipe mouth, and also size of bellows to work same?—Jeff.

[97546.]—**Transformer.**—Would Mr. Bottone or Mr. Avery give me the windings, length of core, size, &c., of a small transformer to be used with a scissors arc lamp? The primary current is to be 100 volts and 3 amps., alternating, which I want to transform into 30 volts and 8 to 10 amps. Also, could this transformer be made like an induction coil, and could it be used for direct current with the aid of a contact-breaker? What would the minimum cost of wire for winding be?—Arc Lamp.

[97547.]—**Induction Coil for Motor.**—To Mr. Bottone.—I have made an induction coil for motor tricycle, but it does not seem quite right. I shall be obliged if you will tell me how to improve it. Core is a bundle of No. 22 iron wire, 7in. long, ⅞in. diameter, properly annealed, and wound with four layers 24 silk-covered wire for primary. Secondary is ¾lb. 36, wound on a brown-paper tube $^1/_{16}$in. thick, in 14 layers, thoroughly paraffined and separated by three thicknesses paraffined paper between each layer. ½in. spark only obtainable with condenser of 50 sheets tinfoil 4in. by 6in. Ought not this to give ¾in. spark at least? The last layer of secondary is nearly 1in. away from core. Is this too far to be of any use, or could I expect a longer spark by putting on more wire? I use four Le Carbone dry cells, giving 1½ volt per cell. The contact-breaker works too weakly. I made the primary to slide out, so took off each a layer of wire. I tried it again, and now I get nearly ¾in. spark with only one layer on, and the contact-breaker works much stronger. This would probably do, but I am afraid the battery will run down much quicker, as there is not so much resistance in one layer of wire. Is this so? The battery is all right, as I have an ignition coil which gives a splendid ¾in. spark with it, and the contact-breaker works very much quicker and stronger, although the core is only ⅝in. diameter. The springs are about equal in strength, and adjusted about the same. I see you advise ¾lb. No. 24 for primary, wound in four layers of about 180 turns to each layer. How do you get it on a 1in. core with only 180 turns to the layer? I can get on easily 240 turns in 6in., and yet do not use more than 6oz. in the four layers. A little information would be acceptable to others, I believe, besides—W. A. J.

[97548.]—**Oil-Engine.**—Will some reader kindly describe the construction, with a sketch, of the most simple vaporiser for a ½H.P. oil-engine? Also, what should be the bore and stroke of the cylinder to give the above power?—H. Severn.

[97549.]—**Hardening Soft Steel.**—Will any of "ours" please tell me how to harden soft steel in whale oil, sufficiently hard. The articles are for cutting pliers. I have added to the oil resin and also prussiate of potash, and yet the required pitch of hardness is not attained. To harden in water would splay the handles, and result in water cracks, &c. What can I add to the oil which will give the desired result?—Polished Pincer.

[97550.]—**Electrical.**—While charging 4-volt accumulator with three quart bichromate cells, single fluid, how can I connect a voltmeter up to it so that I can see what my batteries are doing? Should it be connected up to it all the time it is charging? Also, how much bichromate of potash and how much sulphuric acid (oil of vitriol) is usual for one-quart single fluid battery.—JAMES GIBLING.

[97551.]—**Leather to Glass.**—Shall be obliged for cement or glue to stick wash-leather to glass in pieces about 2in. square. It must not be very expensive, as many pieces are required, and must not injure the leather.—R. S. T.

[97552.]—**Bricquetts.**—I shall be much obliged by an outline of the process of making coal bricquetts. Is a machine for forming them necessary, and which is the best? What substance is generally added to make them plastic, and increase burning? Any further particulars will oblige.—W. G.

[97553.]—**Magnetic Induction.**—Will some of our correspondents kindly explain why the armature of a dynamo revolves at the poles of the field magnets, and the secondary of an induction coil is wound in the centre part of the core?—L. W.

[97554.]—**Morse Code.**—Is there a low-priced manual of the Morse code with arbitraries and other hints useful for telegraph learners?—N. S.

[97555.]—**Tuberculosis in Cattle.**—I see it stated by a medical man that when the "Queen's herd was carefully tested, it was found that 95 per cent. were tuberculous." Is that true?—BOS.

[97556.]—**Glass.**—In a paragraph published by the *Daily Mail*, describing the hotel at which the Queen is to stay, I read that the windows are glazed with cristal de roche, which is far clearer than the ordinary plate-glass. Can any reader tell me what is "cristal de roche," that it should be clearer than ordinary plate-glass? What is "ordinary" in that connection?—M. E. V.

[97557.]—**Horses.**—How much does a horse grow in height from one year to four—I mean average? In a batch of thoroughbreds recently arrived from Australia one youngster of eighteen months is said to stand already about 17½ hands—the biggest thoroughbred ever seen for his age.—A. C.

[97558.]—**Motor Crank-shaft.**—Will the writer of the articles on "Motor Cars," or "Monty," kindly say if malleable iron or steel casting would be suitable for the crank-shaft of small motor? I want one with four cranks, which would be difficult and costly to forge. Are steel castings soft or brittle?—CHARLESWORTH.

[97559.]—**Spectroscope.**—Will some of "ours" oblige by helping a working man whose means are very limited? I have taught myself some chemistry from a few books and back numbers of this journal. My apparatus (glassware excepted) is all home made, including a balance accurate to a $^1/_{50}$ grain. I am getting on nicely with inorganic analysis. Towards completing my outfit I have just made a spectroscope, from information scattered over the "E. M." since 1886. The thing looks decent, and, as far as I can judge, works moderately well. But on this point I want some help. I have never seen a spectroscope, and am not clear if I am right. A reply in a back number to a correspondent tells him to make a scale for his instrument, so as to be able to compare spectra seen at different times with each other. I am quite fast here. I made the instrument as follows:—I bought two achromatic lenses, 1½in. in diameter, 9in. focus; prism I made of plate-glass, 1½in. high, and 1½in. across face clear, filled with bisulphide; it has equal sides. The eyepiece is a single lens, ¾in. diameter and 1in. focus, the slit has screw adjustment; diaphragm of eyepiece has a fine hair across it. The table is 12in. diameter, and has a finely-divided scale on its edge, which is swept by the view telescope. This, the collimeter, and the little table carrying the prism have all screw adjustments. With a Bunsen I can see all the lines of spectra of alkaline metals in Fowne's "Chemistry," and in bright daylight or sunlight I can see about a dozen dark lines and a score or two others very faint, and rather difficult to separate. These are mostly in the green. How can I map these out, and also how to get the instrument so I can always get the same readings? What is a good cheap book on the subject?—WORKER.

[97560.]—**Cellulose Packing.**—Is said (p. 510) to stop leaks in ships excellently, but that it "degenerates and becomes a nuisance from the sanitary point of view." Can any of "ours" tell how long it lasts before it becomes a nuisance?—G. A. HAIG.

[97561.]—**Paint and Oil for Models.**—Can anyone tell me what oil to use as lubricant, and also to put on bright parts of model engines when they have to stand for a time? I find ordinary sweet oil cakes in time, and has to be scraped off. Also, what black paint or varnish will do for the cylinder (steam)? Boiling water and steam must have no effect on it.—CYMRO.

[97562.]—**Water Bath.**—Why is it impossible to get the water in the inner receptacle to boil? Is it the thickness of the metal containing the water abstracts heat from the water in the outer vessel? From the above I should take it oatmeal and similar substances prepared in this manner never really boil. The correct explanation will oblige.—L. A. I. E. E.

[97563.]—**Wireless Telegraphy.**—To MR. BOTTONE.—I wish to telegraph with a Wimshurst machine over water to a moving boat about quarter-mile away. I have used a delicately suspended relay for experimenting on land, but I find it would not be suitable to use in the boat, as the least movement of the boat would cause it to oscillate, and ring the bell. Kindly say how I can make one very delicate, and yet not affected by the motion of the boat?—NO SIG.

[97564.]—**Cleaning Enamelled Slate.**—Can one of "ours" kindly tell me how to clean enamelled slate of clock which has become smeared with fingermarks?—INKY.

[97565.]—**Medical.**—I observe when I move my head sideways a crackling sound at the back of the neck; age forty-seven, abstainer, diet carefully. Can any reader kindly suggest a remedy?—F. W.

[97566.]—**Mould Making.**—I want to cast some silver medals, stamped on both sides, exactly of the same size and thickness as a half-crown, and I want to know how to make suitable moulds for making same, so as to stamp on both sides at the same time. I would also like to know the name of some reliable handbooks on mould-making.—ANXIOUS.

[97567.]—**Selenium.**—Would some reader state the process by which selenium is made to change its electrical resistance by exposure to light? I bought some selenium, which was in the shape of a lead-pencil, and kept it just below its fusing point for some hours. I then placed it, or rather melted it, between two edges of long copper plates. It did not assume the crystalline form, and exposure to light made no difference to its resistance. Kindly give explicit directions in a form which will be understood by one who is ignorant of chemistry.—THOM. CHEAM.

[97568.]—**Eclipse and Spain.**—What seaport is there on the west coast in line of totality, and what steamers touch there?—CORONA.

[97569.]—**Automatic Duplex Diaphragm.**—Will any of "ours" kindly say how thick the floating weight is of this class of fitting, and how are the vibrations from the under side of glass utilised to give increased volume of sound? The stylus is, I think, placed between the centre of floating weight and the weight-limiting screw, and not between the centre and the hinge, as is usually done.—SLIDE-RULE.

[97570.]—**Specification for 3in. Spark Coil.**—I would like Mr. Bottone's opinion of the following details for a 3in. spark coil, if likely to give good results: core, $^{15}/_{16}$in. diam., 11in. long; primary, two layers No. 14 silk-covered wire; secondary, 4½lb. No. 36 silk-covered wire; bobbin ends of ebonite, 6in. diam., ½in. thick; five ebonite discs for divisions, 5½in. diam., $^1/_{16}$in. thick. I have a tube of ebonite 10in. long, $1^1/_{16}$in. internal diam., $1^9/_{32}$in. external diam. Could I utilise this for the bobbin tube? What amount of wire should I have on each division for maximum effect, and to prevent sparking over divisions? Can anyone give hints as to the process followed for polishing ebonite?—BETA.

[97571.]—**Geometry.**—Draw a straight line through the point of intersection of two circles, so that the sum or the difference of the squares of the intercepted segments shall be given.—F. OGRAM.

[97572.]—**Telescope.**—Will any of the readers of the ENGLISH MECHANIC kindly tell me the proper diameter and focal length of the small convex mirror of a Cassegrainian telescope, the large concave speculum being 3½in. in diameter, and 22in. focal length?—W. N.

[97573.]—**Bare Patches on Animals.**—We have a cat and dog, on both of which are bare patches (not through fighting). They are otherwise in perfect health. What is the reason?—CYMRO.

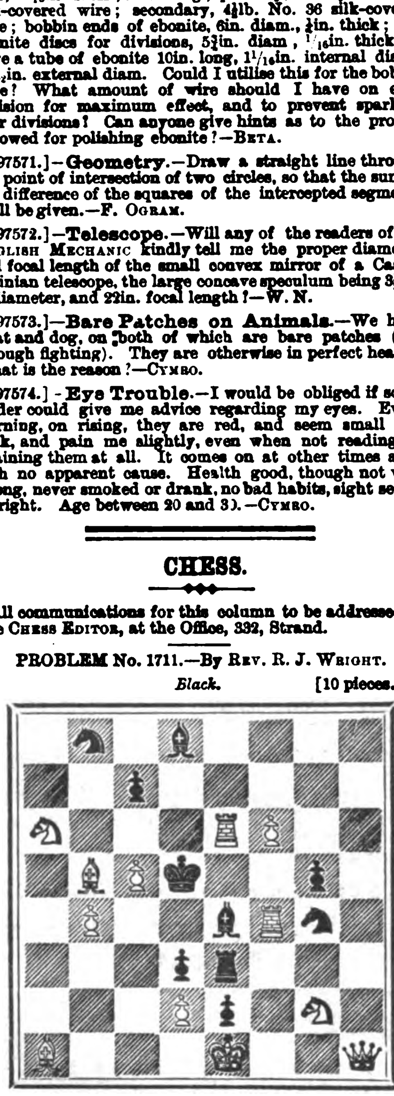
[97574.]—**Eye Trouble.**—I would be obliged if some reader could give me advice regarding my eyes. Every morning, on rising, they are red, and seem small and sunk, and pain me slightly, even when not reading or straining them at all. It comes on at other times also, with no apparent cause. Health good, though not very strong, never smoked or drank, no bad habits, sight seems all right. Age between 20 and 30.—CYMRO.

CHESS.

All communications for this column to be addressed to The CHESS EDITOR, at the Office, 332, Strand.

PROBLEM No. 1711.—By REV. R. J. WRIGHT.

Black. [10 pieces.



White. [12 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Feb. 12.*)

NOTICES TO CORRESPONDENTS.

WHIN HURST.—Try 1710 again as reset.

T. B. CHAPMAN.—Green "Chess" (Bell and Son, York-street, Covent Garden, W.C.)

H. B. F.—List of correct solutions of No. 1710 received will be published next week.

THE Chicago Main Drainage Canal was opened on Jan. 2, by turning into it the waters of the Chicago River.

ABOUT 4,500 miles of new railroad was built in the United States last year. The average mileage for the four years from 1894 to 1897 inclusive was only about 2,000.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

The following are the initials, &c., of letters to hand up to Wednesday evening, Jan. 31, and unacknowledged elsewhere:—

M. B., Galway.—E. H. Micklewood.—S. Elliman.—Clytie.—A. Stamwitz.—H. A. Branley.—A. J. D.—Photo.—Secularist.—R. W. M.—Jack of All Trades.—A Fellow of the Royal Astronomical Society.—J. M.—Usage.—J. E. W.—John Holden.—Henri.—Battery.—Phono.—T. N.—C. E. L.

C. H. W.—The question about the mariner's compass has been answered, so far as is possible, in the textbooks. It is known to dip as the pole is approached; but no one knows what it actually does when carried over the magnetic pole, or the North Pole itself. (2) As to the questions about the moon, there is much literature on the subject in back volumes. (3) The idea of hollow balloons is old. The metal suggested was thin copper. We have not heard that any successful ascents were made with them.

JAMES EDWARD SCOTT.—The best way to qualify as an assayer is to study in the laboratory of an expert. A knowledge of elementary inorganic chemistry will be of great help; but much study and practice are necessary to become a competent assayer.

CHARLES.—The usual remedy is a dose of santonine, with an injection of warm salt water to wash out the lower bowel. Worm powders or tablets containing suitable doses of santonine are sold by all druggists.

GREAT WESTERN.—Inquiry at any drug stores would answer the question; but presumably lanoline could be mixed with any of the essential oils. 2. Do not know of a cure for consumption. 3. Which human voice? Say three octaves as the extreme; but depends on the individual to a great extent. 4. Living rooms, to be comfortable, should have a temperature of 60° Fahr., there or thereabouts. 5. Cows have neither incisors nor canines in the upper jaw. They have six molars in each side of both jaws, and eight incisors in the lower jaw, equal to thirty-two teeth altogether. Why not examine a head, and so answer the question in the most definite way? 6. Depends entirely on how the gas-fire is constructed. If the ventilation of the room is perfect, the purity of the air is not affected. 7. The origin of all such "duties" was the necessity to raise a revenue for the expenses of the State.

STELLA.—We do not know; but a note to Sir Edward Clarke, inclosing stamped and directed envelope, would no doubt bring a reply as to whether his book on shorthand has been published.

W. T. N.—You are quite right. On investigation, we find that our computer took the first minimum from the "Companion to the Observatory for 1900" (the calculations for which are made in the Royal Observatory itself), and calculated forward from that. It now appears that the original time given, loc. cit., was, as you point out, 12 hours too late, an error which we find has been formally acknowledged in *The Observatory* itself. We correct it elsewhere.

NO SIRRAH.—The price is evidently the difficulty. The firm mentioned did publish some years ago "The Telegraph Guide" at 1s. There were also "Popular Guide to the Telegraph Service" and "The Practical Telegraphist," by W. Lynd, respectively 2s. and 2s. 6d., published by Wyman and Sons, Gt. Queen-street, Lincoln's Inn Fields. Query inserted.

AMATEUR, J. C.—It has been frequently stated that, all things considered, the chromic acid cell is the best for electric lighting by battery. See many replies in the back volumes. The cost depends on the voltage of the lamps used, and whether the materials are purchased in large or small quantities. As you are probably going to purchase the battery and the lamp or lamps, any of the advertisers can give an approximate idea of the cost when they know the amount of light required.

A. G.—We cannot tell you. We can only insert advertisements as we receive them. Some advertisers, to save sixpence, omit addresses, or shorten them in such a fashion as to deter rather than induce replies.

E. H. MICKLEWOOD.—The index to every volume is published with the third number of its successor. If you have the numbers, you *must* have the volumes. Binding cases can be ordered through your newsagent for any volume, 1s. 6d. each.

W. J. KING.—They are tempered in the same way as other steel springs—that is, raised to a red heat, as it appears in the dark, quenched in oil, and then placed on a hot plate until the oil blazes. (2) There are works on the subject, but it depends on what information is required as to which would suit you. The booksellers near you have, no doubt, catalogues of the publishers, and can probably give you an idea of the character of the works. They are scarcely likely to be so technical as an "armourer" would need.

SUFFERER'S FRIEND.—Tar water is known technically as infusion of tar. The well-known recipe is wood tar one quart, cold water 1 gallon; stir thoroughly with a stick for a quarter of an hour or more at intervals; allow the tar to subside, strain the liquor, and keep in well-

stopped bottles. As much as a pint a day can be taken. The last question must be answered by a medical man, as it depends on the "system" of the individual. Decoction of tar is made by boiling an ounce in a pint and a half of water. Stockholm tar is the proper article.

F. C. N.—The directions specify "retort or wood carbon." "Retort" carbon is the scurf from the gasworks; "wood" carbon is simply charcoal. The ordinary carbons sold for batteries would answer all purposes. Nitric acid at 40° may mean that it contains 40 per cent. of the pure acid, or 40° on Beaumé's hydrometer. The arrangement does not seem to have come into use to any extent, and does not appear to be so convenient as the chromic-acid cell.

E. P. CLARK (New York).—The numbers required have been out of print for a long time. Current numbers will be sent to the value of the order.

AN OLD READER AND APPRECIATOR.—You should see a medical man. It may have been merely "liver," but it may have been a slight attack of syncope, following, possibly, on an attack of the prevalent influenza.

ARTHUR E. GILBERT.—Thanks; but we have given you all the space we can spare for that matter.

IN TYPE.—Slide Rule.

SPECIAL OFFER.

CHEAP VOLUMES.

In the course of the next few months we are compelled, owing to the making of the new street from Holborn to the Strand by the London County Council, to remove our Offices and Printing Works. Due notice of our removal will be given shortly. In the mean time, to reduce stock and save trouble of removal, we offer readers desirous of making up sets of back volumes *any volume* in the list below at HALF PRICE, or post free for 4s. 1d.

Any reader desirous of making a free library or working men's club a present of a few sets of volumes will find this a favourable opportunity. The offer is only available till our removal.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, post free to any part of the United Kingdom. For the United States, 13s., or 3dol. 25c. gold; to France or Belgium, 13s. or 16f. 50c.; to India, New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-Office Order. Back numbers can also be sent out by the ordinary newspaper post at the rate of 3d. each.

Vols. XXVI., XXVIII., XXX., XXXII., XXXIV., XXXIX., XL., XLI., XLII., XLIII., XLIV., XLV., XLVI., XLVIII., L., LI., LII., LIII., LIV., LV., LVI., LVII., LVIII., LIX., LX., LXI., LXII., LXIII., LXIV., LXV., LXVI., LXVII., LXVIII., also LXIX., price 4s. 1d. each Post free.

Indexes to Vol. LI., and to subsequent Vols., except Vols. LIII., LV., LVI., LVII., LIX., LXI., 3d. each, or post free 3½d. Cases for binding 1s. 6d. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in February and August, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d. each, through any bookseller or newsagent, or 2½d. each post free from the office (except index numbers, which are 3d. each, or post free 3½d.)

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The Charge for Advertisements in the Columns headed:—

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For Sale.
Wanted.
Addresses.
Situations.

is Sixpence for the first Sixteen Words, and Sixpence for every succeeding Eight or part of Eight, which must be prepaid. No reduction on repeated insertions. Advertisers should state under which heading they wish their announcements to appear.

The address is included as part of the Advertisement and charged for. No displayed Advertisements can appear in above columns. Rates for Displayed Advertisements are as follows:—

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Quarter-page	2 10	2 5	2 0	1 15	1 10	"

Back Page, £10 10s. A few dates open during 1899.

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Thirty Words	2 6
Every Additional Eight Words	0 6

Front Page, Five Shillings for the first 40 words, afterwards 9d. per line. Displayed Advertisements, 10s. 6d. per inch. Paragraph Advertisements, One Shilling per line. No Front Page or Paragraph Advertisement inserted for less than Five Shillings.

All Advertisements must be prepaid, and in cases where the amount sent exceeds One Shilling, the Publisher would be grateful if a P.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.'s.

Advertisements *must* reach the Office by 1 p.m. on Wednesday to insure insertion in the following Friday's number.

For the convenience of advertisers, replies to advertisements (except those in the Exchange and Sale Columns) may be addressed to "———," care of the ENGLISH MECHANIC Office, and will be forwarded by post to the advertiser, for an extra fee of Sixpence per insertion over and above the cost of the advertisement.

All Cheques and Post-Office Orders to be made payable to THE STRAND NEWSPAPER COMPANY, LIMITED, and all communications respecting Advertisements should be distinctly addressed to:—

THE PUBLISHER,
THE "ENGLISH MECHANIC,"
332, STRAND, LONDON, W.C.

This is necessary, as there are several papers published at the same address, and unless letters are fully directed, it is impossible to tell for which paper they are intended.

NOTICE TO SUBSCRIBERS.

Home Subscribers receiving their copies direct from the Office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary if it is desired to continue their subscription.

Foreign Subscribers will have the Pink Wrapper sent ONE MONTH before expiration, in order to give them time to forward fresh remittance before subscription expires.

For Exchange.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

SPECIAL NOTICE. — *Correspondents are strongly recommended not to send money or goods to strangers. The safest way when dealing with unknown advertisers is to send a Post Office Order made payable —— days after date, when in case of non-arrival of goods, or dissatisfaction, payment can be stopped.*

Bisschop Gas-Engine, one-man-power, in excellent working order, complete, with gas-bags and regulating valve. Wanted, Shaping Attachment for 5½in. lathe, or small planer.—HUMFREY, Winnington-park, Northwich.

Edison Phonograph, complete, £5. Wanted, Office Desk with drawers.—WALKER, TURNER, 75, Prince George-road, London.

Exchange, for b.g. Lathe, up-to-date **Gent's Cycle**, value £8.—BOYNTON, 11, Magdala-road, Holloway.

"**English Mechanic.**" Vols. XVII. to XXI., XXIII., XXV. to XXIX., XXXIII. to XXXVII., LVI. to LXI. Exchange Screw-plates, Tools, anything useful in workshop, or sell cheap.—THOS. PARKER, Penshurst, Kent.

Pneumatic Safety, good condition, will exchange to value £4.—P., 2, Homeleigh, Mayville-road, Leytonstone.

Portrait Lens, good as new, 18s., approval; will exchange for Banjo.—HUGGINS, 6, Swinburne-street, Derby.

For Sale.

The charge for Advertisements in this column is 6d. for the first 16 words, and 6d. every succeeding Eight, which must be prepaid.

New Illustrated Price List of Screws, Bolts, and NUTS for model work, drawn to actual size, sent on receipt of stamp. —MORRIS COHEN, 132, Kirkgate, Leeds.

Watch and Clock Tools and Materials. Catalogue, over 1,000 Illustrations, post free, 6d.—MORRIS COHEN, 132, Kirkgate, Leeds.

Wheel-cutting and Dividing in Brass or Iron to 12in. diameter.—CLEGG, Belinda-street, Hunslet, Leeds.

Amateur Astronomers.—"Hints on Refractors and Reflectors," by W. Thornthwaite, F.R.A.S., invaluable, 1s., post free 1s. 2d.—Below.

Handy Map of the Moon, by Mellor, F.R.A.S., 2s.; post free 2s. 6d.—HORNE and THORNTHWAITE, 416, Strand, London.

Lathes and Machined Parts, Wheels, Chucks, Fans, Angle-plates. Illustrated list, 2d.—JARRATT, Queen-street, Leicester.

Rubber Outer Covers, 8s. 6d. Prepared Canvas, 90 by 9, 1s. 3d.; rubber solution, best quality, 1lb. tins, 1s. 6d.—PEMBERTON.

Air Tubes, all sizes, best quality, 2s. 9d. each. Air tubes with Dunlop valves fixed, 3s. 9d.—PEMBERTON.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 3s. All sizes stocked.—PEMBERTON.

Detachable Outer Covers (Licensed), 12s. 6d. each; all cycle accessories and cycle rubber goods stocked.—PEMBERTON and Co., 1, Cardwell-place, Blackburn.

"**Acetylene: its Characteristics, Generation, and Uses,**" with Descriptive Catalogue of "Incanto" Apparatus; just published, 3d. post free.—THORN and HODDLE, 1 Tothill-street, Westminster, S.W.

Brass Casting Made Easy by using Wells' specially prepared Moulding Loam. Brass casting a pleasure.—Below.

Sold in 5lb. canisters, 2s. 3d.; 10lb., 3s. 9d.; 20lb. 6s carriage paid, with instructions.—Below.

Plumbago Crucibles, with instructions for melting brass, sixpence each post free.—GEO. WELLS, Needham Market, Suffolk.

Mail Cart Wheels and Perambulator Furniture.—WALKER BROS., Primo Wheel Works, Sheepscar, Leeds.

50,000 Choicest **Microscopical Objects**, New and Second-hand Microscopes, Cabinets, Mounting Materials.—SUTER, 10, Highweek-road, Tottenham.

Catapult Elastic, square, 2d., 4d., 6d., 9d. yard. Capapults, 6d., 9d. Postage 1d.—MOODY BELL, Cheltenham.

Telescope, Calver's patent, best ever designed, Universal adjustment, revolving eye-end. Capt. Molesworth says:—"An ideal telescope."—Below.

Superb 18¼in. **Mirror** for photography or observing; Newtonian or compound, focus 96in.—G. CALVER, Chelmsford.

Books.—All out-of-print books speedily procured; any subject. State wants.—BAKER'S GREAT BOOKSHOP, Birmingham.

Bargain. — Magnificent model **Vertical Engine**, tubular boiler, glass gauge, whistle, double-action slide-valve cylinder; bronze stand. Exhibition model, silver-plated, high speed, and guaranteed perfect; worth £3s., accept 12s. 6d. free. Photograph 1d. —MANAGER, Hassall's Chemical Works, Stratford, E.

Rubber Outer Covers, average 16oz., Para rubber 8s. each.—FRANKLANDS.

Rubber Outer Covers, 8s. 6d. each, 96s. per dozen. —FRANKLANDS.

Cushion Tires, 3s., 4s., 5s. Solid Tires, 2s. 6d., 3s. All sizes stocked.—FRANKLANDS.

Air Tubes, best quality rubber, 2s. 9d. each. Fitted with Dunlop valve, 3s. 9d.—FRANKLANDS.

Air Tube, Para rubber. Marvellous value. Large stock to clear. Perfectly air-tight, 2s. each.; 21s. per dozen.— FRANKLANDS.

Cycle Capes, 3s. 6d., 4s. 6d., 5s. 6d. Also a few cycle Capes, guaranteed waterproof, 2s. 6d. each.—FRANKLANDS.

Detachable Outer Covers, licensed, 12s. 6d. each. —FRANKLANDS.

Saddles.—A clearing line in ladies' and gents' saddles, 3s. 6d. each, 34s. per dozen.—FRANKLANDS.

Inflators, 18in., 1s. 6d. each, 15s. dozen. — FRANKLANDS.

Bells.—Special line, double gong, usual price, 12s. dozen, will clear 5s. per dozen.—FRANKLANDS.

Prepared Canvas, 90 by 9, 1s. 3d. each, 12s. per dozen.—FRANKLANDS.

Pedal Rubbers, 6d. per set of four, 4s. 6d. per dozen sets; no rubbish.—FRANKLANDS.

Spanners, nickel, usual price, 18s. per dozen. Will clear a few dozen at 7s. 6d. per dozen.—FRANKLANDS.

Cycle Accessories and Cycle Rubber Goods. We hold the largest stock in the North.—FRANKLANDS, Astley Gate Blackburn.

Castings in Steel or Malleable Iron made from your own patterns.—DRONFIELD CASTINGS COMPANY, near Sheffield.

Improved flexible stranded **Tire Wires**, protected from rust, standard sizes, 1s. 8d. pair.—15, North Marine-road, Scarborough.

Motors.—Soft clean Castings, machined or rough, ready for immediate delivery, to drawings in "E. M."—H. COLBECK, Electric Cycle Works, Dalton-street, Hulme, Manchester.

The Britannia Co. publish monthly a Register of Gas, Steam, Hot Air, and Petroleum Engines.

Above List contains details of nearly 3,100 lots Lathes, Planers, Shapers, Drilling Machines and other tools.

Also Pumps, Lifts, Steam and Petroleum Launches, and various machinery and plant. State details of requirements.

Send 2d. Stamps for specimen copy—BRITANNIA WORKS, Colchester, or call at 100, Houndsditch, London.

Stamped Steel Boats, various sizes, with air-tight compartments, very light and handy.

When sending, send precise details, and we will quote for items not yet in our list.

Call Britannia Co., 100, Houndsditch, London. All letters to BRITANNIA WORKS, Colchester.

Above items are many of them second-hand, and offered at low prices.

Lathes, Drilling, Planing, Milling, Shaping Machines. BRITANNIA Co., Bonâ-fide Makers to the British Government.

Iron Castings, various, good working quality. Prompt execution of orders.—BRITANNIA FOUNDRY, Colchester.

Britannia Co. Heavy Department make Tools, &c., up to 20 tons. They also continue the Light Tool Department.—Write BRITANNIA WORKS, Colchester.

Britannia Co., having erected large foundry, fitted with electric light and crane, are open to supply light or heavy castings.—BRITANNIA WORKS, Colchester.

Fancy Ornamental Lathes, by Holtzappfel, Evans, and various first-class makers, and various appliances on sale. —LONDON MACHINERY AGENCY, 100, Houndsditch.

Special Tools, as designed for eminent firms, for any special work; interchangeable.—BRITANNIA, Colchester.

Optical Lantern, mixed jets. "Injector" using house gas; also gas gauge, sell.—WILLIAMS, Bishop's House, Clifton.

Watches, Clocks, Jewelry, Musical Boxes, Novelties. Dealers supplied at rockbottom trade prices for cash. Cheapest house in England. Lists on application. Gentleman's crystal face keyless nickel silver, 3s. 9d.; not less than three will be sent.—WOOLRIDGE and Co., 90, 91, Queen-street, London, E.C. Agents wanted. Mention paper.

"Xactli" four-volt **Pocket Dry Battery**, for lighting scarpins, flowers, &c., post free 3s. 4d.—Below.

"Xactli" **Dry Battery**, complete, with Electric Pin or Flower, 7s.—WRIGHT, 318, Upper-street, London, N.

Wheel and Rack Cutting in Brass, Iron, Steel, Aluminium, Bronze, Raw Hide, &c.—MOTOGEAR, below.

Gear Wheels.—Spur, Bevel, or Spiral, machine out any pitch in any metal.—MOTOGEAR, below.

Differential Gear for Motor-Vehicles, all types.— MOTOGEAR ENGINEERING Co., 78, Queen Victoria-street, London, E.C.

The English Mechanic
AND WORLD OF SCIENCE AND ART.
FRIDAY, FEBRUARY 9, 1900.

A SMALL MOTOR-CAR, AND HOW TO BUILD IT.—VI.

THE crank-chamber of our motor is designed of suitable strength for casting in aluminium or one of its many alloys, such as Wolframinium. Those of my readers who prefer it can use one of the bronzes (phosphor-aluminium, &c.) or malleable cast iron, in which case, particularly for the bronze alloys, the body could be made somewhat thinner. Fig. 18 is a side elevation (valve-gear side), Fig. 19 a plan partly in section, and Fig. 20 an end elevation showing the square facing for the cylinder to bolt against. In the upper right-hand corner of Fig. 18 is a small section showing the thickness of the bosses for the studs holding the covers on each side of crank-chamber. These bosses show dotted in the side elevation, and appear also in the plan, Fig. 19. The pattern for this portion of the engine is made solid, the interior being cored out, a suitable core-box being provided. In the upper part a hand-hole is cored out, through which access may be had to the connecting-rod big end. A facing $^1/_{16}$in. high by ½in. wide surrounds the hand-hole, whose position may be obtained from Figs. 18 and 19, being marked A in both views. The part marked B, Fig. 18, bolts against the rearmost cross-bar of the carriage-frame by means of two ⅝in. bolts. There must be a suitable allowance made for machining this facing to enable it to be fitted squarely to the framing. The boss C, Figs. 18, 19, and 20, is to receive the fulcrum-pin of the valve-gear bell-crank lever, and its position is of great importance; therefore the dimensions given should be most strictly adhered to. A small error here will result in a lot of the work being thrown out and rendered useless. To know where to allow for machining in making the patterns, a reference to the general arrangement drawings, Figs. 2 and 3, will be of service.

Having the casting, the first proceeding will be to line it out to the dimensions in Figs. 18, 19, and 20. The casting being rather large (the largest if we except the fly-wheel), I do not suppose many amateurs will be able to machine it themselves; but they can do all the marking off, which will save expense. For the benefit of those whose equipment of tools enables them to do all the work themselves, I will indicate the methods I should adopt. Having marked out and centre-punched circles and witness-circles around the 7in. openings in the sides, I should clamp the casting on a face-plate, setting it by the centre punched circles, and bore out the two sides for the reception of the covers to 7in. diameter. At the same setting the facing, which is $1^1/_{16}$in. wide, can be faced over on one side of the casting. It can now be

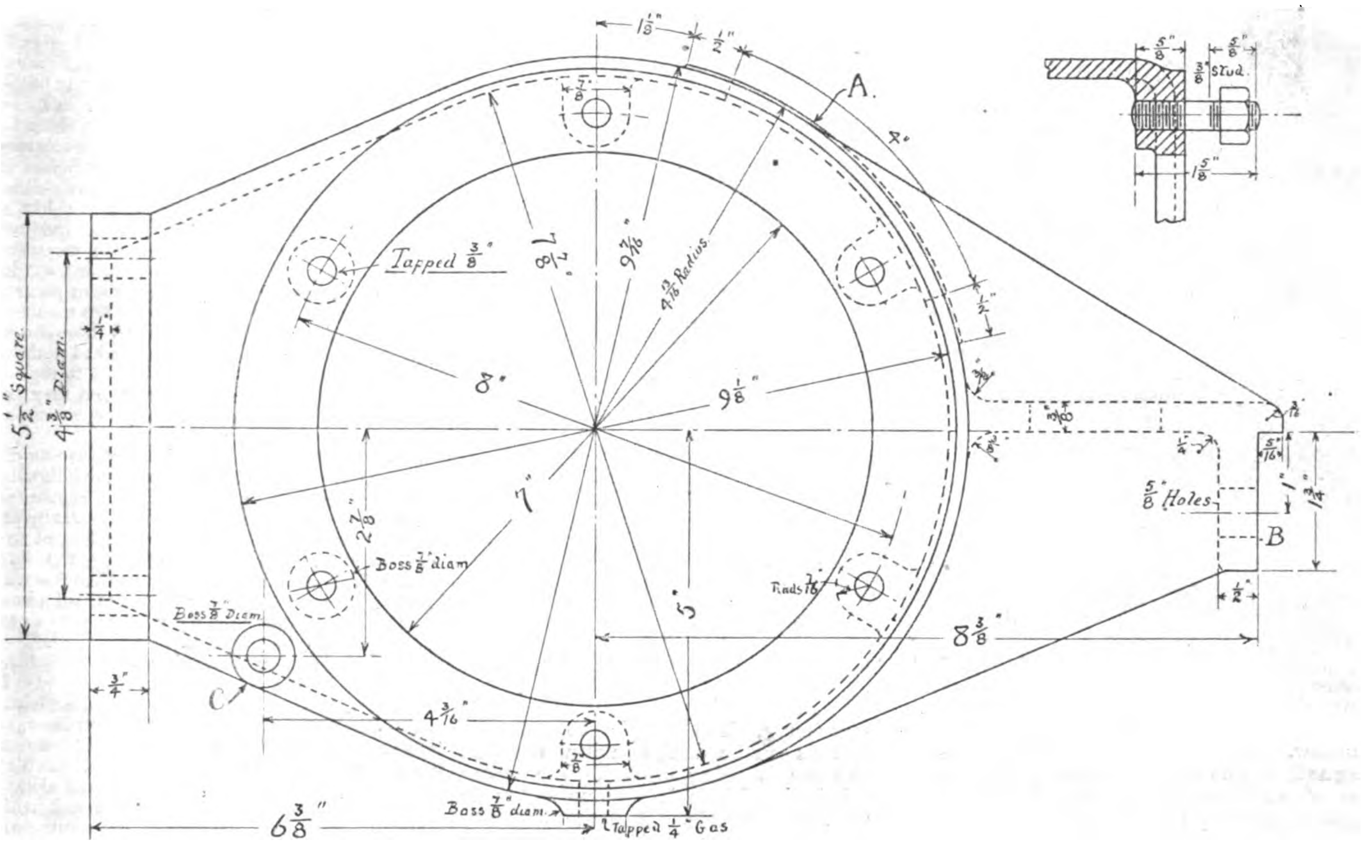


Fig. 18.

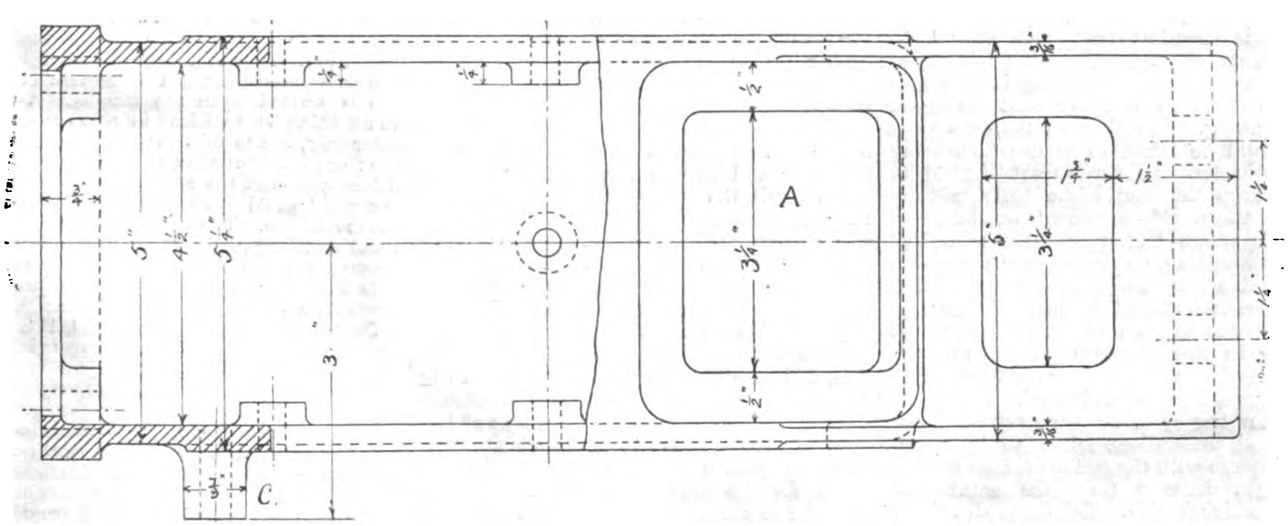


Fig. 19.

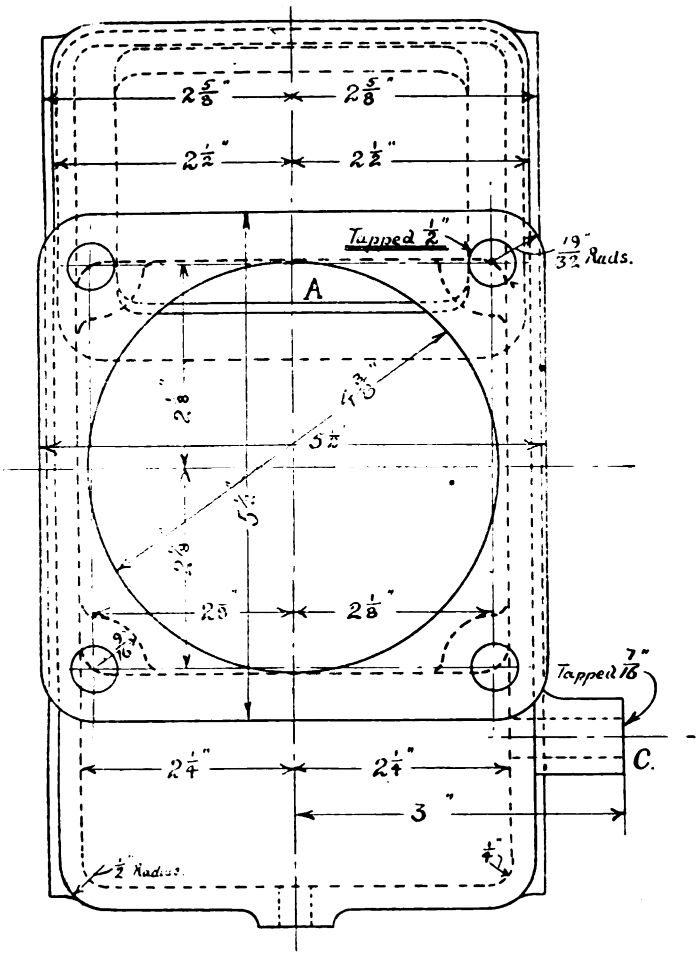


FIG. 20.

removed, and a piece of hard wood screwed to the face-plate, and turned to 7in. diameter. Its thickness is immaterial so long as it can be screwed on securely. This disc of wood serves to centre the casting, which should again be clamped to the face-plate; this time the rough facing being outermost. This is now faced over, and if the face-plate is true, both sides of the casting will be found quite parallel; and it is essential that they should be so. Otherwise, there is small chance of the crank-shaft bearings being in line with each other, which would prevent the motor from running. In facing off the sides great care should be taken to insure their being exactly the correct distance apart—i.e., 5¼in., and to keep the centre line truly midway between them. Measurements can be taken from the centre line, previously scribed all round the casting, to the edge of a straight-edge laid across the cover-facing. These measurements should be made frequently: otherwise too much may be taken off, and packing in this place is an abomination. The holes for the cover-studs will be left till the covers are turned and fitted. The square facing for the cylinder can next be shaped over, and precautions taken to insure its being square with the facings for covers, and the right distance from the crank-shaft centre, which is 6⅜in. Take note also that it must be truly at right angles to the horizontal centre lines of the engine, so that when the cylinder is in position its centre-line produced would cut the centre-line of crank-shaft. Boring out the hole into which the end of cylinder enters at first sight would appear to be difficult. One way is to clamp the casting on to the lathe saddle, the turned facings insuring its being level, with the centre of the 4⅝in. hole in line with the lathe centres, and use a tool held in a chuck to bore it out, advancing the casting by traversing the saddle along the lathe-bed. The flange B is next planed or shaped across, and it must be parallel to the cylinder facing. The two ⅝in. holes for the frame-bolts can be drilled in it now, or left till the car is being erected. The facing around the hand-hole is filed up and made as level as possible. A piece of sheet brass, aluminium, or whatever material the crank-chamber is made of, is to be bent to the radius of, and made the same shape and size as, the hand-hole facing, and secured in place with ¼in. set-screws placed one at each corner and one in the centre of each of the four sides. To prevent the oil which is splashed about the inside of the case from leaking from under the cover, a single thickness of brown paper is to be placed between the cover and the case, and all screwed up tight. Drill the boss C right through into the crank-chamber, face off the end with an arbor-cutter so that it is the correct distance from the centre of motor, and finally tap it out 7/16in. The arbor-cutter is used before tapping to avoid damaging the thread. I need hardly say that this boss must be drilled and tapped quite square with the longitudinal centre line, and parallel with the crank-shaft centre line. The boss at the bottom of crank-chamber is drilled, faced off, and tapped ¼in. gas, to take a small cock, by which waste lubricating-oil may be run off. Drilling the holes for the four studs which hold the cylinder to the crank-chamber is an operation requiring care. The cylinder and crank-chamber should be placed together on the marking-off table, in their proper relative positions, and their centre lines made to coincide so that the facing on the cylinder for the valve-box is parallel with the facing on the crank-chamber for the cover, valve-gear side. The holes can then be marked off on the crank-chamber, using those previously drilled in the cylinder flange as a guide. Drill and tap these very carefully, and screw in four ⅜in. studs tightly. Put the two parts together again, and run the nuts on moderately tight, and again test them with scribing block and square on the surface-plate, to make sure the studs have been placed correctly. If they have not, there is nothing for it but to ease the holes in the cylinder flange, though this should not be permissible on first-class work.

MILLWRIGHT'S WORK.—XXIV.

IF the new wheel is to be a bevel, even more care is necessary than for a spur, because little inaccuracies in wheels of this class, especially when the breadth of face is considerable, soon result in bad gear.

In addition to the trouble of obtaining properly formed teeth, the correctness of the bevel is important. It is very easy to get this slightly out of truth, and when that happens, bad gear is unavoidable. There is no chance to put bevel-wheels farther into or out of action as in spurs, because one end of the teeth is held in check by the other. At the small end, an inaccuracy amounting to 1/16in. will be quite sufficient in many wheels to give trouble. In narrow-faced wheels there is little to contend with; but as width increases, the greater must be the care exercised. The bevel should be both measured and checked by other measurements, and special care must be taken in preparing pattern parts to guard against error on the part of the moulder. The insisting on the necessity for all these checks may seem trivial to those who have had nothing to do with making new bevel-wheels to replace old ones, or to gear with old ones; but they are fully warranted and emphasised by experience of good and bad work.

If a new wheel is to be made to replace an old one yet at work, dimensions taken in the following manner will afford a check on one another in drawing out the wheel in the shop:—Diameters are taken at the tooth-points, on the largest and smallest ends. This can be done in the way previously described as suitable for the measurement of spur-wheels, either by strips laid across the diameter of the shaft, if the latter is so small as to offer no interference to this method of measurement; or by measuring the radius from the shaft to the tooth-points and roots. If neither of these is available, correct dimensions can be obtained by hanging two plumb-lines, as in Fig. 152, and taking measurement between them, the dimensions being obtained on both large and small diameters. The lines can always be suspended from beams or other attachments overhead, or from a strip laid over any convenient support somewhere above the wheel. Measurement at A can be taken with a strip, or small iron rod, or large wire, or with a steel tape —not so safely with a linen one.

A templet is made to the bevel of the tooth-points, Fig. 153 or Fig. 154, whichever happens to be most convenient, and the breadth of tooth-face is scribed upon the templet. A novice would think it sufficient to measure one diameter only, and to take the angle and width of face; or to measure the two diameters and width of face, and omit the angle. In either case the new wheel would almost certainly not be exactly like the old one. The reason is, that the roughnesses and inequalities in castings affect every measurement, and the consequence is that these little irregularities and discrepancies are easily averaged, when each checks the other.

The templets, shown in Figs. 153, 154, should properly be made in sets of two, one giving the angle at the points of the teeth, the other that at their roots. Of course, in properly designed wheels, these should both run to the apex of the pitch cones, and one could be easily obtained from the other, and from the total length of tooth measured at one end. But then millwrights often have to make bastard wheels to match old ones, which are not properly designed according to standard rules, and for this reason nothing must be taken on trust.

The templet in Fig. 153 is shown fitted against one face of the wheel boss, that in Fig. 154 against a parallel straight-edge, which should bridge over the width of the wheel. A large shaft coming in the way would interfere with this method, while a small one would not. Fig. 153 is of sheet iron, tin, or zinc, bent to fit round the shaft, Fig. 154, of wood.

Rubbings are taken of the teeth at the large end. As a check they may be obtained, too, at the small end. It is sometimes safe to check the bevel of the teeth of old wheels in plan view—that is, to see whether their flanks and faces point

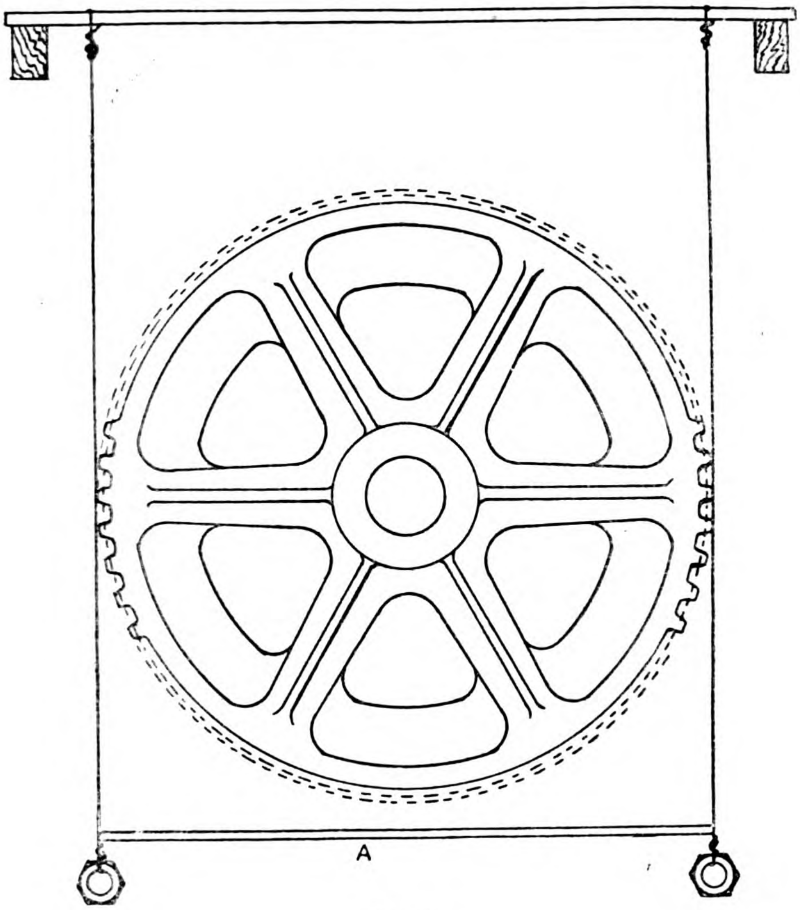


FIG. 152.

to the apex of the cones. They always ought to, but they don't. A templet like Fig. 155, fitted by planing between the teeth, will settle this point. Particulars of bore, boss, and arms follow, and are inserted in a sectional view as in

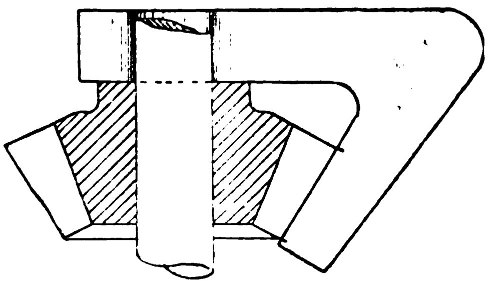


FIG. 153.

Fig. 156; width of rims, &c., being marked on a sketch giving a view as in Fig. 152.

If the bevel-wheel to be newly made has to work with an existing one, then the latter must be measured by the methods just noted in order to the correct matching of the new one to it. If the shaft for the new one is in place, measurement must be taken from that to the teeth of the

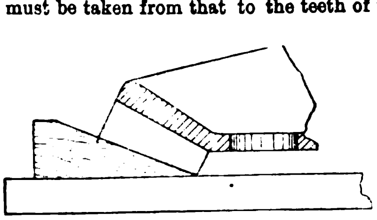


FIG. 154.

existing wheel, to get the correct radius, which must determine the number of teeth in the new one.

Being back at shop, the wheels are to be struck out to full size. The sheet with the rubbing is pinned down upon the board, and the pitch-circle located and struck. Internal and external templets are made in thin wood to the curve of the pitch-circle, and laid in turn upon it. Then generating circles are taken at random, and rolled round on the internal and external curves until a striking-point in the circumference of some

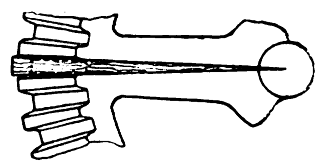


FIG. 155.

circle or circles traces the tooth curves. Then those are the circles with which the curves of the teeth of the new wheel will be struck. Very probably there will be found to be a difference in the diameters of the circles, which suit the flanks

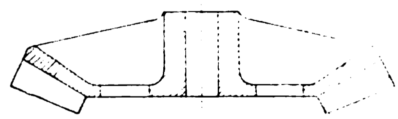


FIG. 156.

and faces respectively. Then the circle which suits the flanks of the old wheel must strike the faces of the new one, and the circle which strikes the faces of the old wheel must strike the flanks of the new one. To apply the circles to the new

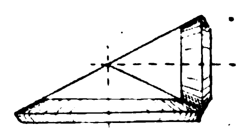


FIG. 157.

wheel, sweeped templets, inside and outside, must be cut to the pitch-curve of the new wheel, and the circles rolled upon these.

So far, the method is identical with that for obtaining the curves of the teeth of spur wheels. But in the case of a bevel wheel the shapes of the teeth will be laid down, with circles on the major diameter only. Having obtained them thus, they are transferred to the minor diameter by drawing lines representing widths and striking centres to the common centre of the two wheels.

Bastard bevel wheels have to be fitted sometimes

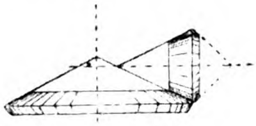


FIG. 158.

to existing ones. Fig. 157 illustrates correctly-formed wheels, correct because the pitch planes of both run to a common apex. Figs. 158, 159 illustrate bastard wheels, so-called because their pitch planes do not meet in a common apex. Such a departure from correct form is necessary when a new wheel has to be fitted to an existing one, but in which the relative velocities will not permit of the right number of teeth and right diameter being used, or in which the original wheel is found to be incorrect. The teeth may be less or greater in number, causing the apex of the new

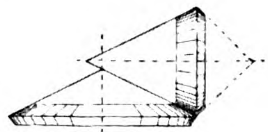


FIG. 159.

wheel to fall short of, or to run beyond that of the existing one. Such wheels, though incorrect in principle, run well if their angles and their tooth shapes are made properly.

To set them out, strike the pitch cones suitably to the number of teeth. Take a templet of the teeth of the old wheel, and find the circles by which its curves were generated. Then strike the teeth of the new wheel to suit, projecting the pitch diameters, in the manner shown, by the method which is well understood. **J. H.**

ORNAMENTAL TURNING.—XXXV.

By J. H. EVANS.

PROCEEDING with our considerations of the various apparatus connected with ornamental turning, we now approach a very important addition — viz., the spiral apparatus. I have heard it argued that all screws are spiral: consequently all spirals can be no other than screws, in the strict sense of the term; but it will be readily understood that, beyond certain pitches or twists, the word "spiral" or "helix" is more applicable, especially for the purposes of ornamental turning and decoration. It is not my intention to deal now with screw-cutting, only as applied to our particular purpose; at the same time the relation between the movements of the mandrel and guide-screw are practically the same—both in the screw-cutting lathe and the spiral apparatus we are now about to consider.

In the case of the former (the slide or traversing lathe), the revolutions of the mandrel are connected with, and derived from, a train of wheels which gear to a similar wheel attached to the main screw of the lathe, which engages with the sliding saddle, and so carries it along the bed of the lathe. Now, as I have already stated, the principle of the apparatus we are now about to deal with is identical, the revolution of the mandrel being conducted by means of a set of change-wheels, which connect to a wheel on the main screw of the ornamental turning slide-rest. This, it will be at once evident, is in every way more suitable to our present purpose, and meets all the conditions likely to be required in the production of ornamental spirals; and many other adaptations we shall find necessary as we proceed. There are two ways of attaching the spiral apparatus to the lathe—either at the front or back of the mandrel frame. This being the case, it will be necessary to go fully into each, so that whichever is deemed the most suitable may be adopted. Again, it may transpire that the lathe

to which it is to be fitted will not have a traversing mandrel; if this is so, there is nothing for it but to have it in the front.

Having thus decided this point, the first thing to do will be to cut out a circular groove in the front of the headstock. I have shown this in Fig. 1, on which also I have illustrated the radial arm in dotted lines, as fixed on the mandrel frame. The circular slot should be about 2in. in diameter, and $\frac{3}{16}$in. wide. The exact dimensions, however, to which it is made, must be governed by the shape and size of the mandrel frame to which it is to be fitted. It must be cut concentric to the mandrel (vide A, Fig. 1) in order that it may partially rotate to suit the requirements of the various trains of wheels which from time to time are to be employed. At the lower extremity of the arm a curved slot B is made, and through this passes a screw into the hole C, which is tapped into the mandrel frame. It is this screw which fixes the arm securely, when the necessary position to sink the train of wheels in use is obtained.

An elongated slot, or mortise 7½in. long, as seen at A, Fig. 2, is made in a line with the axis of the circular fitting A, Fig. 1, and it will be at once seen that although the semicircular slot B is of no considerable length, the amount of elevation and depression of the arm is sufficient for all purposes.

In order to facilitate the manipulations of the fixing screw, a curved spanner, as shown in Fig. 3, is the most suitable. The screw should be made

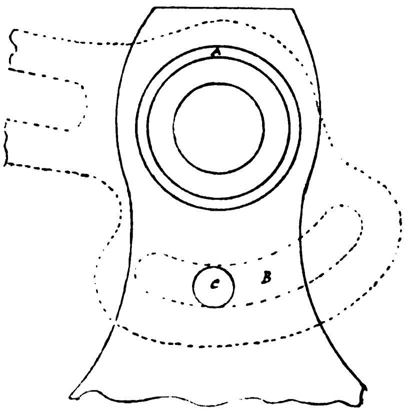


Fig. 1.

one inch across the flats, and for further convenience a hole is drilled in each, so that when required, a tommy, at the opposite extremity of Fig. 3, may be employed.

The mortise A, Fig. 2, must be carefully set out and accurately filed to fit a gauge, which must be made; the usual width being ⅝in. It must be parallel from end to end, also square to the face. The object of this aperture is to receive the fitting attached to the bodies of the arbors, which, when fitted, move throughout its length, and are fixed in the position found to be that which will accommodate the various trains of wheels. In Fig. 2 the radial arm is shown in full with dimension marked. Reference to this engraving will more fully bear out the remarks concerning the same as applied to it in Fig. 1.

We will now proceed to the making of the arbors. Of these there are three—viz., the single, double, and intermediate arbor; the latter being essential to the reversing of twists or spirals from right to left. First let us take the metal body. This is illustrated by Figs. 4 and 5. It is, in the first place, cast in circular form. It is then held in a jaw chuck and bored out at the centre A (Fig. 4). This hole should be slightly taper, as it is for the purpose of receiving the steel spindle A (Fig. 7). The external diameter is then turned all over from this fitting, it being placed on a steel mandrel for the purpose. The next thing to do will be to cut the screw B (Fig. 4). This should be a rather fine thread, but although preferable, it is not actually imperative. Proceeding, we come to the tubular nut (Fig. 6). This must be turned and screwed to fit B (Fig. 4), as it is to be employed to hold it securely to the radial arm when in use. We may now file away the two sides to pass into the mortise slot of the arm. This is seen in A (Fig. 5), and it must be accurately fitted to slide throughout the length of the slot. The nut (Fig. 6) is turned to a cylinder externally, the extremity being filed to a hexagon

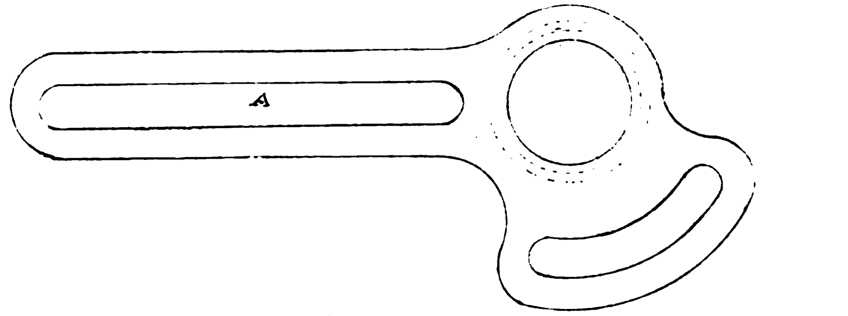
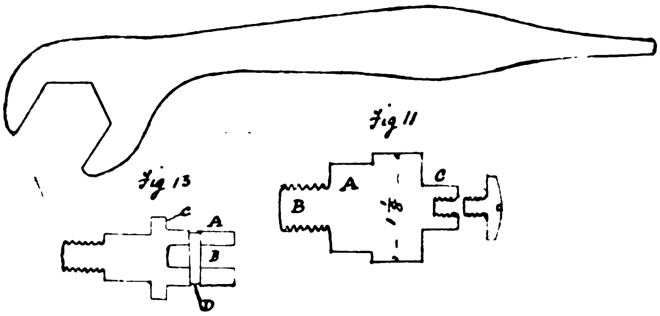


Fig. 2.

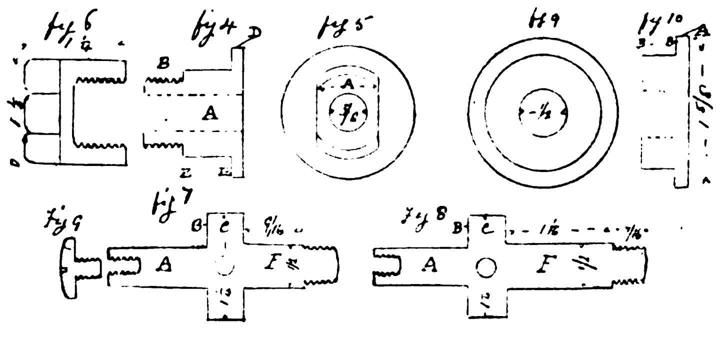
one inch across the flats. It is, of course, necessary to make two of each of these—one for the single and one for the double arbor. Further illustration will, however, be quite unnecessary, as they are identical.

We come now to the steel spindles which revolve within the parts just so far finished. Figs. 7 and 8 give a clear view of these in all parts. They are each accurately fitted at A to revolve in the aperture A (Fig. 4), and retained in position by a screw fitting in the end at B (Figs. 7 and 8)—a screw with head extending beyond the diameter of the fitting, as shown in Fig. 9, in order that it may form an opposite bearing to the face of the collar on spindle, B B, Figs. 7 and 8. The end of the spindle must be in exact accord with

Fig. 3.



that of the face B (Fig. 4), and when the screw is in its place, and the fitting finished, there should not be any movement between the two, but a smooth revolution must be the result. The width of the collars C on Figs. 7 and 8 is about $\frac{3}{16}$in. I say "about" in this case, because the precision must be determined by the dimensions of other parts when fitted. Fig. 4 at D is ¼in. wide, and from E to E the width must be just under that of the thickness of the radial arm. The collar of Figs. 7 and 8 have four holes drilled through each for the purpose of holding them firmly, while the wheels are tightened on to the fitting. This it will be at once recognised as necessary, as there



is no other means of resisting the force required to be exerted by the spanner on the hexagon nut at the end.

I have in this case shown both spindles, as they differ in their actual length at that part, F F, 7 and 8, the former being the single arbor, the latter the double one, the meaning of the term as applied being, on the one, a single wheel only is employed, and on the other, two are placed—that is, a wheel and pinion, the latter being one of those of smaller diameter, and having a hole of ¼in. diameter, and its width the same.

The larger wheels are bored out to 1¼ diameter, and the width when finished is ⅜. The increase in the size of the aperture necessitates the employment of an auxiliary boss or filling piece; this is made as shown by Figs. 9 and 10. A gunmetal casting must be used, and when bored at the centre to ¼in. to fit E F, Fig. 7 and 8, it is placed on a mandrel, and the exterior turned to fit the apertures on the wheel, the total width of fitting and collar, A, Fig. 10, being half, the same as the pinions. These dimensions are necessary to be studied, as any error will affect the trains of wheels running in the same plane, and if this should occur it will cause much trouble and inconvenience. The fitting B B, Fig. 10, must be just under the thickness of the wheel, so that the washer which covers the space of the aperture may take full effect when all is tightened for use, the collar A making up the width to the required dimension.

Continuing, we now come to the intermediate or reversing arbor. This is made entirely of steel. Reference to Fig. 11 will show clearly the shape and manner in which it is made—in the first place of circular form. It is then filed at A to fit, and slid in the radial arm in the same way as those we have just considered, the screw B extending as seen on the one side is provided with a hexagon nut to fit the spanner, Fig. 3, having before it a thin steel washer. On the front extension C a wheel of 30 teeth is fitted to revolve thereon, the front being countersunk to receive a screw, the head of which must be made sufficiently large to form a bearing, by which the wheel is kept in contact with the face of the collar.

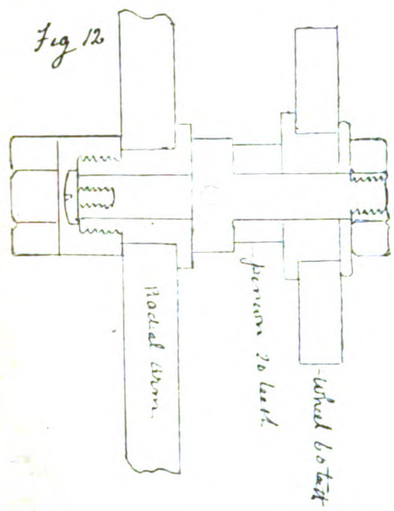
This wheel is simply an idle wheel, or one of communication, used for the purpose of reversing the direction of the spiral, which has been previously cut without its intervention. An important point to study, when fitting up the arbors, is to take care that the diameters of the various parts do not prevent the 30-wheel on the intermediate one being placed in gear with the small pinion. Should it be found that a reduction in any part is required, it may be done by filing a

flat on the intermediate arbor to allow it to pass further along the arm, free of the projection on the double arbor, which carries the wheel and pinion.

It may occur to some of my readers, especially those quite uninitiated in this particular apparatus, to wonder why the larger wheels are bored out to an increased size. It will be seen that many of them have to be employed upon the dividing chuck, which, having to attach to the mandrel nose, must of necessity be left of sufficient substance for strength: hence the increase in the aperture of the wheels which fit over the chuck, and are there fixed, thus forming the connection between the screw of the slide-rest and the mandrel. Being possessed of the filling piece, Fig. 10, we are enabled to employ all the wheels upon either of the arbors or slide-rest screw.

I have shown in Fig. 12 the double arbor as fixed to the radial arm, having both a wheel and pinion attached. This being in sections fully explains the other detailed parts, and will, I hope, be of considerable service in the construction of these parts.

We have still to provide a means of attaching the wheels to the main screw of the slide-rest, and this is done in the following way:—In Fig. 13 will be seen the illustration of a steel rocket, which is fitted in at A into a hole bored to receive it in the left end of the slide-rest, that is, of course, opposite the winch-handle. The best way to insure perfect truth is to make a pin-bit, he pin of which must accurately fit the hole already there, which receives the end of the main



screw. The socket must then be bored at B to fit over the end of the screw, when the face of the socket C bears against the end of the slide-rest. When these fittings are made, a hole must be bored through the slide from top to bottom, in order that the pin D, by which the socket is held to the screw, may be inserted and withdrawn. It will be seen, by reference to the engraving, that the pin D is made of less length than the diameter of the fitting. This is for the convenience of insertion, as it is a difficult job to get it so exactly in position that it will not interfere with the smooth rotation of the screw and socket when in action. Moreover, although it is seldom removed when once placed, it sometimes has to be; and each time the pin is reinserted it may go slightly beyond its previous position; therefore it is better to shorten it off as seen. The opposite extremity of the socket is made to fit the wheels of smaller size—viz., ½in., a second filling piece being employed when it is required to use a wheel with large aperture; the extreme end is provided with a hexagon nut of the same size as those belonging to the arbors. Formerly the nut used for this socket was made of circular form, with a series of holes drilled in the face, and a double-pin wrench made to fit the same. This I found inconvenient, and as the hexagon nut is more readily manipulated and less trouble to make, I have discarded the circular one in favour of it.

With the foregoing details I do not think much trouble will be experienced by any amateur of mechanical ability in the manufacture of it. It is practically straightforward work, and with care there need be no failure. I may mention that it will be as well when preparing the pattern to make those for the wheels. It is always an advantage to have the whole of the castings for such work done at the same time: it insures uniformity of colour and texture. Having said so much, I had better now give the dimensions required for the full set, also the number of teeth in each, which are as follows:—

No. of teeth—

144 120 96 72 60 60 53 50 48 36 30 24 20 18 16 15

Diameter in inches—

$7\frac{1}{4}$ $6\frac{1}{8}$ 5 $3\frac{3}{4}$ $3\frac{1}{8}$ $3\frac{1}{8}$ $2\frac{3}{4}$ $2\frac{5}{8}$ $2\frac{1}{2}$ $1\frac{7}{8}$ $1\frac{5}{8}$ $1\text{-}\frac{5}{16}$ $1\frac{1}{8}$ 1 $\frac{15}{16}$ $\frac{7}{8}$

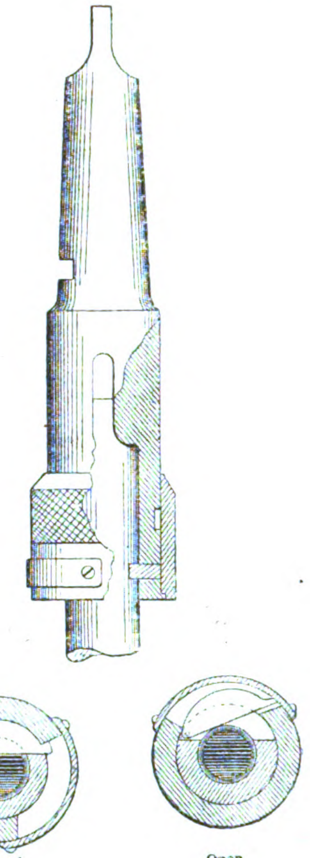
I should strongly advise those who desire to make this apparatus to turn the wheels, and send them to a wheel-cutter to be cut. My next will treat with the dividing chuck, &c.

WIRELESS TELEGRAPHY.

THE promised discourse on wireless telegraphy was delivered at the Royal Institution last Friday by Sig. G. Marconi, M.I.E.E. After describing the principal features of the invention, he referred to its practical uses, and stated that the experiments between the South Foreland and the Goodwin Sands Lightship had demonstrated that wireless telegraphy was trustworthy and certain in operation. He expressed the hope that before long the necessary funds would be found to enable Trinity House to establish communication all round the coast with lightships and lighthouses, by means of which a vast amount of property and many lives might be saved. When coming back from America he established an installation on the *St. Paul*, and by that means all the important news relating to the war was transmitted a distance of about 66 miles, while the vessel was steaming 20 knots an hour. The news thus collected was printed aboard in a paper called the *Transatlantic Times* several hours before the arrival of the steamer at Southampton. This rather pointed to the probability of voyagers being able to keep up communication by means of wireless telegraphy with the land they were leaving or going to. At the tardy request of the War Office he sent out one of his assistants, Mr. Bullock, and five others to South Africa. It was the intention of the War Office that wireless telegraphy should only be used at the base and on the railways; but officers on the spot realised that it could only be of any practical use at the front. Accordingly the assistants volunteered to go to the front, and on December 11 got up to the camp at De Aar; but when they arrived there they found that no arrangement had been made for the supply of poles, which were essentially part of the apparatus on which to erect the screens, and had to be obtained on the spot. To get over the difficulty they manufactured some kites, and in that had the hearty assistance of Major Baden-Powell, a relative of the gallant defender of Mafeking, and Capt. Kennedy. The results obtained were not altogether satisfactory, for the variability of the wind often rendered the kites useless for the purpose. The partial failure was due to the lack of proper preparation on the part of the military authorities, and had no real bearing on the practical utility of the system when carried out under normal conditions. It was reported that the difficulty of getting through from one station to the other was due to the iron in the hills. If it had not been telegraphed from South Africa it would hardly be credible that anyone should commit himself to such a statement. [It is probable that some error was made in confusing wireless telegraphy with the difficulty in making compass surveys.] As a matter of fact, iron would have no more effect than any other metal on the "waves," and signals have been sent across New York, where the tall houses have steel frames. During the naval manœuvres signals by means of wireless telegraphy went through a fleet of thirty ironclads and the apparatus was not affected thereby. However, on getting the kites up, communication was easily established between De Aar and the Orange River over a distance of 70 miles. Poles had now been obtained, and although not quite high enough for conveying messages long distances, yet they were sufficiently high to be useful. Stations were now established at Modder River, Belmont, Orange River, and De Aar, and had worked well, and would be invaluable in case the field-lines should be cut by the enemy. It was also satisfactory to know that the military authorities had arranged to supply small balloons to his assistants for portable installations on service wagons. While he admired the determination of his assistants to do the best they could with the most imperfect local means, if he had been on the spot he should have refused to open the station until the officers had found means to obtain poles for elevating the wires which were necessary for success. In concluding his discourse, Sig. Marconi expressed the opinion that by means of wireless telegrams would soon become as common on the sea, and as much in daily use, as they are upon land. It was stated that the War Department is now sending out a number of small balloons for taking up the "screens," and these, being portable and practically independent of the wind, will probably be found of great utility.

A NEW DRILL-SOCKET.

THE newest thing in the way of a drill-socket, designed to prevent twisting off the tangs, is shown by the accompanying engraving. The new feature consists of cutting a rectangular notch across the taper shank, as shown, into which a hinged steel plate is locked by rotating upon the collet a collar, the construction of which is shown very clearly by the engravings, and which, when in one position, allows the plate to swing outwards and free the drill, and when rotated to another position, forces the plate into engagement. It is stated that



Closed Open

this device has been used sufficiently to show that it is practical, and that it prevents broken drill-shanks. It is made by J. L. Cook, Springfield, Ill.—*American Machinist*.

ANIMALS IN KHAKI.

THOSE who doubt the rationale of khaki as prescribed for the gentlemen ordered South, should pay a visit to the Natural History Museum in Cromwell-road, says Mr. F. G. Aflalo in the *Morning Leader*. Inside and out the building is a study in the fashionable colour, and even the presiding statue of Darwin wants only a few weeks of neglect to blend in ghostly fashion with the khaki tiles behind. It may be objected that these are not true khaki colour, and indeed the objection has some weight. But it must be remembered that several shades have lately been included in the term, and some of the wools in which charitable ladies have knitted socks and caps for the absent troops bear little resemblance in colour to the peculiar Indian material associated with the name. In order to guard against confusion on a recent quest of khaki animals, I furnished myself with a khaki belt that of yore encircled my slender waist on Afric's plains. For—I confess it—my eye for colour resembles the ear for music of the man who knew only one tune, the one that was not "God save the Queen!"

Given a little latitude in shade, however, it is amazing how many of earth's creatures are clad in khaki or in some useful tint closely approaching it. The very first case in the museum entrance hall, the remains of the giant sloth, is full of khaki, and on the same floor is a still more striking group from the Egyptian desert, khaki jerboas and birds and reptiles hiding against a background in harmony. Look, again, at the stony soil in a beautiful case of cream-coloured coursers in one of the bird galleries,

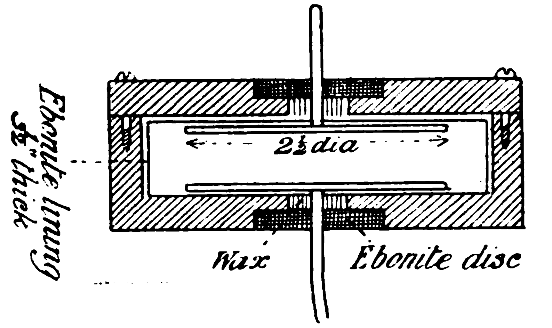


FIG. 1.

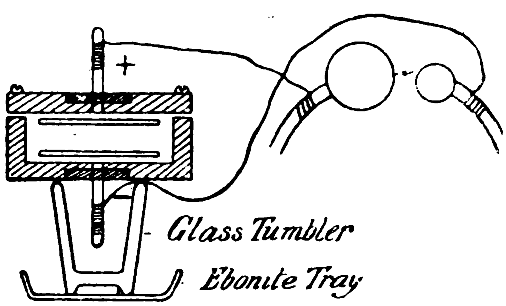


FIG. 2.

or, in another, at a fragment of sand-pit peopled with martins.

The colour protection achieved by khaki comes midway between the melanism and albinism so strikingly figured in that same entrance hall; and, ascending the great stairway, the visitor, turning to the left and resisting the seductions of the Gould humming birds, finds himself in an avenue of South African gentlemen in khaki, antelopes of every size, the gemsbuck, beisa, lichi, and—most striking of all—the puku and hartebeest. These timid and defenceless creatures, that must often trust wholly to colour protection when swift flight would but attract notice, are in khaki uniform from head to foot, but there are shades of the prevailing colour on the lions, river hogs, wild asses, and giraffes; there are khaki seals and sea-lions, khaki monkeys and otters and foxes, hunting dogs and wolves and hyænas.

Against the sandy soil of Natal the protection of khaki raiment is invaluable. Nature knew this before the War Office, as witness some of the local spiders and centipedes and grasshoppers, or the moths and butterflies. Every continent has its gentlemen in khaki; Australia its kangaroos and thylacines, North America its wapiti, South America its guanaco, Asia its camel, swamp deer, and markhore. Even the British gallery gives us, among prudent sand-dwellers, hares and rabbits and adders.

Search below the waters of the seas, and we shall find the upper surface of many flat fishes that pass their time on a background of khaki sand, uniformly khaki, in some variegated with red spots. Some of the mountain dwellers, whose homes are white with winter snows, themselves assume a white coat to assimilate with their altered surroundings. Of such are the stoat and the mountain hare. Even here nature has her lesson for those whose campaigns may extend far into the snows of winter. That horror, however, we are spared in our present trouble.

ON MAKING TRANSPARENCIES BY ELECTROSTATIC INDUCTION.*

IN following up the line of research indicated by my former paper in the *Photogram* of December, 1897, I have succeeded in obtaining some interesting results upon photographic plates; the energy emanating from a condenser plate which is subjected to a series of rapidly recurring electrostatic charges, is made to do the work of light, when allowed to act through an ordinary photographic negative or positive on glass. Some of these results I now record.

In order to produce a transparency on glass from a photographic negative, the apparatus required is of the same general construction as that described in my former paper only somewhat better insulated. Without going into unnecessary details of construction, Fig. 1 will fully explain matters.

The apparatus consists of a wooden box of rectangular shape, about 6in. by 5in. by 2in. (external measurement), and having inside a chamber of such size as to allow an ordinary ¼-plate negative to lie inside, and to leave a ⅛in. margin all round; this, to allow of strips of $\frac{1}{16}$in. ebonite being cemented round the sides—a precaution which I find necessary to prevent stray discharges taking place between the charged conductor inside and the wooden sides of box through ebonite discs or squares, let into suitable cavities in the upper and lower portions of chamber respectively, such that the disc of ebonite shall lie flush with the surface of wood. It is also desirable that a considerable portion of wood be removed from the centre of both top and bottom of the apparatus in the shape of a round hole about 1in. in diameter, passing right through the thickness of the wood. This is to allow a clear annulus of air all round the copper rods which form the electrodes. For purposes of insulation these might with advantage be filled in with paraffin wax. This is preferable to anything harder, because the rods must, by slightly twisting, be able to slide through the wax so as to bed the copper discs attached thereto evenly upon the negative.

Through these ebonite centre-pieces pass, fairly stiffly, pieces of ⅛in. copper rod about 2½in. long, and having attached, exactly at right angles, copper discs about 2½in. diameter one to each rod (on the ends which come inside the chamber). These discs may be cut from fairly flat and stout sheet copper, but are better turned in the lathe from thicker material which has been cast into thick discs, so as to be about ⅛in. thick when finished.

On the bottom of the chamber there is cemented a sheet of $\frac{1}{16}$in. ebonite (the disc and rod being removed for the purpose) of such a size as to exactly fit the rectangular space—i.e., before the strips of ebonite forming the side lining have been attached. Next attach the latter and finally fix to an area of the removable lid which is equal to and faces the bottom piece of ebonite (when the apparatus is screwed up for working), a piece of such size as will just fit into the diminished rectangle which results from attaching the ebonite side strips. Each of these ebonite bottom and top pieces must have in their centres a hole slightly exceeding in diameter the copper rods. These must be inserted from the inside and pushed right through until the copper disc rests upon the ebonite surface. They should fit just so tight as to remain in position until pressure or a twisting action be applied to the projecting extremity outside for purposes of adjustment.

It will be seen by reference to the diagram (Fig. 1) that the cover is removable and screws down upon velvet surfaces at the joint so as to be light-tight.

In order to produce transparencies on glass with this apparatus, take into the dark room and lay upon the bottom copper disc, film-side upwards, either an "ordinary" or "special rapid" plate, above this, film side downwards, a clear photographic negative. I find, curiously enough, that only wet plate collodion negatives can be relied upon for a good result. Upon the upper side of this negative arrange a (*metal, preferably*) ring of the same exernal diameter as the copper disc and about ¼in. to ⅜in. wide and made from $\frac{1}{16}$in. sheet metal. This ring may be cut from ebonite and may be covered neatly with tinfoil (a metallic rim seems to give the cleanest-cut edges to the transparency). Now screw on cover in such a manner as not to disturb the metal ring, which must be fairly central. Things being arranged thus, gently push inwards by twisting the rod projecting from the cover until it just presses the metal or ebonite ring evenly into contact with the negative (this is somewhat a matter of guesswork, but can generally be managed sufficiently well). Now connect up to a Wimshurst machine, as shown in Fig. 2, being particular to see that the positive terminal of machine goes to the copper rod projecting above the cover of the apparatus (i.e., the plate or disc of copper which lies above the negative becomes positively charged). The terminal balls must now be placed so close together (somewhere about ⅛in. or ¼in.) that, upon working the machine, the copper discs inside the apparatus immediately become charged, and at once discharge themselves across the small air gap between the balls of the machine. Sometimes, in damp weather, this sparking is obtained with some difficulty; for the best results it must take place rapidly with a decided clicking sound. Keep this sparking up for from half to one minute, according as you are using a rapid or ordinary plate.

It is important to note here that the time necessary is purely a matter for trial, and varies with the weather and the total thickness between the copper discs of the apparatus—that is, if the negative and dry plate be of specially thin glass the action is quicker than if of thick glass. In all probability, if both negative and sensitive plate were in the form of celluloid films the action would be much quicker, owing to the diminished distance between the charged discs. This I have not, however, tried. Should other readers try films in place of glass and get good or bad results, they might report their experience to the Editors.

In the dark-room the cover is removed, the dry-plate is taken out and placed in the developing dish with any ordinary developing solution, somewhat less alkali than usual being added. There should now appear very quickly an image of the photographic negative equal in area to the copper discs (that is, about 2½in. diameter) nearly large enough if cut down to make an ordinary lantern-slide.

My idea of how the latent image (in this case) is formed, is that the silver bromide molecules are normally arranged in such a condition that the bromide atoms lie in some other plane than that in which the film lies (and in this condition are undevelopable); that, after presenting to such a sensitive film a positively charged plate of metal, the bromine faces of the molecules either immediately turn into the plane in which the film lies, or partly so, and under the action of a succession of these efforts completely so; that they are developable only when turned into this plane. A photographic negative is really nothing more than a sheet of glass or celluloid having either clear glass or metal deposits of varying thickness. Where metal exists of sufficient thickness to obstruct light, it also cuts off completely the directing energy of the charged plate above it: where deposits of metal exist able to transmit a little light they also transmit a little energy of the plate; and lastly, where clear glass exists, the greatest transmission of plate energy takes place. The formation of the image results from a corresponding number of silver bromide molecules being turned into the plane in which they are most easily attacked by the developing solution which has the power, when rendered alkaline, of removing the bromine from the silver bromide molecules. Or something of the above kind takes place, and the bromine is then pulled so energetically from the silver with which it is combined that it, as it were, partially lets go of the silver, and is about to enter into some loose combination with the gelatine or other organic support, with which bodies bromine and iodine seem to be able to combine either physically or chemically. At all events, these combinations can easily be upset by the application of heat, as, for instance, iodide of starch is decomposed by heat. Reduction to the metallic state would in this case take place with great facility by applying some halogen-absorbing substance such as alkaline pyrogallic acid.

This seems to me to be the best way to look at the production of the latent image (at all events under a succession of electric induction charges), if not in the case of light itself which is a physical agent like electricity.

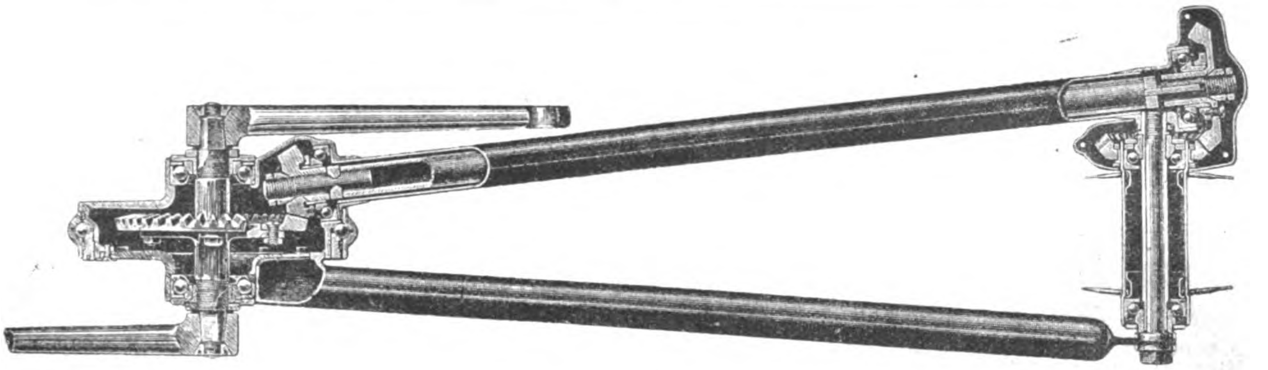
The editors of the *Photogram* append a note: "Mr. Whitworth's article touches a field of experimental photographic work which contains much that is obscure, and probably much that is likely to prove important. In the present state of our knowledge, facts are the things needed, the dearth of which makes theorising a tempting but rather profitless task. We shall be glad to hear from any readers who may repeat or extend the experiments here described."

* By JOSEPH WHITWORTH, in the *Photogram*.

THE PIERCE CUSHION-FRAME CHAINLESS BICYCLE.

IN order to relieve the rider of the shock due to inequalities in the road, many bicycle manufacturers have provided their wheels with cushioning devices, the most common form of which is a coil-spring located within the rear tube, and yielding under the weight of the wheelman. But the spring-supported saddle has the defect of changing the distance between the saddle and the crank-hanger, and thereby causes a loss in the application of power. With the object of providing a cushion-frame which would yield under the rider, but which would constantly maintain the distance between the pedal and the saddle, the George N. Pierce Company, of Buffalo, N.Y., have devised a novel arrangement which has very successfully withstood tests far more severe than those to which a bicycle is ordinarily subjected.

In the Pierce chain-driven wheel the usual spring is supplemented by a hinge-joint at the lower extremities of the rear forks, and by a flat plate-spring connecting the crank-bracket with the lower



rear tubes. From this construction it follows that, under the rider's weight, the entire frame will yield, and not merely the saddle, with the result that the distance between the saddle and crank-hanger will always be constant.

In the chainless bicycle it is evident that the flat plate-spring between the crank-bracket and lower rear tubes cannot be used, and that some arrangement must be employed essentially different in construction, but like in function.

With this end in view, the driving-shaft bevel-gear is mounted within a crank-bracket composed of two side-pieces firmly fastened together. In a central raceway on the outer periphery of the bracket, balls are placed which are received by a corresponding raceway in a bearing-ring rigidly connected with the lower front tube and the seat mast. The two side members of the crank-bracket, being firmly fastened together, rock on this bearing, and, acting in conjunction with the cushion and rear hinge joint, serve the same function as the flat plate spring previously mentioned.

Besides taking up the shock caused by obstructions in an uneven road, the cushion frame, with its rocking bearing at the crank-hanger, possesses the merit of relieving the wheel of much of the strain to which a bicycle is subjected, both in climbing hills and in riding over rough surfaces.—*Scientific American.*

THE ACTION OF STEAM IN THE CYLINDER.

FEW subjects connected with the steam-engine have produced more discussion, not to say wrangling, than the fall in pressure between the cylinder of a compound or triple-expansion engine, known as "drop," and represented on combined indicator diagrams as "gap," says *The Engineer*, commenting on a paper read before the North-east Coast Institute of Engineers and Shipbuilders by Prof. B. L. Weighton. The very title of Prof. Weighton's paper suggests a fray. He has, however, been careful to express no opinion whatever on this matter. He has prudently contented himself with setting before his hearers the results of his experiments, leaving them for the most part to draw their own general conclusions. He confines himself to particularities. His engine trials were made with a view to determine the most economical point of cut-off in the larger cylinders of multiple-expansion engines—that is to say, in the low-pressure cylinder of double-expansion, in the intermediate and low-pressure cylinders of triple-expansion, and in the two intermediate and low-pressure cylinders of quadruple-expansion engines. The specific object of the trials was to determine the receiver drop, "often referred to as free or intermediate expansion," between any two cylinders, with which was associated maximum economy; and incidentally to discover, in addition, the general effects of varying amounts of receiver drop in given conditions. We commend Prof. Weighton for his cautious use of the words quoted in the preceding passage. The triple-expansion engine tested has cylinders 7in. + 15½in. + 23in. × 18in. The trials were carried out with steam in jackets and without it. The steam-chest pressure was about 201lb. Experiments were also made with a compound engine. The general results of the trials as set forth by Prof. Weighton, are that for maximum economy of consumption, steam must be cut off at a certain point of the stroke in the larger cylinders of multiple-expansion engines. For any given cylinder this point depends solely upon the ratio between the capacities of that cylinder and the preceding cylinder R, and is expressed as follows, viz.:—

$$\frac{\text{Maximum-economy cut-off}}{\text{stroke}} = \frac{R + 6\cdot 6}{6\cdot 6\,R}$$

The cut-off in the larger cylinders, once fixed, should never be altered, whatever may be the cut-off in the high-pressure cylinder, or the steam pressure employed. This means that automatic-expansion governors, or linking-up gear, should act upon the high-pressure cylinder only, if maximum economy at all powers is to be preserved. The cut-off in the larger cylinders affects materially the total horse-power developed by the engines. As regards the low-pressure cylinder of triples, and the second intermediate and low-pressure cylinders of quadruples, maximum power cut-off in these cylinders coincides with the cut-off of maximum economy. As regards the second cylinder of triples and quadruples, maximum power cut-off is very considerably later than that of maximum economy. In compounds the maximum power cut-off in the low-pressure cylinder is only slightly later than that of maximum economy. Jackets have no material effect upon the cut-off of maximum economy; variation in vacuum capacity within practical limits has no effect upon the cut-off of maximum economy. Here is plenty of food for reflection. We may add that the brake-power of the engines, making about 140 revolutions per minute, was about 141 horses, the indicated power about 152 horses, and the consumption of water varied between about 14·4lb. and 15·98lb. per brake horse-power per hour.

Now, we venture to say that the formula quoted above will not necessarily hold good of any other engine working under somewhat different conditions. Furthermore, there are several points which are worthy of attention—one of these is the practical inefficiency of the jackets. It made next to no difference in the consumption of steam whether they were in use or not. Another is the small effect of wide variations in the points of cut-off on the economy of the engine. But, perhaps, nothing about the whole trials is more suggestive than the statement that cylinder capacity has next to no effect on the point of cut-off giving maximum economy. It is only the difference in capacity that operates. At the end of his paper Prof. Weighton gives the usual expanded combined diagram, and the saturation curve, in which "drop" is set forth graphically, and just in the right way to elicit discussion. We have more than once said in these columns that these combined diagrams are misleading, and it may be worth while to say so much once more. The gaps in such diagrams are very easily mistaken as representing losses of efficiency—dead loss, in fact—while, as a matter of fact, they merely represent losses of pressure, accompanied by augmentations of volume. That is say, we have so many cubic feet of steam at a given pressure, instead of a smaller number at a higher pressure. Of course, it must be understood that we except that element in drop represented by the actual condensation of steam. But for the moment we may neglect this. To make our meaning clear, let us suppose a single cylinder of considerable length in proportion to its diameter; on the side of this cylinder let a receiver be secured, and the communication between them effected through a valve, which can be closed or opened. Let, now, steam be admitted on the piston supposed to be at the end of the cylinder. After it has made a few inches of its stroke, the steam is cut off, and expanding, drives the piston before it. When the piston has passed the port opening into the receiver, steam rushes into the receiver from the working cylinder. The result is an immediate fall in the pressure behind the piston. This is "drop." The piston then goes on to the end of its stroke, when the valve of the receiver is closed, bottling up in it a certain weight of steam of the terminal pressure in the cylinder. The exhaust is then opened, and steam admitted at the other end of the cylinder. As soon as the piston passes the receiver port again, steam will, as before, rush in, and raise the pressure in the receiver at the expense of that in the cylinder. Again we have drop, and so the process is repeated stroke by stroke. Leaving, as we have said, all question of condensation on one side, a moment's thought will show that no matter what the size of the cylinder in proportion to that of the receiver, the whole weight of steam coming from the boiler must in all cases be available for work; and although it is quite true that the indicator card will show a drop at, say, half-stroke, yet it is certain that the diagram will be flattened near the end. According to all known laws of physics, the free expansion of the steam into the receiver cannot represent a loss, since no waste work is done; and it follows that the only source of loss is that represented by the circumstance that the steam is finally exhausted at a rather higher pressure to the condenser than would be the case if there was no drop.

Now, the receiver on the side of a single long cylinder gives conditions quite analogous to the two cylinders of a compound engine with a receiver between them. Prof. Weighton does not say what the condensation in each cylinder of his experimental engine was; nor does he give the distribution of power, so that we are unable to state what amount of work a pound of steam did in each of the cylinders. But it is known that in any good triple-expansion engine the available efficiency of the steam per pound is about the same in all the cylinders. It is further known that the capacity of the receiver has next to nothing to do with drop; that the amount of drop is settled mainly by the point of cut-off in the second and third cylinders, and that drop may, indeed, be wholly eliminated. Furthermore, in Woolf engines gap almost disappears, there being no intermediate receiver, yet it is well known that the Woolf engine is not so economical as that with an intermediate receiver. But the combined diagrams of a Woolf engine will show to much better advantage than those of receiver engines. In a word, the significance of a combined diagram is very small, and may, as we have said, be easily misleading, and we have further to remember that none of the diagrams show, or can pretend to show, what is the actual work done by the steam in the particular cylinder to which the diagram refers. Thus the high-pressure diagram only gives the net horse-power exerted, and not the total horse-power. But we have insisted on the importance of this point very often, and will not dwell on it now.

It is matter for regret that Prof. Weighton has said nothing to guide us as to the reasons why his experiments have given the stated results—why should the point of maximum economy for a cut-off depend solely on the capacity of the preceding cylinder? Perhaps Prof. Weighton has not yet made up his mind. The question is one of very great interest. We confess we do not see our way to answering it. Prof. Weighton contents himself with the bare statement, that "An examination of the whole of these results shows that the one and only factor which affects materially the cut-off of maximum economy in any one of the cylinders following the high-pressure cylinder is the ratio between the cylinder in question and the immediately preceding cylinder. In other words, the ratio between any two successive cylinders is the one factor which determines the point of maximum economy cut-off in the second of the two cylinders." It is fair to the author to give the following explanation in conclusion:—"This paper does not profess to deal with the questions of the best cylinder ratios or the best total number of expansions for steam of different pressures. The particular values of the cylinder ratios used in these trials are, therefore, of no economic significance, except in so far as they are associated with the best cut-offs in the larger cylinders of the engines."

THE EXPLOSIVE SIDE OF ACETYLENE.

IT is well known that acetylene gas when mixed with air is explosive, and Mr. F. A. McGahie, in the *Scientific American*, says that the experiments have given the limits within which the new illuminant must be produced and utilised to avoid dangerous and uneconomical conditions. Some cases deviating from those treated possess much interest in having found practical application, and having been studied from the point of view of possible explosion. Special burners have to be used with pure acetylene, as the ordinary ones do not give satisfaction with regard to illumination or economy. There is a deficiency in the supply of oxygen afforded by their construction, and combustion with them is not sufficiently complete to

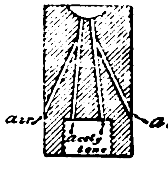


Fig. 1.

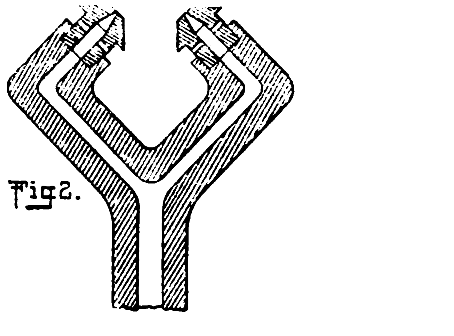


Fig. 2.

give rise to the temperature needed to carry to incandescence the large amount of carbon contained in acetylene. The first solution consisted in making the burners with holes, permitting air to be drawn in and mixed with the acetylene just before combustion (Fig. 1). Such would act satisfactorily for a time, and then begin to clog up and give a weakened, smoky flame. By adding 15 to 30 per cent. by volume of nitrogen to acetylene, Bullier was able to employ ordinary burners. Others have proposed carbon monoxide, carbon dioxide, hydrogen, water-gas, as diluting-agents. Of these, Prof. V. B. Lewes, Gas Engineer for the City of London Authorities, has stated :—The great trouble which has presented itself in diluting acetylene with any cheap diluent is that the illuminating power of acetylene is reduced to an enormous extent, and it has been found that hydrogen, carbon monoxide, and water-gas are useless for this purpose, as 10 per cent. of acetylene mixed with either of them gives a practically non-luminous flame, while if the acetylene is used in sufficient quantity to give a satisfactory light, the percentage of acetylene needed is too high to be commercially possible."

Prof. Lewes made a long series of experiments to discover a cheap diluent that "would maintain the enrichment value of acetylene at something near the value of the gas when burned alone. His conclusions were that "methane was the only gas that would do the work required, and further, that the presence of 30 per cent. of methane when mixed with hydrogen, carbon monoxide, or water-gas, converted it into an excellent diluent, with which 10 per cent. of acetylene gave a 20 candle-power gas, capable of being burned in ordinary gas-fittings." He found that each 10 per cent. of diluting gas mixed with acetylene raised the temperature necessary to originate explosion 180° Fahr. The practical value of this investigation lies, from our point of view, in the fact that a mixture containing enough acetylene to make a brilliant illuminant for railroad lighting can be compressed and utilised safely, since the temperature needed to cause explosion is high enough to melt the metal cylinders carrying the compressed gas. Such a system has been introduced with satisfaction on the street railways in Prussia. The preliminary tests were made by the Julius Pintsch Company, of Berlin, and the Prussian railway management in common. The conclusions of Berthelot and Vieille in regard to the explosiveness of acetylene were confirmed by these experiments. A tank was filled with acetylene at six atmospheres pressure, and a small pipe entering the tank was brought at a point 59in. from the tank to a red heat by a gas-flame. A violent explosion followed. Another tank was filled with acetylene at a pressure under two atmospheres, and a pipe heated as before at a point 59in. from the tank to a white heat. Local decomposition took place in the pipe, but no explosion occurred. With mixtures of 30 per cent. acetylene and Pintsch oil-gas, or coal-gas, compressed to as high a degree as was desirable, it was found that the fusible solder used in the joints of the tank would melt long before a temperature involving explosion of the compressed gas could be reached, and, further, that explosion did not result from heating highly the pipes leading to the tanks so filled.

For the small generator involved in the lighting of country houses by acetylene, the above methods are not available, and pure acetylene must be burned to secure a maximum simplicity of system. There are now satisfactory burners based on the principles of the one shown in Fig. 2. The escaping acetylene draws in air for mixing with itself, and the two jets impinge upon each other to form a vertical flame at a distance from the burner sufficient to avoid the overheating of the tops, with the consequent formation of the condensed polymers of acetylene, such as C_6H_6, C_8H_8, that causes smokiness and clogging-up with the burners of Fig. 1 type. It has been proposed to mix air in proper proportions for good combustion in usual gas fixtures with the acetylene after its generation, and a simple apparatus to this effect has been patented by Dickerson. But it involves an element of danger in introducing an explosive mixture into the distributing part of the system. The air can be mixed with the acetylene all right in the small passages of the burner, since the explosive laws of large masses do not hold in small tubes. Le Chatelier found that in tubes with diameter not exceeding 0 02in. any mixture of air and acetylene would not propagate explosion. The influence of the diameter of tubes is shown in this table determined by him :—

Diameter.	Inferior Limit of Inflammability. Percentage Acetylene.	Superior Limit of Inflammability. Percentage Acetylene.
0·03in.	7·7	10
0·08in.	5 0	15
0 78in.	3·5	55
1·57in.	2·9	64

There are some who hold that compressed, and even liquefied, acetylene, has a future. For compressed acetylene gas Claude and Hess have brought forward a method possessing distinct advantages, that of dissolving acetylene in acetone. At 60° Fahr. acetone dissolves about 26 grammes of acetylene per litre for each atmosphere of pressure, the factor decreasing with elevation of temperature. Berthelot and Vieille investigated this case to determine the conditions of explosion. They found that the acetylene gas above the liquid acted the same as pure acetylene, and would, therefore, detonate by a spark at two atmospheres and above. At pressures up to 10 atmospheres the acetylene dissolved in the acetone will not explode either through the detonation of the free gas or through the action of a highly incandescent wire placed in the liquid. Above 10 atmospheres a danger region is approached. In experiments at 20 atmospheres pressure inflammation of the free gas gave rise to an explosive pressure of 550 atmospheres. Since the decomposition of acetylene at 20 atmospheres would give a round 200 atmospheres pressure, it is evident part of the dissolved acetylene participated in the action. When the inflammation was provoked by an incandescent wire in the liquid part, a pressure of about 5,000 atmospheres was observed. In using cylinders charged according to this system it is imperative to take into account the fact that the pressure increases rapidly with the temperature In the charged cylinder experimented with a pressure of 6 5 atmospheres at 57° Fahr. became respectively 8·4 atmospheres at 80° Fahr., 10 2 atmospheres at 96° Fahr., and 15·8 atmospheres at 140° Fahr. It is desirable, then, in using acetylene dissolved in acetone to fix the charging pressure at 7 to 10 atmospheres, calculated for 60° Fahr., in order to obviate the danger of charged cylinders reaching, through exposure to the sun, or through being in the vicinity of some source of heat, a pressure at which the dissolved acetone would take part in any explosive decomposition. These figures have been given to exhibit the great increase of storage capacity afforded by the system. A cylinder of one litre capacity, carrying 0·7 litre of acetone saturated with acetylene at 7 atmospheres pressure, will carry 127 grammes of acetylene. The same cylinder will contain but 11 grammes of acetylene gas compressed to 10 atmospheres. If explosion should occur in the free gas of a cylinder properly charged, the maximum press obtainable would be below the safety limit of the cylinders employed, and the dissolved acetylene would be still available. The advocates of this acetone-acetylene method hold that it gives an excellent solution of the problem of storing acetylene in a condensed state in cylinders for subsequent transportation to any place where it is desired to feed a receiver, that it is more economical and safe than acetylene compressed in the ordinary manner, and that it is practically free from all danger in the hands of the skilled workmen who would handle the cylinders. Those who believe in the possibilities of liquefied acetylene have invented valves which make it impossible for ignorant workmen to open them too quickly, and to bring about thereby the danger of adiabatic compression in the gaseous column to a degree involving explosion.

THE *Cambrian Natural Observer* is the quarterly Journal of the Astronomical Society of Wales, and, as usual, is full of useful and interesting notes.

A LAKE of boiling mud exists near Grobogana, Japan. It is about two miles in circumference, and columns of steaming mud are constantly arising and descending.

SCIENTIFIC SOCIETIES.

BRITISH ASTRONOMICAL ASSOCIATION.

THE third ordinary meeting of the tenth session of the British Astronomical Association was held on Wednesday, Jan. 31, at Sion College, Thames Embankment, Mr. W. H. Maw, F.R.A.S., the President, in the chair.

The names of eleven candidates for membership were read and passed for suspension, and the election by the Council of seven new members was confirmed.

Mr. Holmes read a paper in which he first referred to the investigations of Prof. Schaeberle in regard to the defective definition of the Crossley 36in. mirror, and expressed his opinion that Prof. Schaeberle's grounds were sound and mathematics irrefutable, but thought there was an underlying misconception of the manner in which a mirror acts in producing an image. After describing the results of considering a mirror as made up of many small circular mirrors, and referring to the size of star discs from the various portions, as well as the many various planes in which they would exist, and after further describing the results of decreasing and increasing the size of the small mirrors of which the large one was supposed to be made up, Mr. Holmes went on to argue that this conception of a final image built up of superposed images in many planes and of many sizes was a mistaken one, and that the image of a star at the focus was not the result of such piling up, but was an interference phenomenon, the effect of the mirror taken as a whole, and not the effect of an assemblage of parts working more or less discordantly. The image of a star is not a composite image, not an accumulation of images, but is one only, and in one plane only. But the discussions upon the subject have treated a mirror as made up not of small mirrors, but as consisting of zones. This did not affect the reasoning. We are told that with a ratio of aperture to focus of 1 to 14 no discernible defect occurs. If we take a 12in. mirror of 80in. focus, the central 5½in. will give a practically perfect image, and, as we know, will result in a spurious disc about 0·8" in diameter. Now, according to Prof. Schaeberle, a zone ½in. wide round this will make a larger image and superpose on the original 0·8", and so on to the outer 12in. zone, which will produce the largest disc of all. Now, every one of the zones produces a larger spurious disc than the central aperture, and therefore their superposition cannot reduce the size of the disc produced by that central aperture, but must increase it, and therefore the larger the aperture the larger must be the star disc. This we know to be contrary to fact, and the reasonable inference is that the mirror acts as a whole in producing the focal image, and not piecemeal, and that the image is one only and not a composite of superposed images. If we study any zone alone the action is rather peculiar, for (still supposing it can produce a disc), then the rays from opposite ends of any diameter of an outer zone would produce discs in planes at an angle of 8° or 9° to each other, and every point of the annulus would make an image in a different plane to any other, and the sum of the action would be an image in a multitude of planes. But a narrow annulus of wide diameter has very little effect in producing a spurious disc at all. It throws most of the light into a ring with fainter rings both inside and outside it. These are mostly broken up by atmospheric unsteadiness, and the unsteadiness causes the flares and spikes, with which everyone is familiar who has experimented with narrow zonal stops. This failure of image is quite irrespective of the goodness of the figure of the annulus employed. I have so far referred only to a single or close double star in the optical axis. There must be some deformation of figure of disc as we depart from the axis of the telescope; but except for this the same considerations apply to other stars in the field as to one in the centre. They are equally the effect of the action of the entire mirror, and the definition of the stars in the outer portion of a star cluster would not be spoiled by the superposition or partial superposition of discs in different planes any more than the central star. And as the focal image of a body of sensible size, like a planet or the moon, is made up of points, and each point, like the image of a star, is the product of the whole mirror, and also, like that of the star, is as perfect as the slight inclination to the axis permits, the entire image is not made up of superposed images of different sizes and in different planes, but is one only. I think we must seek elsewhere for the cause of failure of large reflecting telescopes.

Mr. Seabroke said he had not had an opportunity of reading Prof. Schaeberle's paper, and, therefore, hardly liked to say he differed from the gentleman, or that he was in any way wrong; but from what Mr. Holmes said, it appeared that to treat a mirror for the purpose in question as consisting of a number of smaller sections or parts of a mirror was entirely wrong. The only proper method was to consider what took place when a wave of

light fell upon the surface of the mirror as it existed. It did not do to treat the matter simply geometrically—it was not a matter of geometrical optics—but one which should be treated from the point of view of a wave falling on the surface, and Mr. Holmes had certainly taken quite the right view of the matter. It was obvious that the image did not lie in an infinite number of planes just as they divided up in their own minds the surface of a mirror; but it existed in probably one surface only, and as to what Mr. Holmes had said with reference to the sizes of the several spurious discs, although he would not go so far as to say that, if they took a very small surface, the size of the spurious discs would be infinite, still it would be very large. If Mr. Holmes would consider those question from the wave-theory point of view, perhaps he would on another occasion give them a futher exposition of the matter.

Mr. Holmes, upon invitation by the President, said he could add something to what he had written. Prof. Schaeberle tested the 36in. mirror, he relates, by having a disc made 34in. in diameter, with a 12in. aperture in it. He placed the disc upon the mirror, and, having got the best focus he could, he found the 12in. central aperture with 8in. stopped out by the flat gave him only a fair image, and not a very good one. He examined the in-and-out focal planes with an eyepiece, and found he got a larger blurred image from the outer zone, and, on withdrawing the eyepiece, the image sprang into two rings, one larger than the other. This is what would be expected without any experiment at all, but Prof. Schaeberle appeared somewhat surprised at it. Then he found that the marginal 2in. ring (though if the mirror were 36in., and disc 34in., there would only be a 1in. ring left, and even if the mirror were 37in., which he understood was originally the case, it would only leave 1½in. ring) gave an image many times less bright than the central ring, although he says the outer reflected more than twice the light of the central portion. But he further tells us that the tube cut off some of the rays from this marginal zone, and the flat allowed more of what he calls the injurious rays to pass by it, so that, taken also with the larger image formed, he thought the result just what might be expected. A narrow annulus could not give a neat disc. If we wish to understand how it acts, we have only to consider the diffraction effects of a narrow straight aperture. This makes a straight bright line, with diffraction fringes on both sides. Now, conceive the straight line curved into a circle, and the result will be a bright ring with fringes inside and outside. Each annulus, in the experiment, made its own focal image, which images sprang apart on withdrawing the eyepiece as separate rings. The bad definition of the outer ring, taking the small tube and flat into consideration, would come from diffraction at the mouth of the tube acting as a stop, diffraction at the outer edge of the annulus, diffraction at the inner edge of the annulus, and diffraction at the edge of the flat—the result being a mass of diffraction fringes broken up by air currents, and not a disc at all. The central image being also the product of a narrow 2in. ring accounts for the merely fair disc that resulted from it.

Mr. Seabroke said Mr. Essam, of Billingborough, had sent him a drawing of Saturn, carefully executed, which was on the table for the inspection of members. Unfortunately, Mr. Essam did not give the date on which he made the drawing—it would probably be in May or June last. Mr. Essam informed him he was able to trace Cassini's Division just below the North Pole, and this remark, he says, corroborated Mr. Townsend's observations, which were, in short, to the effect that the fact of seeing Cassini's Division where he saw it showed that the measures of the diameters of the rings or globes of Saturn could not be exactly the measures of those diameters: either the measures, or the inclination of the plane, or something or other was out, or Cassini's Division could not have been seen in the place where he saw it. The drawing was made with a 12in. Newtonian reflector. Mr. Essam desired his name to be added to the list of members of the Saturn Section, and he (Mr. Seabroke) hoped other members of the Association would follow his example.

Mr. Crommelin read some notes on the total solar eclipse of 1900, May 28, which were accompanied by two diagrams; the first showing the position of the more important reference lines on the sun's disc at the time of the eclipse, and the second showing the stars and planets in the neighbourhood. The sun, he pointed out, would be in Taurus not far from Aldebaran. The 4th and 5th magnitude stars κ^1, κ^2, Tauri would be within the corona. To the left of the sun, Orion and Sirius; above, Auriga and Gemini; to the right, Perseus; while Mercury would be some 2° below and to the right of the sun, and as its disc would be fully illuminated and it would also be near perihelion, it would be quite a conspicuous object. In fact, the possessor of a good instrument might do worse than devote totality to a critical examination of Mercury. Venus at its greatest brilliancy in the middle of Gemini would be visible with the naked eye before the beginning of the eclipse, and would be resplendent during totality. There would be an unusual number of bright stars round the sun, and it would be interesting to see how many of them could be detected with the unaided eye. The Zodiacal Light might be visible during the expedition, though not to such advantage as it would be earlier in the year, but the probable clear skies and shorter twilight would be in its favour. Venus, Jupiter, and Saturn would be very favourably placed for observation. They might probably reckon on having sixty-four seconds of totality at Algiers. The *Nautical Almanac* data gave sixty-seven seconds; but from the experience of 1898 it would probably be less than this.

Mr. Maunder said that in 1895, when they were preparing to go to Norway, a number of papers were contributed to the *Journal* in the way of suggestions for observations that might be undertaken, and, thinking it would be found useful to follow a similar course in regard to the approaching eclipse, he had sought the co-operation of several of those who went to Norway in 1896 or India in 1898—viz., Miss Bacon, Mr. Johnson, Mr. Gare, and Dr. Downing. Proceeding to review the suggestions which had been made, Mr. Maunder said the observations of first importance which could be undertaken by those who had no large instruments at their disposal were first photographic, and next with the telescope. Photographs of the corona could be taken on a sufficiently satisfactory scale with fixed cameras, and therefore they need have neither equatorial nor driving clock. Instantaneous exposures might be given, and exposures up to one second, if they had the image of the corona on a scale of not more than half an inch to the sun's diameter, would be quite permissible, and would secure a very fairly dense image even to a considerable distance out. Then there were a large number of miscellaneous observations that a photographer could make. Miss Bacon, in 1898, in India, took a series of photographs of the landscape at regular intervals before the eclipse, and the result was to give a very striking picture of one way in which the illumination was diminished as the eclipse came on. It seemed to him that that experiment needed to be repeated, and with a very much larger number of photographs on the next occasion; and it would be as well if this were done at three or four stations, if so many were occupied. Then he would like to see repeated the experiment (for which Mr. Gare and Mr. Johnston prepared the plates, exposures being made by Mr. E. W. Johnson) on the brightness of the general corona; that was to say, a photographic plate was exposed for a graduated series of seconds or else under a sensitometer to the full light of the corona, not in the camera but simply by exposing the plate. In that way they might get a useful record of the total brightness of the corona from eclipse to eclipse, such as, before the Indian eclipse, had never been secured. Then with small telescopes a good deal of useful work could be done—telescopes with an aperture of from 2in. to 4in., and with an ordinary tripod stand. Perhaps the most important work that could be done with a telescope of that description would be the drawing of a small isolated portion of the corona. That had never yet been satisfactorily attempted; and certainly a good draughtsman, confining himself to a small portion of the corona, could add considerably to their knowledge of its structure. It was not the slightest use for a draughtsman to entertain the idea of sketching the whole corona. One small section alone, and that a typical one, would be of very great value. Probably the most important thing to do would be to pick out a bright prominence and sketch the corona in its immediate neighbourhood, because the particular region of the corona could be determined from the photographs. Next to that, one of the polar plumes would be a very good object for scrutiny. A telescope of the size he had mentioned would be very useful in order to give them the times of contact, and there were a number of small phenomena that it would be interesting for the observer to watch; for instance, the appearance of Baily's beads, the distance to which the moon's limb could be detected on the background of the corona, and away from the sun, and a number of similar small details. One very important point which the possessor of a small telescope could determine would be to forecast beforehand, within a few seconds, the actual beginning of totality. Having explained various ways in which this could be done, Mr. Maunder proceeded to say that shadow-bands had been observed for a great number of years; but more observations were needed, and these should be conducted at each of the stations. It was distinctly advisable that they should be observed both on the horizontal plane and in the vertical plane, and that the observation should be made in such a way that the exact direction of the motion of the shadow bands should be determined. Remarking that in shadow-band observations the direction of the wind was a very important point, Mr. Maunder said this would lead to the question of meteorological observation. In Norway their one successful observer was Mr. Mitchell, who took a number of meteorological observations, and he hoped that at each station next May one person would imitate Mr. Mitchell's example. Then, Mr. Crommelin had already pointed out how very favourable this eclipse would be for the observation of stars. The sun could not well be in a richer portion of the heavens, and those who had no instruments at all could well occupy themselves during totality in identifying as many stars as possible. They should study Mr. Crommelin's map well beforehand, so that they might know exactly where to look for stars and planets. The sun, of course, would be one point of reference. Venus would form another, for she would be visible no doubt before the beginning of the eclipse, and certainly very early in the partial phase she would be a brilliant, unmistakable object, so that they should be able very easily to get the bearing of the other stars with relation to those two points. Mercury would probably also be quite a conspicuous object. Usually only two or three stars were noticed during a total eclipse, but in the present case he expected they would have a great many more. Mr. Shackleton had suggested to him that there was one kind of photographic observation that it would be well for some photographer to undertake—viz., to photograph the corona with light as nearly as possible monochromatic, by the use of a special sensitive plate and a coloured screen. The active rays on the plate should be cut down as nearly as might be to the green given by the coronium gas. It would be a matter of very great interest if that could be done. It would be very much cheaper than to arrange for a heavy spectroscopic battery, and probably would give the distribution of coronium pretty nearly as effectively as would the spectroscope. The same could be done perhaps more easily for the line of hydrogen by selecting, partly with a coloured screen and partly with a special sensitive plate, just the region that corresponded to the blue line of hydrogen. During the eclipse of 1898 it occurred quite independently to two or three observers—Mr. Backhouse, a friend of his, and himself (the speaker)—in different places to try and compare the twilight illumination in the evening with the illumination during totality, and their attempts, made without the slightest knowledge of what the others were doing, gave an extremely gratifying concord. Of course, Spain not being in the Tropics, the twilight would not be so rapid as in India; but he thought this experiment was worth trying, and he would be glad if everybody who was fortunate enough to view the eclipse would remember this on the evening after the eclipse, and try and fix accurately the time when the illumination in the sky corresponded to the illumination during totality.

Mr. Seabroke desired to ask Mr. Maunder the proportion of focal length to the aperture of the camera lens to which he had referred when he said the exposure might approximately be taken at 1 sec. for the corona. It occurred to his mind while Mr. Maunder was speaking, that in 1870 Prof. Thorpe made some experiments on the change of general illumination; but in those days only sensitive paper was used—dry plates not then being known—and this was passed under circular apertures and exposed for a certain time.

Mr. Crommelin wished to ask Mr. Maunder how nearly he thought the screens to which he referred could be made to only transmit a light of one colour. He understood that the light of the corona was made up of two elements—one a continuous spectrum, and the other bright lines. Unless they could make their colour screen to transmit practically only one colour, the continuous part of the spectrum might get mixed up with the one colour they were trying to photograph, and might lead to confusion in the result.

The President said a good deal had been done in the way of getting monochromatic screens for microscopic work, and he thought some of the screens produced did admit light of a very limited range of wave-lengths, but, possibly, not confined to the part of the spectrum which Mr. Maunder desired to deal with.

Mr. W. H. Wesley said that he warmly endorsed Mr. Maunder's recommendation to those who drew to restrict themselves to small portions of the lower part of the corona. He had long urged upon those who proposed to make hand drawings; the uselessness of attempting to delineate the whole. The only further service that a draughtsman could render had been in drawing the extreme extensions of the corona, but since the remarkable photographs that Mrs. Maunder took during the eclipse of 1898, it seemed evident that photography would do that perfectly. Those who make hand drawings should therefore take some portion of the corona near the limb. We shall not advance in building up the corona from the projection of it seen during an eclipse without an exhaustive study of the lower coronal rays.

In reply to Mr. Holmes, who asked what would be the probable temperature at Algiers at the time of the eclipse, Mr. Crommelin said a guide-book he had consulted stated that the temperature varied very little throughout the year. It was 14° C. in January, and 24° in August, which was a range of 10° C. or 18° Fahr. during the whole year. The mean between January and August would be 19° C. or about 66° Fahr.

Mr. Downing: That does not represent the temperature at three o'clock in the afternoon.

Mr. Crommelin: No; that is the mean of the day. (Another guide-book gives 69° Fahr. as the mean temperature in May.)

The President, referring to what Mr. Maunder had stated as to the use of a screen, said that if he could determine a range of wave-lengths that he thought would be useful, and would give particulars of it at the next meeting, some of the members who had been paying particular attention to the construction of screens for monochromatic work would very possibly go into the matter, and probably they might be able to evolve a standard screen suitable for employment in the way Mr. Maunder had suggested. It would be very desirable not only that a screen of approximately the true colour should be used, but that all screens should be very closely alike. Mr. E. M. Nelson and Mr. Curties had made a great many experiments on the production of a standard screen for microscopic work, and probably they would aid in the matter if asked.

Mr. J. J. Vezey said that Mr. Giffard, of Chard, had devoted great attention to lens subjects, and had been very successful in producing screens for transmitting monochromatic light.

Mr. Maunder said, with regard to Mr. Seabroke's question as to the relation of aperture to focal length, he had in his mind such a ratio as 1 to 15 or 1 to 16. Of course, if the aperture were relatively greater to the focal length, the exposure might be shorter. With regard to the question of the screens, his notion was that one might work in two directions—one by limiting the sensitiveness of the plate, and the other by limiting the quality of light transmitted by the screen. He thought the combination would give them greater control of the exposure than the one alone would. Practically, the hydrogen line, in his opinion, would be far easier to compass than the coronium line. He ought to have mentioned amongst the eclipse suggestions the drawing of the corona with the naked eye, which was carried out so successfully in India in 1898; but he was more impressed to lay stress on the drawing of the corona at the telescope because it had been so entirely neglected on former occasions, and he would be glad to see it restored to a place in regular eclipse observations. With reference to the proposed expedition to view the eclipse, the committee had made a provisional arrangement with the Royal Mail Steamship Company for the conveyance of the party by one of their finest vessels, the *Tagus;* but at present the number of members who had actually engaged their berths and paid their deposits was only about half that required to make the expedition a success. He hoped, therefore, members who were thinking of doing so would send in their names and their deposits without further delay; otherwise, the proposed expedition would have to be abandoned. The Association, of course, could not enter upon a speculation in the matter, and as they were not providing for making any profit in the matter, they could not take any definite step until they were perfectly certain of such an amount of support as would insure the Association against the risk of loss. The Royal Mail Company had extended the time for signing the contract to Feb. 12. If by that date a sufficient number of passengers had actually engaged their berths, the steamer would be secured. If not, the idea of engaging a steamer must be entirely abandoned. He (the speaker) felt sure that if this was the case, a good number who were now holding back would, when they found how difficult it was to make satisfactory arrangements, regret exceedingly that they had let so good a chance fall through.

The President said it would be a very serious thing for the Association if the proposed expedition were to fall through, and he hoped members would do their best to get their friends to make up their minds immediately, and communicate with Mr. Maunder on the subject. The support the committee had received up to the present time was only about half large enough. The matter had been thrown back a good deal by the war in S. Africa, which had affected a great many people, and had been the means of crippling the Irish expedition, which was to have been organised on the same lines as that of this Association. The Royal Dublin Society, the Irish Academy, and two other societies had expected to send out an expedition of 140 members; but this number had dwindled down to six, who intended, under the circumstances, to take part in this Association's expedition. They had themselves been affected in the same way, and although things did not look very rosy at present, he hoped they might yet organise a successful expedition.

In a paper on "Where the Day Changes" Dr. Downing pointed out that when it was six o'clock of the afternoon of Wednesday in London, to the eastward-going traveller, upon reaching the 180° of longitude, it was six o'clock of the morning of Thursday; whilst to the westward-going traveller reaching that point it was, at the same time, six o'clock of the morning of Wednesday. To set things right, therefore, it was necessary, in the first case, for the traveller to call two successive days "Thursday," and in the second case, omitting the Thursday altogether, to pass from Wednesday to Friday. This was the practice observed in ocean-going ships, when crossing the 180° of longitude. Dr. Downing proceeded to deal with the question of where the day changes for the portion of continents and the islands contiguous to the 180° of longitude, or, in other words, the course of the date line, as it is called, from the Arctic to the Antarctic regions. With the aid of a map he dwelt upon the strange disagreement which exists at the present time in the position of the date line laid down by the different authorities, pointing out, however, that Wharton and Davidson only differed in one particular, affecting a small group of islands.

Dr. Downing added that a good deal had been heard recently about when the century began, and he had been amazed at the ignorance of history and arithmetic which had been displayed. It was declared by some that the century began on Jan. 1 last; but, as a matter of history, that is quite wrong. Proceeding to deal with the history of the subject, the speaker said that about the middle of the 6th century of our era—in 530 A.D.—the Roman abbot Dionysius looked into the question, as there was considerable confusion at the time, and the Christian community, which was then becoming large and powerful, wished to reckon time from the birth of Christ, and not from the foundation of the city of Rome, as was the practice in those days. Dionysius investigated the question as far as it was possible to do in those days, and he decided that A.D. 1, the first year of the Christian era, coincided with a certain year of the City of Rome, and, according to his calculations, our Lord was born on the 25th Dec., B.C. 1, but he did not wish to upset the Roman usage of beginning the year on Jan. 1, so that it was settled then, and the practice had continued ever since, of calling the first year of our era A.D. 1 and beginning the year on Jan. 1. It was a mere matter of arithmetic to conclude from that that the 20th century must begin on 1901, Jan. 1. The little map, therefore, which he had prepared would show where the day began, and the historical sketch he had given would, he hoped, show when the century began.

Mr. Crommelin remarked that Dr. Downing's very interesting paper cleared up in a most lucid manner a question one was often asked. It had hitherto been difficult to give a very definite answer to the question; but they could now simply point out the exact place where the day began. It was rather a curious anomaly that for twenty-four hours a portion of the earth would be in one century and another portion in another. He might even go so far as to say for thirty-six hours, for there were two different methods of reckoning the beginning of the day, the civil day commencing at midnight and the astronomical day at noon, so that at Greenwich they were accustomed to using the date of the old year until noon on January 1st. There would thus be twelve hours when for one purpose one would be in the 19th century and for another in the 20th century; and if they extended that right round the world and added the twelve hours to the twenty-four hours' rotation, it would make thirty-six hours of ambiguity.

Mr. Kennedy asked whether it was not perfectly true that the birth of Christ was three years B.C.? If so, that rather added to the difficulty. They had also to take into consideration the Old Style, in which there was a difference of thirteen days as compared to present-day reckoning; so that, quite apart from the three years, the 19th century would go on for another thirteen days if they took the Old Style into account.

A Member remarked that in the East they did not hold to Dec. 25 as the date of Christ's birth. He had been told by missionaries that it was reckoned to be somewhere near March.

Dr. Downing agreed with Mr. Kennedy that it was quite probable the reckoning of Dionysius was three, or even five, years wrong; it depends on the identification of the Governor of Syria, mentioned by St. Luke; but that, he submitted, did not affect the question at all. The first year of our era was called A.D. 1, and we still called that year A.D. 1, and counted on from it. Neither did it matter, in this connection, whether Our Lord was born on Dec. 25 or not. He (the speaker) did not hold to that himself—but it did not affect the question at all. The point was that Dionysius decided that the birth of Christ took place on Dec. 25, B.C. 1, and therefore the Christian era was to commence from the following Jan. 1.

Mr. Goodacre read a paper by Mr. C. F. Smith on "The Palus Nebularum Region of the Moon," in which, in the light of recent views regarding the origin of lunar surface features, he explained some of the formations of the Palus Nebularum, dealing also with many similar regions in different portions of the surface. The paper was accompanied by an illustration of the region taken from an oil painting in monochrome, copied from pastel drawings made during the spring of last year. Dealing with the question of the probable history of the region, judging from its various features, the author said:—"In the first place, this part of the moon's surface was at one time completely covered with mountains and crater-formations, the latter of a size not less than Theætetus. In course of time, a large area became depressed (probably through contraction of the cooling interior), and liquid material welled up through cracks and rents in the surface. This gradually spread, covering many formations entirely, almost wrecking Cassini, and reaching the northern and western walls of Archimedes in a viscid state, but ceasing to rise before breaking down the massive ramparts of that crater. Although upheavals and elevations on the most gigantic scale were now at an end, internal activity continued to manifest itself in the formations of the craters Theætetus, Kirch, Piazzi Smyth, and the numerous smaller openings freckling the surface of the *mare*. The interiors of Autolycus and Aristillus filled with liquid which flowed through the cracks and gorges in their walls, and spread in radiating streams far over the surrounding plain, while, again, the form taken by the escaping fluid was that of an 'exudation cone,' which gradually and quickly built itself up. To put in concise form the fourth order of formation, we have:—(1) The Caucasus and Alps. (2) The craters Archimedes, Autolycus, Aristillus, Cassini, and others now buried. (3) The dark plain of the Palus. (4) The craters Theætetus, Kirch, and Piazzi Smyth. (5) The mountain mass Piton. (6) The minute craters on the surface of the *mare* and elsewhere. The most doubtful date is that of Piton, which may possibly be a protruding peak from an early mountain range; but, on the whole, it is more probable that it was formed after the sea."

Mr. Goodacre said that in the main he was rather inclined to agree with what Mr. Smith said as to the chronology of the various formations. He had some doubt, however, as to whether Mr. Smith's theory to account for the radiating ridges was one which could be altogether accepted. It appeared to him that they were not ridges of lava which had overflowed from the rim of the crater, for, as far as his own observation went, there was no appearance of cracks or gullies in the walls which would form apertures through which the lava would flow. This was a phenomenon which was accounted for by the sudden upheaval of the mountain ring itself.

Two slides were then thrown on the sheet which had been prepared from instantaneous photographs of a boiling mud crater in the N. Island of New Zealand, within twenty miles of the well-known volcano whose eruption some time ago destroyed the beautiful terraces of pink and white. As Mr. Goodacre remarked, these slides showed details very similar in appearance to what was seen on the moon, and the study of such terrestrial features might throw a considerable amount of light on the way in which the lunar craters had been formed.

Mr. Hardy said some lunar formations were described as being 7,000ft. high, and other parts of moon's surface 10,000ft. deep; but, in the absence of anything similar to ordnance data, no one knew what the depth and height were from the mean level of the moon. If such ordnance data were taken—and it did not appear to be impossible—they would be able to speak of the heights of the mountains above that surface and the depths of the hollows below it.

Mr. Crommelin said there would be great difficulty in ascertaining the difference of level between two distant plains on the moon. There was on the moon no liquid surface to give a uniform standard of measurement as we had on the earth. They could only measure heights by the shadows, and where the surface had so slight a slope as to throw no shadow he did not see how they were to get the relative heights of two flat regions some distance from each other. The only way in which to do this would be to take advantage of the libration of the moon and take two photographs at extreme libration, and compare the forms in one and two. Some result might be obtained by that means; but it would be a laborious and difficult task.

Mr. S. A. Saunder said that our knowledge of lunar altitudes was very insufficient—we did not know the heights of the mountains within 20 or 30 per cent. If anyone would open Schmidt's book at random, and take any mountain he had measured ten or a dozen times, it might be found that its greatest height was double its smallest—it would very frequently be 50 per cent. greater, so that there was little or no possibility of their getting any accurate measures of levels as yet, and he thought it would be exceedingly difficult to compare the level of one plane with the level of a distant plane. Dr. Weinek, a short time ago, published a pamphlet in which he described how he found the height of Pico by measurements made on photographs, deducing the sun's altitude from Mädler's position of Pico by computation. He measured it on three or four photographs, and obtained very consistent results, very much more consistent than those obtained by Schmidt. As the position of the mountains of the moon became known more accurately, so that the altitude of the sun could be computed, they would have a very good chance of arriving at the height of the mountains. He doubted whether Mr. Smith was accurate in saying that MM. Lœwy and Puiseux placed the date of the formation of such craters as Autolycus and Aristillus previous to the

formation of the seas. His own idea was that they placed the date later. MM. Loewy and Puiseux divided the history of the formation of the lunar surface into five periods, and he was almost certain that Copernicus, which was a mountain much like Aristillus, was placed in the last period as having been formed after the plain. They said some of the ringed mountains were formed in an early period, and some after the large plains, and that the formations in the latter period could be distinguished by the regularity of the formation of the wall, by their isolated situation.

The meeting adjourned at 7 p.m.

ROYAL MICROSCOPICAL SOCIETY.

AT the annual meeting, Mr. E. M. Nelson, the President, in the chair, the President said it was with very great regret that he had to announce the death of the Treasurer, Mr. W. T. Suffolk. He was an old member of the Society, having joined it in 1863. In addition to acting as Treasurer for some years, he had examined and catalogued the slides, about 7,700 in number, in the Society's cabinet, and had remounted a great number of them which had been found to be leaking, or otherwise imperfect. A resolution expressing the great sympathy of the Council with Miss Suffolk, and also acknowledging her gift of her uncle's cabinet of slides, was read to the meeting, and at the request of the President the Fellows present endorsed the action of the Council by show of hands. After the report of the Council for the past year and the statement of accounts had been read and adopted, the President announced that the following had been elected as officers and Council for the ensuing year:—President: Wm. Carruthers; Vice-Presidents: A. W. Bennett, G. C. Karop, A. D. Michael, E. M. Nelson; Treasurer: J. J. Vezey; Secretaries: Rev. Dr. W. H. Dallinger, Dr. R. G. Hebb; Ordinary Members of Council: J. M. Allen, Conrad Beck, Dr. R. Braithwaite, E. T. Browne, Rev. E. Carr, E. Dadswell, Sir Ford North, H. G. Plimmer, T. H. Powell, C. F. Rousselet, Dr. J. Tatham, G. Western; Curator: C. F. Rousselet. The President then delivered the annual address on the work done during the past year in connection with the Society, including the standardisation of the substage and eyepieces, and concluded by reading a paper, which was a continuation of the optical subjects dealt with in his previous addresses, and had special reference to the aplanatic oil-immersion front and the construction of the Huyghenian eyepiece. Mr. Michael proposed a vote of thanks to the President, not only for the address which they had just heard, but also for his eminent services to the Society during the time he had occupied the chair. In this period he had given a series of addresses which will form an admirable record of the practical application of the principles upon which the optical part of the microscope was constructed. Dr. Braithwaite having seconded the vote of thanks to the President, it was put to the meeting and carried unanimously. The President then introduced his successor, Mr. Wm. Carruthers, who, having taken the chair, made a short address to the meeting. Mr. Rousselet exhibited a mounted specimen of *Stephanoceros Eichhorni*, a rotifer which is very difficult to kill with its cilia fully extended; but, after many trials, Mr. Rousselet has succeeded in overcoming the difficulty, and the specimen exhibited presented a very life-like appearance.

LOCKWOOD'S BUILDER'S, ARCHITECT'S, CONTRACTOR'S, AND ENGINEER'S PRICE BOOK for 1900, edited by Francis T. W. Miller (London: Crosby Lockwood and Son), is the new edition of a well-known annual which all interested must have this year, as prices fluctuated considerably during the last.

FOURTEEN ten-wheel two-cylinder compound locomotives have been built at the Schenectady Locomotive Works, for freight service on the Northern Pacific Railway. These engines weigh 78½ tons, of which 60 tons are carried by the six-coupled drivers. The heating-surface is 3,012·7sq.ft., and the grate area 34·22sq.ft. The boiler is of the extended waggon-top type, the first ring being 70in. in diameter. The driving-wheels are 63in. in diameter, and the cylinders 22in. and 34in. by 30in. The high-pressure cylinders have piston-valves.

Lightning and Trees.—As a result of observations carried out by the German Government on lightning and its effects on trees, it has been found that the oak tree is by far the most susceptible to the attacks of lightning. The observations were made by the overseers of nine foresting stations scattered throughout an area of 45,000 acres in the dukedom of Lippe. The percentages of the various species of trees in the forest are as follows:—Beech, 70 per cent; oak, 11; pines, 13; and firs, 6. During a period of several years 275 trees were struck, of which 159, or 58 per cent., were oaks; 59, or 21 per cent., firs; 21, or 8 per cent., beeches; and only 20, or 7 per cent., pines; the amount of damage sustained by other species being still smaller.

SCIENTIFIC NEWS.

AT the annual general meeting of the Mathematical Association it was announced that the Mathematical *Gazette* will in future be issued six times a year instead of three. As the aim of the Association is to supply a serial of direct and special interest to teachers of mathematics, it is intended that amongst the special features of the *Gazette* there shall be articles suggestive of improvements in methods of teaching, or covering ground not satisfactorily treated in textbooks, with reviews of books of the first importance, or giving an elementary presentation of the history and treatment of their subject.

With the beginning of March a new almanac complication will arise in Russia, says the Odessa correspondent of the *Standard*:—Owing to the fact that this year is bissextile with the Russians, Greeks, and Balkan Slavs, who still retain the Old Style chronology, there will ensue a difference of thirteen, instead of twelve, days between the Julian and Gregorian Calendars. Feb. 1, Old Style, becomes the 14th, New Style, instead of the 1st—13th, as heretofore. After all the talk of the last twelve months, there is no immediate prospect of a rectification of the calendar being made in Russia. The Church is bitterly opposed to the suggested reform; and the various learned societies which have latterly discussed the question are utterly divided in their views and opinions. Personally, the Emperor Nicholas is known to favour the long-mooted project for adopting the Gregorian reckoning. The necessity of a calendarial assimilation with Western Europe becomes every year more pressingly felt with Russia's rapidly-increasing commercial and industrial development, and her enlarged and enlarging intercourse with Western nations.

According to the official reports the fall of snow on Friday-Saturday last seems to have been one of the heaviest—at any rate in recent years. In many parts of London it melted rather quickly, but at the reporting-station of the Meteorological Office at Brixton the total fall when melted gave ·74in., equal to a fall of snow of between 6in. and 7in. At Westminster the melted snow yielded ·63in., but in parts there were drifts, and the hands of the clock at the Houses of Parliament (sometimes called Big Ben) were stopped just before 2 a.m. on Saturday—those on the face most fully exposed to the force of the blast being clogged with snow.

According to the Berlin correspondent of the *Standard*, Prof. Assmann states that the Royal Prussian Meteorological Institute in Berlin is about to make arrangements for the systematic examination of the higher strata of the atmosphere by means of special apparatus. The registering apparatus, which automatically notes the pressure, temperature, humidity, and wind velocity, is taken up by a kite-balloon connected with the earth by piano wire. It is inflated with hydrogen, and can take fifteen hundred mètres of wire. The control of the kites is effected by means of electrically-driven windlasses.

The addition to the Engineering School of Cambridge University, erected in memory of the late Dr. John Hopkinson, was formally opened on Friday last. Dr. John Hopkinson was Senior Wrangler in 1871, and took great interest in the Engineering School, and a few days before the fatal accident had expressed an intention of making a movement to secure funds for an enlargement. This has been accomplished now by the generosity of his widow, son, and daughter. The memorial is most appropriate, and engineers and others have responded handsomely in fitting up the laboratory and in providing apparatus. After the Vice-Chancellor had formally opened the building, Lord Kelvin (Master of Trinity) delivered an inaugural address, in which he said that John Hopkinson showed to quite an exceptional degree the rare power of grasping a high scientific truth, and applying it practically to mechanical art for the use of mankind. This was splendidly illustrated in the work which he did in improving the dynamo-electric machines, upon which we depended so much for light and power. Then there was his great discovery of a certain alloy of nickel and steel. Hopkinson's group-flashing light, a splendid application of scientific optics, was now in use in lighthouses and lightships all over the world. Everything that was for the good of clients, of engineers, and of the engineering profession itself Hopkinson had at heart.

M. Daniel Osiris offered the Institute of France a sufficient sum of money to found a triennial prize of a hundred thousand francs (£4,000) for the most remarkable discovery or work in science, art, or letters. It is announced that the Institute has accepted the gift on the conditions laid down by the donor.

University College, Liverpool, is to have a completely-furnished botanical institute, the gift of Mr. W. P. Hartley. The building, which will be erected close to the new chemical laboratories, will contain museum, lecture theatre, laboratories, library, herbarium, and private rooms, is expected to be opened early in 1901.

At the meeting of the Royal Society at Burlington House, last week, a paper was read describing some of the results of a remarkable investigation which has been undertaken by Prof. Dewar, Sir James Crichton-Browne, and Prof. Macfadyen, who have submitted a large number of disease-causing microbes for prolonged periods to the temperature of liquid air, which is $-190°$ C., and have found that they are not a bit the worse. After twenty hours of this frigid environment the bacteria proved as lively as ever. Doubt is thus thrown on the popular belief that a sharp frost can cut short epidemic disease, for frost is genial warmth when compared with the terrible chills administered in the laboratories of the Royal Institution. The photogenic or light-giving bacteria went out when immersed in liquid air, but resumed their luminosity when thawed and warmed up again. The microbes are to have a dose of liquid hydrogen shortly, and if they stand that they can stand anything.

At the meeting of the Royal Geographical Society on Monday, Dr. H. R. Mill read a paper on "The Geography of South-west Sussex," a specimen of the scheme he suggested in 1896 for drawing up a geographical description of the British Islands based on the maps of the Ordnance Survey. The idea is to compile a handbook calling attention to the main features of the land surface, and then to add a description of the climate, the agriculture, the trade, and the movements and distribution of population from the different official returns. The paper dealt with the Rother Valley and the Chalk Downs, and is a specimen of what might be done for every district in the kingdom. Dr. Mill finds that the coastal plain has an average density of population close on 400 per square mile, or one-third more than the average for England. On less fertile soils of the Rother Valley the density of population was only 200 per square mile, and on the Chalk Downs above 300ft. only 14 per square mile, the contrast between the three regions being even greater in population than in agriculture. Farming was the staple industry. There was no mineral wealth except chalk, flints, brick-earth, and here and there sandstone. Taken altogether, the district was a typical sample of rural England, untouched by manufacturers or trade, practically stationary in population except for the yearly increasing influx of summer visitors, and the seat of a remarkable number of parks and historic houses.

The following officers have been elected for the Association of Technical Institutions:—President, Sir Swire Smith. Vice-presidents: Lord Spencer, Sir Bernard Samuelson, Bart., Mr. H. Hobhouse, M.P., and Mr. W. Mather. Treasurer, Mr. R. F. Martineau (Birmingham). Hon. sec., Prof. J. Wertheimer, B.Sc., B.A. (Bristol).

At the meeting of the Society of Arts, on Wednesday, Feb. 14, Prof. R. W. Wood is to read a paper on "The Diffraction Process in Colour Photography." Sir W. de W. Abney, K.C.B., F.R.S., will preside.

A memoir has been recently presented to the Paris Academy of Sciences by M. Frillat, which is of interest to students of the science of photography. It refers to the transformation of the photographic image of a negative into the lamellar state by exposing it to the vapours of nitric acid, which dissolve the precipitated silver, and cause the disappearance of the image. The silver is reprecipitated by exposing the plate in an atmosphere of moist sulphuretted hydrogen, when the image reappears in colours—not necessarily the true colours of the objects, although, it seems, there is some possibility of exercising a little control.

Sir Thomas Grainger Stewart, Professor of the

Practice of Physics and Clinical Medicine in Edinburgh University for nearly a quarter of a century, and an ex-president of the Royal College of Physicians, Edinburgh, died on Saturday in Edinburgh, at the age of sixty-two. He was educated at the High School and University of Edinburgh, graduating M.D. in 1858, and subsequently pursued his studies at the medical schools and hospitals connected with the universities of Berlin, Prague, and Vienna. After his return to his native city, he was elected a Fellow of the Royal College of Physicians there, and appointed Resident in the University Wards of the Royal Infirmary. This position gave him opportunities for the study of the special forms of disease to which he particularly devoted himself, those connected with the kidneys, and led to his appointment as Pathologist to the Royal Infirmary and Lecturer on General Pathology at Surgeons' Hall. After filling with great success these offices for between six and seven years, he was, in 1869, elected Junior Ordinary Physician to the Royal Infirmary and Lecturer in Clinical Medicine. He held these posts until 1876, being also, from 1873 to 1876, extra-mural Lecturer on the Practice of Physics, and Lecturer on the Practice of Medicine. In the last-mentioned year, on the death of Dr. Thomas Laycock, he was elected to the Chair of Medicine in the University of Edinburgh, which he most efficiently filled. Sir Grainger Stewart was the recipient of many honours, and was a member of many learned societies in Europe and America. He was the author of several valuable treatises on medical subjects.

The well-known orthopædic surgeon, Mr. William Adams, died on Saturday last, aged 80. He was admitted a member of the Royal College of Surgeons, England, in 1842, and elected a Fellow in 1851. He was Lecturer in Surgery at the Grosvenor-place School of Anatomy and Medicine, Demonstrator of Morbid Anatomy and Conservator of the Museum, St. Thomas's Hospital, Surgeon to the Great Northern Central Hospital, the National Hospital for Paralysis and Epilepsy, and National Orthopædic Hospital, and afterwards Consulting Surgeon. He also filled the offices of President of the Medical Society of London and of the Harveian Society, and Vice-President of the Pathological Society. Mr. Adams was the author of many valuable works.

The death is announced of the distinguished Russian geographer General Alexis de Zillo, for more than twenty years an active member of the Russian Imperial Geographical Society, and a correspondent of the Paris Academy of Sciences. In a recent number of the *Izvestia* of the Russian Geographical Society there is an interesting article by the deceased general, in which he deals with the meteorological observations made in the Lukchun depression of Central Asia, which is believed to be quite 17 mètres below sea-level. The yearly amplitudes of the barometer are greater there than anywhere else on the earth.

The secretary of the Trinity House has, by the desire of the Elder Brethren, replied to some statements which have been made as to the supposed slowness with which the Trinity House moved in the matter of wireless telegraphy. The experiment, he says, at the South Foreland commenced at Christmas 1898. The Board afforded the necessary accommodation to the Wireless Telegraph Company free of charge, and aided and encouraged them in every way, being from the outset favourably impressed by the advantages of the system. The Elder Brethren have, however, good ground for stating that the alleged facts as to the saving of property of the value of £52,000 by means of this particular connection are incorrect; and, while they are of opinion that electrical communication with light-vessels might, in certain circumstances, be the means of saving both life and property, they do not consider that any property which would otherwise have been lost has been so far saved through the agency of electrical communication of any description with light-vessels on the coast of England. It is further pointed out that the expense of the permanent adoption of the system would be considerable, and that is not altogether within the control of the Board as the general lighthouse authority.

The Right Hon. W. H. Long, M.P., President of the Board of Agriculture, has appointed a departmental committee to inquire and report as to what regulations, if any, may with advantage be made by the Board of Agriculture under section 4 of the Sale of Food and Drugs Act, 1899, for determining what deficiency in any of the normal constituents of genuine milk or cream, or what addition of extraneous matter or proportion of water, in any sample of milk (including condensed milk) or cream shall, for the purposes of the Sale of Food and Drugs Acts, 1875 to 1899, raise a presumption, until the contrary is proved, that the milk or cream is not genuine. The difficulty of dealing with the above-mentioned branch of the subject of adulteration is well known, and inspectors find it almost impossible in some places to obtain samples of new milk. They are generally told that it is separated milk, or is not sold as pure milk.

A distinguished and influential deputation waited on the Duke of Devonshire and Mr. Ritchie on Monday, to urge the desirability of retaining the Frank Buckland Museum at South Kensington, to be placed under the Board of Trade, so as to add to its usefulness in helping fish culture in the United Kingdom. The Duke of Devonshire made a long and sympathetic reply, but concluded that although it was possible to give a home to this Museum in the new buildings to be erected at South Kensington, he doubted much whether that was a place where they could be shown to the very best advantage. Mr. Ritchie said he agreed that this question was of the greatest importance to the whole community. The Board of Trade was responsible for everything connected with the fishing industry; and if, after inquiry, the work should be intrusted to them they would be very glad to undertake it, and they would do all in their power to further the views of the Deputation. It was quite clear that the Museum at present was comparatively worthless for the purpose for which it ought to exist, and it would be better to abolish it altogether than not to do something to improve it. He hoped that their inquiries would lead to results which would be satisfactory to the Deputation.

It is stated that the whole coast of New South Wales is suitable for the cultivation of the oyster, and it is suggested that a method might be devised of bringing over the oysters (minus the shells), preserved in hermetically sealed vessels. Most people—amongst epicures, at least—prefer oysters freshly opened, and it is doubtful whether it would pay to bring them over in the shell.

Very little has been heard of late years in connection with the Colorado Beetle, which at one time created some alarm in this country when a few specimens were found in cargo arriving from America. It appears from an announcement made by Mr. C. E. Mead in a recent number of the *American Naturalist* that in New Mexico a beetle of the genus Collops has been observed feeding on the larva of the Colorado Beetle. It is known that the crops of potatoes in the district are not much affected by the Colorado Beetle, and if the observation is proved steps will no doubt be taken to transport specimens of Collops to other districts.

The new East River bridge connecting Manhattan Island and Long Island is a short distance above the Brooklyn bridge, and will be the longest, and considerably the largest, suspension bridge. Although it will be only a few feet longer than the Brooklyn bridge, the main span being 1,600ft., the roadway will have a full width of 118ft., accommodating two sets of rails for steam locomotives, four trolley tracks, two roadways, and two sidewalks for pedestrians. The cables will be four in number, each consisting of 37 strands of No. 8 steel wire, each containing 281 wires. A cable will thus have 10,397 wires, the interstices between them being filled with an anti-oxidation preparation.

The owners of autocars, automobiles, and other vehicles using the light hydrocarbons for the explosive medium in their engines, are threatened with a serious difficulty, as it is stated that the railway companies are refusing to convey "petrol" except at the sender's or receiver's risk, which means that the consignor or consignee will have to be responsible for any damage done, no matter how it occurs. There is here an opportunity for an inventor to devise some vessel in which petrol, gasoline, &c., can be carried with the least risk.

Amongst improvements in military rifles, it may be noted that a new Mauser was patented last year in which the loading is entirely automatic. With the ordinary magazine rifle, after every shot the firer has to open and close the breech, during which operation the spent case is ejected and a fresh cartridge transferred from the magazine to the powder chamber. With the new Mauser, all the marksman has to do is to keep his magazine charged. After firing, the breech is automatically opened, the spent case ejected, a fresh cartridge inserted, the striker cocked, and the breech closed ready for firing, these operations requiring only the fraction of a second.

A patent has been recently completed for what is believed to be an important series of alloys containing vanadium. The patent No. is 1694, 1899, H. H. Grenfell. Iron, steel, copper, and other metals are alloyed with vanadium and sodium, the latter being used probably for its purifying effect. According to the invention, both sodium and vanadium are added to the molten metal, either simultaneously or separately, in the metallic state, or as salts; or ferro-sodium and ferro-vanadium, or an alloy of these may be employed. It is stated that the process is adapted to be worked on a large scale, and that, in consequence of the purifying properties of the sodium, it is not necessary that the iron should be in a very pure condition before the vanadium is added.

It is stated that the "Prizes of Honour" which the commissioners of the Swedish Nobel "Million Fund" have at their disposal are to be allotted for the first time this year. The late Herr Nobel desired that the prizes should be given for some work of eminent social or scientific importance produced "during the past year." But, with the approval of Nobel's heirs, a slight change has been made in the limit of time, and the prizes are to be allotted to works of "the last few years." Five of the persons who are to receive the first prizes have already been named: (1) for eminent scientific discoverers, Prof. Röntgen, Sig. Marconi, and Prof. Nordenskjöld; (2) for eminent social work, Henri Durrant, the founder of "The Red Cross," and Frederick Bajer, of "The League of Peace."

USEFUL AND SCIENTIFIC NOTES.

The Practical Electrician's Pocketbook for 1900, edited by H. T. Crewe, M.I.Mech.E. (London: S. Rentell and Co., Limited), is a very useful work for all who have anything to do with electrical machines, and the power employed to drive them.

The following figures represent the amount of water supplied per head per day by the various metropolitan water companies during October last:—Chelsea, 44·74; East London, 29·98; Grand Junction, 47·08; Kent, 30·51; Lambeth, 35·43; New River, 30·88; Southwark and Vauxhall, 37·88; and West Middlesex, 33·41. The average daily supply of water delivered to the metropolis from the Thames during October was 124,622,505gal.; from the Lea, 35,439,164gal.; from springs and wells, 45,333,485gal.; from ponds at Hampstead and Highgate, 635gal. The daily total was, therefore, 205,395,839gal., for a population estimated at 6,003,271, representing a daily consumption per head of 34·21gal.

Power for a Great Exhibition.—No less than 20,000H.P. of machinery will be required for the Paris Exhibition. As it is intended that process of manufacture shall be displayed side by side with exhibits of raw material, much machinery will be distributed throughout the Champ de Mars, and the transmission of energy will be electrical. About 5,000H.P. will (says *Engineering*) be needed for this purpose, besides 15,000H.P. for lighting, making a total of 20,000H.P. The steam-producing plant will be collected in two buildings placed parallel to the old Machinery Hall. Of course, in each case the generators supplying steam will constitute exhibits, and payment will be made for the steam supplied, with an allowance towards the cost of installation. The coal supply will be taken through underground passage.

An artificial stone made in Belgium has been tested in the Malines Arsenal. It is said to have four times the resistive force of French freestone, is insensible to the action of cold, absorbs only 6 to 7 per cent. of water, even after a long dry spell, and cannot be crushed under a pressure of 40 kilos. to the square centimètre. This artificial stone is manufactured in the following manner:—Eighty parts of extremely clean and dry coarse sand are mixed with 20 parts of hydraulic lime reduced to a fine dry dust; this mixture is put into an iron box, which is plunged into a boiler of water, and this is hermetically closed. During 72 hours the cooking goes on under a pressure of six atmospheres, the temperature being maintained at 165°. At the end of this time the iron box contains a perfect homogeneous mass of stone, which rapidly hardens upon exposure to the air.

LETTERS TO THE EDITOR

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, *332, Strand, W.C.*

*** *In order to facilitate reference, Correspondents, when speaking of any letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks; a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE PHYSICAL CONDITION OF MARS—SIRIUS IGNORANCE—THE REPORT OF THE DIRECTOR OF THE YERKES OBSERVATORY—PATH OF THE MOON AS REFERRED TO THE SUN—ANIMUM MUTAT—THE TOTAL ECLIPSE OF THE SUN OF MAY 28, 1900—SHORTEST DAY IN TRINIDAD—ROTUNDITY OF THE EARTH—FINLAY'S COMET; AND THE SOLAR MOTION IN SPACE — POSITION ANGLE OF EQUAL DOUBLE STARS—PRONUNCIATION OF ASTRONOMICAL TERMS — LIQUEFACTION OF AIR — THE ASTRONOMICAL SOCIETY OF WALES — DR. ISAAC ROBERTS'S PHOTOGRAPHS OF STARS, STAR CLUSTERS, AND NEBULÆ — THE CIVIL AND ASTRONOMICAL DAY — APERTURE AND FOCAL LENGTH—LADY FLOATING IN SPACE — HAIDINGER'S BRUSHES—SPANISH STATION FOR VIEWING THE ECLIPSE OF MAY 28.

[43280.]—READING the report of a lecture in Belfast by that very eminent astronomer Sir Robert Ball, last month, I am a little surprised to find him lending the weight of his great authority to Mr. Lowell's craze concerning the artificial nature of the markings seen, or alleged to have been seen, upon the surface of Mars; and looking, at least, not unfavourably upon the hypothesis that the so-called "canals" are the stupendous work of intelligent beings, presumably akin to the human race. Now I venture to say that we have no right to assert, nor any tangible ground for asserting, that life on Mars in any way resembles that upon our own world. *Imprimis*, the mass of Mars can only be something like 0·1073 that of the earth, and the force of gravity must, *ex necessitate*, be to that extent reduced there. One result of this would be, as pointed out by Dr. Johnstone Stoney, F.R.S., in his excellent monograph published three years ago in the *Scientific Transactions* of the Royal Dublin Society, not only that an atmosphere whose constituent elements are as light as those composing our own could not be retained by the planet, but that, in Dr. Stoney's own words: "*it is legitimate to infer that water in which* $\rho = 9$, *cannot remain on Mars*"; ρ being the density of a gas as compared with hydrogen. Under these circumstances he expresses his belief that the atmosphere of Mars must consist mainly of nitrogen, argon, and carbon dioxide, and that the latter gas, from its great density, must always remain close to the surface of Mars: "descending into valleys, occupying plains, and pushing its way under the nitrogen, &c." In short, what we describe as the Polar snows of Mars, he regards simply as frozen carbonic acid. If all this be true—and if we admit the kinetic theory of gas, it seems impossible to doubt its validity—what sort of creatures must the "canal" builders be, and whence can they derive the water to fill their "canals" with? This then, I take it, is a case in which suspension of judgment is eminently necessary; and in the light of our existing information (or want of it) to talk of sentient beings constructing canals on Mars is perfectly unwarrantable.

In a familiar passage Carlyle laments that he was not taught the names of the stars in his youth. From the narration of a fact contained in a letter from Ladysmith, which appeared in the *Standard* of the 24th of January, it would seem that the lament of the Chelsea Sage might well be re-echoed by many of the inhabitants of the beleaguered town, for he tells us that: "Night after night, groups of excited civilians watched the Dog Star rise over black Bulwana, and hurried into the streets, declaring that the enemy was signalling to some traitor in the town"! . . . That Sirius should be mistaken for a Boer signalling balloon certainly does show a very painful want of acquaintance on the part of the beseiged population with the very rudiments of a knowledge of the stars. Let us hope that as soon as the Boer republics are incorporated in Her Majesty's dominions, a branch of the British Astronomical Association will be established in Natal to begin with.

The first Annual Report of the Director of the Yerkes Observatory, albeit it does not extend beyond September 30, 1898, has only just reached this country; and very interesting reading it is, containing, as it does, a record of the amount of excellent original work which has been the outcome of the more than princely munificence of Mr. Yerkes, Miss Catherine Bruce, and others. Of course, *the* instrument of this observatory is the mighty 40in. refractor of which so much was expected, and which seems by no means to have belied that expectation. As many who will read these lines will be aware, the dome covering this leviathan instrument is 90ft. in diameter. On two nights in every week Prof. Burnham has devoted his entire time to the measurement of double-stars with this telescope, picking up a few fresh ones in the course of his work. Prof. Barnard has also measured certain double-stars for various purposes. Among others whose distance apart was determined appears κ Pegasi, and this was effected with a power of 3,750, when its components were only 0·1" apart. Mr. Barnard has no difficulty in verifying, with this instrument, the variability of Prof. Pickering's stars in the well-known cluster 5 M. Libræ. He has also fixed the position of 95 stars in this cluster, and of 27 in the even more splendid one, 13 M. Herculis. Furthermore, he has measured the diameters of Mercury and Venus with the giant achromatic, but has utterly failed to perceive the linear markings on those planets which have been imagined by certain other observers. Dickens, in his "Christmas Carol," speaks of poor Bob Cratchit trying to warm himself at the candle, going on to add, though: "in which effort, not being a man of strong imagination, he failed." I rather fear that some of the gentlemen at Flagstaff, Lussinpiccolo, and cognate localities, will be tempted to include Prof. Barnard in the same category as old Scrooge's clerk. Prof. Barnard further used the 40in. telescope to observe Jupiter's Vth Satellite, the Satellite of Neptune, and the position of the now famous planetoid Eros, to say nothing of employing it, and the 12in. one, in numerous observations of the markings on Jupiter and Saturn, measures of the dimensions and position of nebulæ, and the positions of comets. The same indefatigable observer has also obtained a large number of photographs of stars and nebulæ with portrait lenses of various sizes attached to equatorial mountings. By the aid of the great equatoreal, again, and a large solar spectroscope, the Director, Prof. Hale, has succeeded in observing a large number of new bright lines in the spectrum of the solar chromosphere. The green and yellow flutings of carbon were identified, as was the yellow one later on. As the layer of carbon (or hydrocarbon) to which these lines are due is probably less than 1" in thickness, and is in immediate contact with the chromosphere, it is scarcely likely that any instrument materially smaller than the great Yerkes refractor could possibly show these lines. Prof. Hale has further detected bright lines in the spectra of stars of Secchi's fourth type, and has devised a new and larger spectrograph. A very interesting series of experiments has been carried on by Dr. E. F. Nichols, who has been studying stellar-heat radiation, by the aid of a 24in. silvered mirror, into which the rays from Arcturus and Vega were reflected from a large heliostat, and were converged on to the small mica vanes of an exceedingly delicate radiometer. So sensitive was this radiometer, that a deflection of 0·004in. corresponded to the heat that would be received from a candle 15 miles away! were there no loss by reflection or from atmospheric absorption. The mean deflection obtained from 106 measures made on seven nights of the heat radiation from Arcturus gave a deflection of 0·0236in., and from Vega of 0·0106. Hence we apparently receive the same amount of heat from Arcturus as we should from a candle six miles off. I think that I have said enough to indicate something of the very valuable work that is being done at Williams Bay; but I may just add that to the equipment of the observatory there is added an instrument shop capable of turning out the most refined optical and physical apparatus, and an optical laboratory in which, at the date of the Report, a 5ft. glass mirror was being ground. Verily the University of Chicago may be proud of its superb observatory, and no less of those who direct and work in it.

In connection with letters 43248 and 43249, on p. 536, I may say that I myself gave a diagram of the concavity of the Moon's path to the Sun (in letter 39472) on p. 500 of your LXIVth Volume, and unless my memory is curiously at fault, had done so in a much earlier one.

I do not quite understand whether Dr. Godfrey (letter 43251, p. 538) contends that no one, to be consistent, should ever change his opinion, or admit that he may formerly have been in error. Whether or no, though, it is perfectly true that *thirty-three years ago* I did, as he says, imagine and allege, that there had been a year 0, and that hence a new century would begin with 1900. I was young and foolish then, and confess that I made a regular blunder, not having gone into the chronological question in the thorough way in which so many years later I have perforce had to do. Presumably my critic would respectfully admire that witness in our Central Criminal Court in London, who, giving evidence about a horse, stated that it was "16ft. high"; a statement, of course, immediately pencilled down on the back of his brief by the opposing counsel. "What," said that counsel, in beginning his cross-examination, "did you say was the height of the horse?" "Why, 16 hands of course," was the reply. "Oh dear no" responded the advocate, "You said 16 *feet*. I took the words down from your own lips." "Did I say 16ft?" rejoined the witness. "Well, if I did, *I'll stick to it!*" Surely here is an example of consistency after Dr. Godfrey's own heart. But, as said the wise man, "He who never made a mistake never made anything."

The quotation by "Meteor" (in letter 43252, on p. 539) from *Whitaker's Almanack* contains one curious mistake at least, if not more; for, *imprimis*, I gravely doubt if the line of central eclipse will cross any part of the Gulf of Mexico at all, and secondly, certainly will not leave the east coast of America anywhere near Charlestown; but at Cape Henry in Chesapeake Bay, some 379 miles to the north-east of it as the crow flies. An expedition to the Southern States of America would be rather a costly matter, whereas the party sent out by the British Astronomical Association to Portugal, Spain, and Algeria will fill the mail steamer chartered as a yacht, and so be able to travel economically. The joint committee of the Royal and Royal Astronomical Societies only propose to despatch observers to the same localities as the B.A.A. does. There is one thing to be said, and that is, that there are so many brilliant and competent astronomers among our American brethren, that the observation of the phenomena of the eclipse may be left entirely in their hands with the utmost safety.

The difficulty of "Trinidad" (query 97464, p. 545) apparently has its origin in his neglect of the equation of time, and tacit assumption that it is real noon by the clock when the sun is on the meridian or due south. Now, on December 22 the sun souths about 12h. 1m. 20s. p.m., but on November 22 does not cross the meridian until 12h. 13m. 48s. by a well-regulated clock. If he will calculate by a formula which I have given more than once in these columns the times of sunrise and sunset—i.e., the hours, minutes, and seconds from *apparent* noon at his station for the two days specified, and then apply the equation of time—he will see how his illusion has arisen.

I cannot give the date of the Act of Parliament for which "Rota" asks (in query 97489) on p. 545, and which was quoted by Mr. Ebenezer Breach of Portsmouth in his letter to Sir John Gorst; but I fail to see the sequitur of "Rota's" assumption that "the rotundity of the earth was known and taught long before any of our statutes were framed." The earlier Acts of Parliament certainly go back to the XIIIth century or sooner, and the Reformation was not completed in England until 1532. Does "Rota" know that Galileo's works teaching the Copernican system were not finally removed from the Index Expurgatorius of the Romish Church until 1835? I may add that I took the word "statute" from the paper in which the notice of Mr. Breach's action appeared, but for aught I know, he may have relied on Canon Law; and is "Rota" aware that mediævally the "round" meant a *circular* and not a spherical world?

Whence, may I ask, did "Efe" (query 97510, p. 545) learn that Finlay's comet is now visible? I make this inquiry because, up to the time of writing this, I have not heard a syllable about its rediscovery. Under any circumstances the question is an almost meaningless one, because it fails to specify whether it signifies the same orbit or whether it means, Is the comet in the same part of the sky, or in the same constellation (or constellations) as it was in May and June, 1893? At any rate, until the comet actually reappears, the query must be unanswerable in any form. With reference to the rest of "Efe's" question, he may take it that the motion of the Solar System in space has *not* been the cause of the disappearance of comets that used to be periodic. Some, like Biela's, may have broken up and been dispersed, and others perturbed to an extent which has carried them into fresh orbits with major axes so long as to render them practically parabolic. As for the number of miles that the Sun and his attendant planets move through in space in a year, there are 31,558,149 mean time seconds in a sidereal year, and the probable rate of Solar motion lies between 10·6 miles and 16 miles a second. "Efe" can now do a multiplication sum. Why should the Solar motion affect the Leonid showers? The entire system moves as a whole, the ring of Leonids and all. If "Efe" is sitting in a railway carriage and drops his glove, it falls on identically the same spot beneath his hand on the floor of that carriage, whether the train is standing still at a station or travelling at the rate of 60 miles an hour.

In reply to query 97519 (p. 546), I am not quite sure that I ever confronted the difficulty concerning which "Antares" puts it. "γ Virginis," though, did, I seem to remember, once bother me in days gone by; but I surmounted it in that case by looking up the last authentic measures. Had I, however, to measure *de novo* a pair of sensibly equal stars, I should take the *preceding* one as my initial point.

In connection with query 97521 (p. 546), I remember giving, some time ago, in these columns the pronunciation of the names of a considerable number of the fixed stars; and, if I remember rightly, some brother correspondent gave a more elaborate and exhaustive list than mine. For these "N." may, if it is worth his while, search the indices. "Mare" is pronounced Mair-ee, and the Greek letters Al'pha, Be'ta, Gam'ma, Del'ta, Epsi'lon, and so on, just as they would be in learning the alphabet.

It has been pointed out to me by a scientific friend that my reply to "Mark," in the third paragraph of my letter (43244), on p. 534, is of too unqualified a character, conveying as it does the impression that liquefaction of the lunar atmosphere could under no circumstances occur without stupendous pressure. Merely as a matter of course I meant at any temperature which we are justified in assuming to have existed on the moon. Given a sufficiently low one, and our terrestrial atmosphere would liquefy without any extraneous pressure at all; but we have no reason to suppose that, even now, the temperatures of the lunar surface approaches that at which a mixture of nitrogen and oxygen would be reduced to a fluid state, and *à fortiori*, at the time during which the moon was passing through an actively volcanic stage, it must have been very much higher. And, by the way, whence would "Mark" get his winds after the atmosphere of the moon was solidified? If he can obtain the perusal of the latest edition of Deschanel's "Natural Philosophy," translated by Everett, and published by Blackie and Co., he will find much that is instructive with reference to the liquefaction of gases, critical temperature, and the like.

I have just received the current part of the *Cambrian Natural Observer*, the quarterly journal of the Astronomical Society of Wales, and am gratified to find that the membership of the society has increased from 75 to 90, or between 8 and 9 per cent. Verily what Virgil said of rumour may well be applied to this excellent little association: "Viresque acquirit eundo." The number itself is largely occupied with records of the observation of the Lunar Eclipse of Dec. 16, which did occur, and of attempts to observe the more or less expected phenomenal shower of Leonids which did not. Among the latter will be found an account of the sensational balloon ascent made by the Rev. J. M. Bacon and his daughter, which was fraught with such danger to the aëronauts. I am amused to find the editor congratulating himself that the "C. N. O." "is the only popular scientific periodical that contains no portion of the Twentieth Century unpleasantness."

Every student of the physical structure of the Stellar Universe will welcome the second volume of Dr. Isaac Roberts's classical "Photographs of Stars, Star Clusters, and Nebulæ," which has just issued from the press. It would be difficult to exaggerate the value and importance of this splendid work, the more especially as its gifted author has experimentally discovered that with every conceivable care in the development and fixing of negatives, the images of faint stars fade out of the films after a comparatively few years. In illustration of this he gives two instances; one of a plate on which, soon after it was taken in February, 1886, he counted 403 star-images on the negative, whereof in May, 1895, only 272 remained; and the second of a negative of the same region taken in March, 1886, on which 364 star-images appeared, but upon which, on re-examination in May, 1895, only 234 were left. Now one purpose of capital importance which such photographs are taken to serve is that of presenting an irrefragable facsimile of the region depicted at the given date for comparison with others made at future and distant ones, by which any actual objective changes in the heavens would be instantly rendered apparent. If, however, details disappear after the fashion indicated by Dr. Roberts, it is abundantly evident that the negatives must in future ages become simply valueless; and hence the policy and necessity of obtaining positive copies of them in indestructible printing-ink as adopted in this beautiful volume. It is one which scarcely admits of description. It must be seen and studied for its beauty and value to be estimated. The student approaching the subject for the first time may well be struck with amazement at the intricacy of structure shown in the spiral nebulæ which occupy a considerable share of the volume, as also with the arrangement of groups of stars in so perfectly definite a form as certainly to indicate a direct physical connection between them. For Dr. Roberts's views on the genesis and evolution of suns and systems, and explanation of the probable origin of those temporary stars, or Novæ, which from time to time have blazed out in the sky, the reader must go to his book itself. I would fain hope that anyone who does so will thank me for having directed his attention to so interesting and important a work. I hear, on what I believe to be good authority, that only a limited number of copies of it have been printed. If this be true, the sooner the student obtains it the better.

In connection with letter 43262 (p. 554), I should like to say that the latest *Nautical Almanac* in my possession is that for 1902, but that I certainly should have heard of any intended alteration in the assumed beginning of the day in that for 1904, had it been in contemplation. The *Annuaire* of the Bureau des Longitudes is not the equivalent of our *Nautical Almanac*. The French analogue of that is the *Connaissance des Temps*. The practical astronomical day begins when the true sun's centre is on the meridian —a perfectly definite and easily-observable phenomenon, which cannot be predicated of midnight. It would be impossible for astronomers to adopt the senseless division of the day into two periods of twelve hours each. It would, in many cases, produce the wildest confusion. I may perhaps add that I see from your "Answers to Correspondents" on p. 565 that your computer took his first minimum of Algol from 'The Companion to the Observatory' for the current year. I now notice from the February part of *The Observatory* that it, in turn, was led into error by the *Annuaire* of the Bureau des Longitudes (which is of course intended for popular reading), having given its Ephemerides for 1900 in civil time. Undoubtedly this was the origin of the *Times* paragraph, which, equally as a matter of course, was blindly copied into all sorts of other papers, even (so-called) scientific ones. No alteration has been, or is likely to be, made in the *Connaissance des Temps*.

"A. S. L." (letter 43267, p. 556) is perfectly correct in his assumption that there is no *optical* reason for the 14 or 15-to-1 proportion between the aperture of a refractor and its focal length. It is simply a matter of practical detail and application of experience. With him I have always thought that instruments of short focus give more brilliant images than long-focussed ones; but they involve much sharper curves in the lenses, and after a certain point has been reached the word "achromatic" as applied to them becomes a mere euphemism.

It might interest Mr. Wadsworth (reply 96919, p. 559) to turn back to pp. 34 and 35 of your LXIVth volume.

"E. H. R." (query 97538, p. 564) may read p. 90 of Spottiswoode's "Polarisation of Light," in Macmillan's "Nature Series," with profit. It is impossible to improve on the description of Haidinger's Brushes and the method of seeing them given there.

In reply to "Corona," the eclipse of May 28 next will not be visible as *a total one* from any port to the West of Spain. Alicante and Cape Santa Pola, in the Mediterranean, will be the only Spanish stations on the coast whence it can be so seen. Over, on the Portuguese coast, would seem to be the likeliest place for your correspondent.

A Fellow of the Royal Astronomical Society.

VARIABLE STAR OBSERVATIONS, JANUARY, 1900.

[43281.]—R AURIGÆ was very faint during the last three months of 1899. Most of this time it was below 13·0 magnitude and beyond the reach of the Rousdon telescope. A rise has now set in, and it was observed 13·1 magnitude January 5, and by the end of the month had increased to about 11·5 magnitude.

R Lyncis passed a minimum, 13·0 magnitude, January 10, when it was a very minute faint point just seen with power 132. The interval since the previous minimum, January 16, 1899, was 359 days. On January 30 it was 12·2 magnitude.

T Ursæ Majoris. Owing to unfavourable weather the minima could not be well observed; but from an inspection of the light-curve it may be assumed at 13·0 magnitude November 15, 1899. The interval since the previous minimum, March 16, was 245 days. This variable is now on the rise, and will soon become a conspicuous object.

S Boötis passed a minimum, 13·0 magnitude, November 20, 1899. The interval since the previous minimum, February 1, is 292 days. A steady rise is now in progress, and 9·2 magnitude was reached January 27.

R Cygni has been below 13·0 magnitude, and invisible with the Rousdon telescope for nearly five months; at times a very faint nebula has been seen in its place. On January 24 the variable had reappeared as a minute but well-defined point 12·7 magnitude.

The instrument in use was the 6·4in. equatorial refractor by Merz. Weather was fairly favourable, and observations were made on 14 nights, some of which were remarkably clear. **C. E. Peek.**

Rousdon Observatory, Lyme Regis.

MINIMA OF ALGOL.

[43282.]—AT the risk of appearing needlessly hypercritical, I venture to suggest that the directions given on p. 553 (viz., to subtract 12 hours from the several times given on pages 439 and 527 as Minima for Algol) scarcely meet the requirements of the case, at least so far as the generality of your readers are concerned. In almost every instance this would only give the daylight occurrences of this phenomenon, when, of course, they would be invisible, and, therefore, not usually recorded, and would leave out altogether any mention of those for which the lists are specially designed, but, of which, being supposed to occur in daylight, all record was omitted. Of course January being now past and over, no useful purpose would have been served by giving a fresh list for that month; but this would not have been the case with February, wherein all the visible occurrences are still future (but with one exception not mentioned in the list given on p. 527), and for which a revised list, similar to that contained in my previous letter, would, I think, have been found useful. **W. T. N.**

LUNAR SEAS AND RAYS.

[43283.]—I HAVE just read "F.R.A.S.'s" remarks in 43189. I think I have not misrepresented Mr. Tepper's suggestion—it is scarcely right to call them his *views*; but he wished the idea to be discussed.

I am not anxious to sustain the meteoric theory; but I think it is an important factor which should not be forgotten in any effort to understand the causes of the lunar formations. Mr. L. B. Tappenden introduced it in Dec. *Knowledge*, and hence my reference to it. But neither Mr. Tappenden nor myself is the originator of this view. Mr. Gilbert held views much like it in 1892, and Mr. Proctor before then. "F.R.A.S." says it is obvious I have not read Prof. Darwin's work on "The Tides." I have seen his large mathematical treatise; but I could not wade through it if I would, and, I had almost said, would not if I could; it would be too much work for a lazy man. But I have read his popular book, "The Tides," and though he states that both earth and moon did rotate more rapidly than now, I still think it impossible that the moon ever could have rotated faster than it revolved in its orbit if it was ever attached to the earth, and separated from it by such means as Mr. Darwin suggests; but my views on this point will not be presented now.

"F.R.A.S." asks many questions. I will answer as concisely as possible.

1. Has he reflected . . . . on the size of those formations?—*Yes*. Is he aware that the diameter of Copernicus, Tycho, and Kepler are 56, 54, and 21 miles across.—*Yes*.

2. What sort of a meteorite and of what size to make a hole 56 miles in diameter?—*I should expect such a one as falls on the earth*, specimens of which exist in the museums of London and Paris. The size required would depend on the nature of the surface on which it fell, and the mass and velocity of the meteor. "It seems impossible that your correspondent can ever have examined those formations with adequate optical power."—My own telescope is only a 3in. achromatic, but I have had the use of others which are larger as often as I found more power needful. A 4in. Wray, and the 6in. by Cooke in the observatory, besides reflectors by Browning 10in., and by Turnbull 12in. If the work is bad it is in the observer, not in the instruments.

But I have not been a careless observer, and I have made drawings and paintings from the telescope many years ago which exist still, and a comparison of these with the fine photos. of the Brothers Henry, and the Lick and Paris atlases shows them too good for eye drawings. But it is to the great photographic work of the Lick, Paris, and other observatories to which we turn for light on the lunar surface, which, added to work of Rutherford and Draper will help us to solve the question of lunar seas and rays. I have not advanced any views of lunar cosmogony in my letters. My object was to get Mr. Tepper's suggestion discussed in "our" paper. I hope this will be done, and I thank "W. R. P." (43192) and "F.R.A.S." for calling attention to it.

Toronto, Jan. 24. **A. Elvins.**

THE ZODIACAL LIGHT—PHOTO OF RAINBOW.

[43284.]—THE night of Sunday, Jan. 28, being the first clear night for some time, I went out to look for the Zodiacal Light, and at once perceived it. It was a long thin cone, in whose base Venus was brightly shining, reaching up through Pisces to a little south of γ Arietis, beyond which I could not trace its blunt apex. It seemed to me to decidedly dim the fainter stars of Pisces over which it passed. Time, about two hours after sunset.

Some time ago "F.R.A.S." mentioned the difficulty of photographing meteoric phenomena. I inclose an ordinary sunspot of a rainbow, which is, however, too faint, I am afraid, for reproduction. It was "snapped" on a Sandell "Perfect" plate last September in an ordinary Kodak.

The brightness of the portion of sky within the

bow is well shown in comparison to the sky outside, as it ought to be by theory. On the negative the supernumerary bows may be just made out.

Galway. M. B.

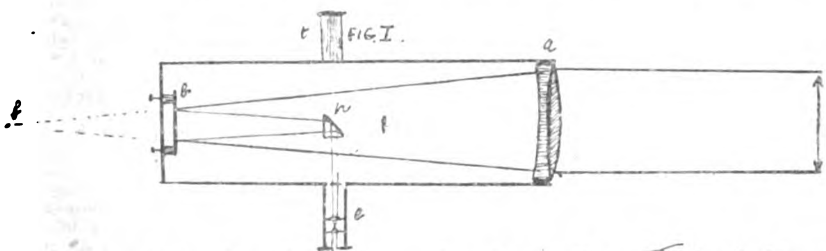
TWO NEW FORMS OF TELESCOPES.

[43285.]—I BEG to lay before you my idea for two new forms of telescopes, which I think present some advantages. One objection to the construction and use of large refractors is, of course, since focal length is a consideration, the vast amount of material and labour necessary to produce tubes long, and at the same time rigid, enough for the reception of the glasses. Again, to those who use both the reflector and the refractor to any large extent, it becomes evident that, although the reflector cannot compare with the refractor as regards illuminating power, yet the ease with which it can be used in almost any position (I am speaking more especially of the Newtonian and such like forms), and its portability and compactness are such as to commend it to many.

Now my idea is to combine the refractor with parts of the reflector in such a way as to make an instrument differing very little in appearance, size, and compactness from an ordinary reflecting telescope, and at the same time possessing all those desirable qualities which are so well known as appertaining to a refractor. I have called this form a combined refracting and reflecting telescope. Such an arrangement would be, of course, suitable for refractors of moderate and large dimensions, and having a considerable focal length, and by the very simple arrangement I shall mention, the tube length would be reduced *by more than one half.*

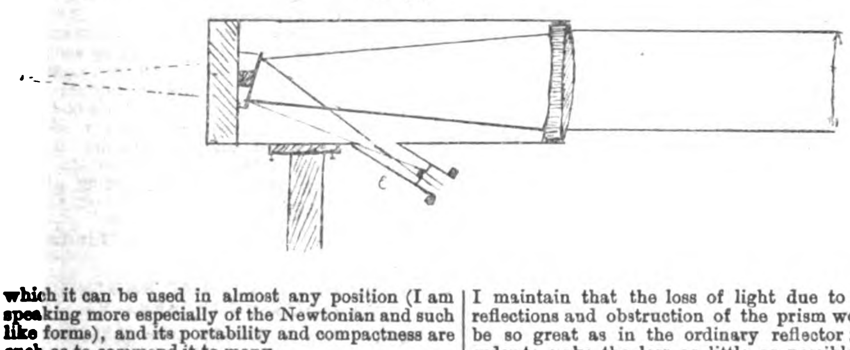
A reference to the accompanying diagram I will explain the arrangement. Fig. I. represents the telescope arranged in the Newtonian manner. About half way between the o.g. (*a*) and the focus (*f*) in the cone of rays is placed a *plane mirror* (*b*) which reflects back the rays until they fall on a total-reflection prism (*p*) which again diverts them, this time at right angles to the tube, into the eyepiece-tube (*e*). As in the Newtonian reflecting telescope, the eyepiece-tube may be one of the trunnions (*t*, *t*) on which the tube can revolve in altitude, and therefore the eye would not require to be moved at all. Shortly, the advantages would be these:—

1. Great reduction in tube length. 2. The definition of a refractor combined with the compactness, &c., of a reflector. 3. No air currents in tube.



a = o.g.; b = plane mirror; e = eyepiece-tube; f = foc. of o.g.; p = prism
t = trunnions.

FIG. II.



I maintain that the loss of light due to the two reflections and obstruction of the prism would not be so great as in the ordinary reflector; but in order to make the loss as little as possible, I have adapted the form shown in Fig. 2, or Herschelian. In this form the small mirror is tilted so as to reflect the rays into the eyepiece-tube (*e*) placed at an angle to the body-tube.

In the diagrams Fig. I. is a plan, and Fig. II. an elevation.

I shall be glad to see criticisms and opinions on the subject from some of your very able contributors and fellow-amateurs.

Alpe-street, Ipswich. Henry A. Bromley.

TELESCOPES AND MICROMETERS.

[43286.]—HERSCHEL, in describing in "The Telescope" the proposed construction of a Gregorian with the two mirrors silvered at the back, ends somewhat disappointingly. Having discussed the conditions of the problem, he merely says that Airy's calculations showed such a construction was possible, but gives no example. The main difficulty appears to be the correction of both the spherical and chromatic aberration by making both reflectors of the same kind of glass.

Is there any theoretical or practical objection to making the large mirror of crown and the small one of flint glass, so as to thereby destroy the chromatic aberration, and thus leave merely the spherical aberration to be corrected by the curves employed? The possibility of protecting the silvered surfaces would be considerable again; but perhaps the difficulties of construction and the excessive cost of optically pure glass (which would be a necessity) may more than balance this advantage. Has such a telescope ever been actually made? Lacaille, in his "Traité d'Optique," throws doubt on the accuracy of micrometrical (telescopic) measurements, on account of the image being curved, and thus not coinciding with the plane of the (filar) micrometer. If this is correct, what becomes of the decimals of a second that are to be seen in published measurements? What says "F.R.A.S."?

A. S. L.

IS THE UNIVERSE INFINITE?

[43287.]—MR. BURNS is no doubt quite justified in his contention as regards the number of stars, on two suppositions. (1) That the dark stars (dark bodies in space) bear no larger proportion to the bright ones at remote distances than at near ones; and (2) that there is no other medium in space which absorbs light. I might perhaps add (3) that the ether extends to infinity; for I do not see how light could reach us from a place where there was no ether. On these assumptions, the number of stars is not merely finite; but, if I may employ the term, moderate. Not so large, for example, as the number of animated beings at present on the earth.

The effect of an absorbent medium, whether composed of small opaque bodies or not, would probably resemble that of a haze, which, though its effects are imperceptible as regards objects close at hand, completely obliterates a distant mountain range. Such a haze would make an infinite universe appear to be finite to the beholder, even though the components were self-luminous.

W. H. S. Monck.

IS THE THEORY OF GRAVITATION A FINALITY?

[43288.]—MR. ALEXANDER (in letter 43260) asks the question: "Is the theory of gravitation a full and final explanation of the mechanical and physical cause of the known movements of the Solar System?" The answer is: "No; it does not profess to be so." Gravity explains the *restraint* which is put upon the motion of the planets by the attraction of the sun; but it does not explain the motion, or, rather, the cause of motion. A mechanical explanation may be given of the action of the reins upon the bit and mouth of a driven horse, and perhaps of the consequent change in the horse's direction of progression; but a similar explanation cannot be given of the cause which produces the trotting or galloping of the horse, and of the consequent motion of the carriage attached. The attraction of gravity prevents the planetary motion from being other than it is—*attraction*, whether the planet is receding from or approaching to the sun; but gravity does not profess for one moment to explain the cause of motion. "There is no defect in the theory of gravitation because it cannot explain what it does not profess to explain."

That is an answer to the *second* question in letter 43266, and the answer to the *third* is: "Yes; plenty of new facts have come to light since the first statement of the theory of gravity; but none of them suffices to explain the cause of motion. It remains for future generations to discover it."

Peasmarsh. F. B. Allison.

MOTOR-CARS.

[43289.]—KNOWING personally the responsible position the writer of the articles has held in the motor industry, I have the greatest respect for his designs, and although he states that a car has not been made from the designs now appearing, the readers may have every confidence in following his instructions. *Re* the horizontal valves, cheapness of manufacture is no excuse for placing them in that position. The valve-stem always wears the bottom of the guide, and when the guide-hole gets elongated they depend solely upon the spring to draw them into their seats, and after a time they give trouble. Valve should always work in a vertical plane, and when designing a motor this practice should never be departed from, however tempting the horizontal valve may appear.

I am glad to see the motor has a water-jacket.

Too many people are just now spending or wasting a lot of time and money in trying to make a small air-cooled motor drive a car satisfactorily. Keeping the motor at a proper working temperature is much more important than many people think; but I think the writer will agree with me that people owning water-cooled motors find more trouble with the joints going and flooding the cylinder than any other complaint.

However much the writer may say to the contrary, no matter how good the workmanship, or of what material they are made, they occasionally want remaking, and this is not a pleasant job. I have found a layer of tinfoil or lead paper next the water-face last as long as anything; but even these go sooner or later, and they manage to leak in the most provoking manner just when you are many miles from nowhere on a dark cold night. I think that very important item should have been avoided; it easily can, the cylinder not costing more than the one described.

I am pleased he is describing a carburettor of the surfacing type, as this class of vaporiser is simple; if properly managed, is reliable; and can be made by anyone for a few shillings. Besides, they leave less smell than those of the spray variety, and will run a motor any speed up to 2,000 revs. per min.

Yes, jockey pulleys and belt transmission are cheap, simple, and reliable in dry weather; but unless some means are taken to protect the belts in wet weather from the mud, the driver will have trouble, and plenty of it; the jockey may be tightened to breaking point, and then the belts will persist in slipping. As to fitting governors, what is the good of advancing the ignition to gain revs. on the engine if the governors cut out at the normal speed? The sole secret of success of electric ignition on small cars is being able to alter the speed of the car by altering the revs. of the engine; this being done by advancing or retarding the ignition. I take it the governors are to be fitted to prevent the engine racing when the work is taken off. The engine can be stopped from racing without governors by connecting the handle of the advance ignition to the pedal of the brake, which takes off the jockey pulley at the same time. By this pedal the engine could be slowed down simultaneously with the stopping of the car.

Lowestoft. **W. L. Adams.**

MOTOR TRICYCLES.

[43290.]—IN reply to Mr. Russell (letter 43274), perhaps he did not clearly understand my description, though I made it very plain. The gist of the whole thing is the engine's flywheels run in *opposite* directions. To do this you must use an intermediate pinion. This prevents the explosive impulses from synchronising; when they do, vibration is the result.

The engines must be on either side of axle to get the best effect. I mentioned about even number of teeth to prevent amateurs from using an odd number on intermediate pinion. To run engines as you suggest is quite useless as regards balancing. Dividing it into two or more cylinders gives you a less initial shock, but will not reduce vibration much. You must have an interesting sample of motor tricycle from your description of it, and I should judge you have many pleasant recreative hours by the road side, which no doubt tends to make you of a thoughtful and sceptical turn of mind. However, there is not any difficulty about running them, though chief fault is noisy gear, which also causes loss of power, as gear-wheels soon get worn and run badly. Why some motor-tricycle maker has not adopted multi-thread worm and worm-wheel driving is what I cannot understand; seeing how well and silently it runs on some of the new electric cars. A 7 or 8 to 1 ratio can easily be made and motor could be secured to small coupling on worm shaft to prevent ever disturbing worm. I merely offer this as a suggestion. If any one has a better method shall be glad to hear of it, as I am always open to receive any information. I think if some of our readers would send *small* rough outline sketches of frame for small cars it would do much to hasten what is needed by the public—viz., a small two-seated car to take two side by side not exceeding 3ft. 6in. wide in any part to go through about same space as tricycle, the seating of which could be arranged to overhang the wheels to get comfortable width, and motor I think should be secured to a separate frame from which the seating is, with good springs between. Speed is not so important as reliability and freedom from breakdown and motor shedding parts of its bowels by the wayside. It must be designed for *bad weather*—not merely for conditions of sunshine and dry roads, and should most certainly have a two-speed gear. Above all, it is a *sine quâ non*, that it is fairly cheap to be within the reach of persons of moderate means. This is the class of motor vehicle that will take on and pay well too. Who will be the first to make it remains to be seen. **Monty.**

STEAM-ENGINE.

[43291.]—I SHOULD like to endorse E. W. Fraser's remarks on steam-engines for amateurs and small power users. I made myself a steam-engine, cylinder 2¾in. diam., 5½in. stroke, and find it drives a 6in. lathe well. But it takes me three-quarters of an hour to get steam up, and that is not much catch, say to drill four holes. My injector is always failing, and it is by a first-class firm. Then you have to stop for steam, or oiling the engine, or stoking, and the result is you waste half your time, and do your job in pieces, and do not improve the finish of it. I am now making myself a gas-engine, and shall be very glad when it is done. **C. Wade.**

[43292.]—MY own experience with gas-engines is somewhat different to E. W. Fraser's. A steam-engine at least runs evenly, and it will go when steam is turned on. I have never had any trouble in keeping up the pressure, always providing that the boiler is large enough. A boiler that is too small for the engine wants constant attention. A steam-engine is less liable to go wrong, and requires less fiddling with than any gas or oil-engine I have yet met with. The gas-engine seems to be designed to keep one's pocket for ever on the bleed. Some engines burn out iron ignition-tubes at the rate of a dozen a week. Iron tubes may be cheap, but two a day makes the cheapest costly. Alloy tubes last sometimes a few weeks, but they cost a good bit, so that in the end they are no cheaper. The drive of a gas-engine is a succession of jerks more or less violent, according to the make, which causes breakage of small drills and milling cutters. In outlying districts or parts where the gas pressure is weak or varying, there is always the possibility of the tube burner going out suddenly. With a ½H.P. engine driving a 3in. lathe, this is a small matter; but where you have a big engine driving a lot of heavy machinery, it is exceedingly annoying, as all the machines have to be thrown off before the engine can be moved. In the matter of space occupied, a 3H.P. gas-engine is about as bulky as a 6H.P. steam-engine. The cleaning out of a boiler is nothing compared with the cleaning of a gas-engine cylinder, which is the filthiest and dirtiest job conceivable, and the operations connected with it are not calculated either to improve a man's temper or his language. No, a gas-engine is not all lavender, and, in my opinion, is a highly overrated machine. If it would do all that is claimed for it, it would be a most ideal motor; but it does nothing of the kind, and it lets you down badly if you repose the slightest confidence in it. Every engine ought to have a timing valve; but, for the sake of cheapness, they are usually omitted in small motors. The consequence is they waste the gas, and fire too early or too late, according as how the load and the gas pressure varies. Any tinkering about with the flame of ignition-tube only results in a waste of time and language. An oil-engine is a still more bulky machine than the gas-engine—has all its defects and a good many more of its own. **S. B. K.**

[43293.]—WHAT our friend E. W. Fraser (letter 43279) says is perfectly correct, and is not only applicable to such small engines as depicted here, but much larger, and for why, but that the boiler that is constant in its action has yet to be found? Some two years ago I was on the way to show how a constant boiler, and with automatic feed perfectly safe, could be made, when, on the Christmas Eve two years ago, I met with a terrible accident from which I was for a time afraid I should have lost the sight of both eyes, and was compelled to be compulsorily idle, and am in consequence now forced to have lazy spells every now and again, as my eyes will not stand to their work, and that means misery. The above is applicable to large as well as small engines. All want constant attention if you want to get anything out of them, even in an engine where the engine is of 100H.P. and the work constant; as, for instance, a pumping-engine for water-works where the draught from well and lift up a stand-pipe are always constant. Things want looking after sharp to keep things regular; oil, air, and gas the same. The latter—i.e., gas—if properly constructed, can be trusted to take care of itself for hours. If run at its proper speed, you will have no trouble to get what you want; but if throttled or attempted to govern the affair by the charge, i.e., wire-draw it, if you expect anything certain out of it; but in constancy you will be disappointed, that is certain; for small motors, no matter what they are, must be run at their highest capacity, and kept to it, if you want anything out of them, and they will not overrun themselves if properly constructed. The theory laid down as regards steam space and grate surface will not do for these as per scale. A surplus quadruple will not be found equal to the occasion unless you work up to three times the pressure upon your boiler, and reduce the same by a reducing valve between boiler and engine, to keep it constant. I have wondered many times why this has not been done for the pumping engine, as above; it might be and perhaps is done, but it has never come under my notice. The difficulties in my experience do not lie only with small plant as regards feed, and if you refer to the "E. M." for 1897 you will find some lines to get over the difficulty in constant automatic feeds in steam generators not boilers. For these light engines and generators that are perfectly safe at anything from 40lb. up to 200lb. or 300lb. per square inch, slow combustions, that may be left for hours. There has been a great mistake as regards steam generators—i.e., boilers, and so there is now; but things are looking up, and it has been an acknowledged mistake for years, the throttling of engines. But there are many such on the market now, as see query 97440, in the number for Feb. 2, 1900, and see queries *re* gas-engines, from faulty construction, the hundreds that are on the market that are—well, I might say useless. Difficulties and queries are cropping up every week, and they cannot be depended upon unless properly constructed—an independent valve for ignition, gas, air, and exhaust, all positive action by cams, and springs regulated to all requirements. Air-valve the weakest; and why? Because you cannot gauge the reaction after the explosion. As to free action in running for speed, according to the construction, there is a limit to taking in charges and ignition that you cannot get beyond, and they should be allowed to work up to that limit—i.e., small plants.

The time has very nearly come when we shall only have to agitate a pound of water to get a ton of steam with a tenth part of the fuel we have used to agitate a ton of water for a pound of steam. I live in hopes of finishing what I commenced—i.e., the generator and an aërial condenser. I have looked things up, though a series of accidents cropping up one after another has not left me breathing-time scarcely. I gave it up for a bad job; but I am about as tough as they make them, I think, and have pulled together once more, though to-day I felt very much inclined to shut up shop, seeing the blunders I have made recently, and which I never realised until I dreamt about them, and woke up with the words "I never could be such an ass!"—so, between 2 and 3 a.m., I jumped out of bed and hunted up the "E.M.," and, sure enough, my dream was true. It upset me not a trifle. **Jack of All Trades.**

DOUBLE-ENGINE RUNNING ON RAILWAYS.

[43294.]—YOUR correspondent "Large Boiler" (43259) does not seem to realise the fact that large boilers mean large fireboxes, and large fireboxes mean increased coal consumption and increased work for the fireman. The quick transit of heavy engines over the line means quick deterioration of the permanent way, for in double-engine running the weight is scattered over a large space compared to the concentrated weight of a single heavy engine.

Another point to be considered is the fact that the weight of almost all trains fluctuates greatly between the various stopping places. One train may commence its journey very heavy, but at the first stop may be relieved of half that weight, whilst another may start light, but soon become very heavy. In the case of the first example, the auxiliary engine could be detached when no longer necessary, whilst in the second an engine can be attached. I believe if "Large Boiler" goes into the matter he will find but few cases of the second engine completing the through journey.

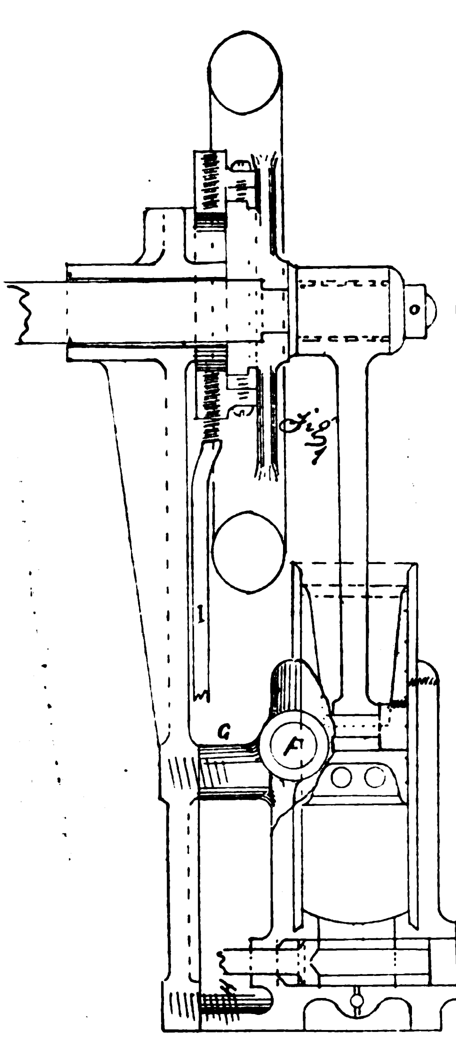
A point both "Large Boiler" and "L. T." (43271) seem to ignore is the weather. An engine can pull over dry rails what is impossible over wet and greasy metals. Thus a train may commence a long run with a fine dry road; but a shower of rain falling in the midst of that journey may delay the train several minutes through wheels of the engine slipping over greasy rails.

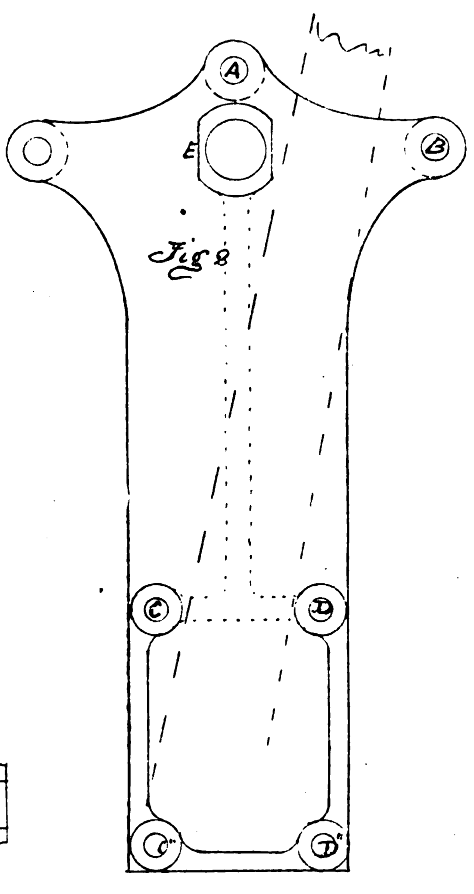
But, when everything is said and done, the chief difficulty lies in the fact that it is almost impossible to foretell the weight of any particular train until all luggage and passengers are on board. It is then far easier to requisition the services of any express engine which may be on hand, than to keep any particular heavy engine waiting for such an emergency. But, granting that heavy engines were used habitually on certain trains, it would be found that whilst on some days the engine would be utilising its full power, on uncertain days a light load would mean a loss of power, in the same manner as in the double-engine running of the present day on trains of a *uniform weight for the through journey*, of which there are few. **Lindum.**

HOW TO BUILD A LIGHT ENGINE FOR VARIOUS PURPOSES.—VI.

[43295.]—THIS is the edge view of the same as appeared in No. V.—i.e., Fig. 1—and, therefore, will not require the explanation that is there. F is shown here one of two lugs that are cast upon the cylinder jacket for the purpose of turning to account the convenience that it may be laid upon either side as a horizontal engine, when it would be policy to make one of these into an outlet for the exhaust to right or left to suit your convenience, and if not wanted, would not be in the way of anything; and drilled out and tapped and studs put in may be utilised for fixing or fixing anything to; but when put upon its side, bored out, as shown, down

to, and including the two chambers for exhaust. G are bosses for carrying the entablature, and from these to the foot is bored in. From there upwards the face is plain that a light sheet brass or iron casing may be riveted on, forming a bore with a sliding front or side to give the engines an extra long lease of life, or an extra chance of doing well. I have put in where possible a loose liner in the shape of a steel bush, perforated, and in applying this, care must be taken that the sharp angles and burrs are taken off with a scraper to make them rounding. At G and H studs may be fixed instead of set-screws—that supposing you were going to fix it to the supporting upright of a tricycle (see Fig. 2, where such is shown), that if A B C D are furnished with studs that pass through saddle-pieces or clamps, you have the means of fixing it to the same, no matter what the angle. Here you will see that there are bosses C D, C′ D. These are slight projections for taking the unnecessary surface off





in fitting the entablature to the cylinder E. This inside boss is filed away on both sides for the gate to slide over that carry the rubbers for the eccentric motion to the valve. Now, when this guide is only the shaft, the motion can be carried around at any point. Now, this is done in this instance that the bearing may be continued up to boss of wheel for shaft, as in a confined space we must take every advantage of getting as much bearing-surface as possible. Some of you will say: Why this motion? Why not have the usual eccentric and strap-levers, &c.? First, it is simple; second, easily fitted, light, no complications, easily adjusted for wear, if any; and last, but not least, direct-acting—no swing of the rod, and no bolts to work loose, and the whole can, as I have said, be boxed up snug.

Jack of All Trades.

As evidence of the tendency towards heavier locomotives and longer trains used on American railways during recent years, some interesting figures have been published regarding the weights of engines turned out by the Brooks Locomotive Works in the years 1891 and 1899. The average weight of the engines built in the former year was 82½ tons, and in the latter 121 tons. The figures are based on an output of 226 and 300 locomotives respectively. The weights given are those of engine and tender in working order.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[97180.]—**Marine Navigation.**—I am not surprised that "J. H. H." cannot refer me to any work which treats of the subject; but perhaps there may be something in the records of the Institute of Marine Engineers. As to what "Charlton" (p. 559) says about the Davey motor, I remember seeing that in the Inventions Exhibition in 1885. I am also aware that water from condensed steam is used in the boilers; but I am not aware that exhaust-steam from the auxiliaries is used to drive the main engines at four knots. G. S. N.

[97301.]—**To Lanternists (U.Q.)**—I think cylinders are preferable and cheaper in all ways to automatic generators, unless living in very out-of-the-way places. I have used a double band (Ives) saturator, and although this is, by many people, considered about the most dangerous one, have never had an accident, and never failed to get a good light; but, at the same time, you would not save much by using a saturator, and no doubt the best plan, when working where gas is not laid on, is to have two cylinders, one for oxygen and one for coal-gas (not hydrogen); and if you use your two lanterns as a biunial, you are obliged to. All books on the lantern treat of lime-light. Rileys publish some small handbooks.

Optical L.

[97327.]—**Sparking Coil.**—There have been many replies on this subject—sparking coils of all sizes. As to a work on the subject, there are several. Allsop's, perhaps, as good as any. The articles which form that were published in these pages some few years ago. T. W.

[97328.]—**Small Dynamo.**—Mr. Chase will find in back numbers full directions for making all sorts of small dynamos. See the indices of the last six volumes, say, for references. M. D. P.

[97345.]—**Wax Phonograph Records.** — If "Junius" wants to obtain full particulars about the wax used for phonograph records, he should look up the patent specifications. I suspect he will find that every substance which can be considered wax, or can be used as wax, is protected by patent (probably out of date now). In one of the volumes for 1879 there is an account of the sixpenny phonograph, in which it is said that stearine wax was used for the "records." Essar.

[97355.]—**Mercury Interrupter.**—I have to thank Messrs. Bottone, Avery, and Drysdale for kindly answering my query. Owing to its over-conciseness, and perhaps partly also to the fact that the Wehnelt interrupter bulks so largely in men's minds just now, I have failed in making my meaning clear. What I wished to know was how the electrical contact is made in the ordinary mercury interrupter, between the mercury in the cup and the primary of the induction coil. Perhaps I was mistaken in assuming that this is done by means of platinum passing through the bottom of the cup, and it may be that copper is used. If so, and if the hole is sealed up with glass after the copper wire is passed through it, is there not a risk of the glass cracking when it cools, owing to the unequal expansion of glass and copper, and, if this be the case, how is the risk obviated? A. T.

[97381.]—**Piston-Speed for Launches.**—This was answered by "Regent's Park" in your issue of the 19th ult.; but he failed to impart the knowledge I sought, perhaps because I did not make myself understood. What I want to know is, what number of revolutions I may expect to get from a compound engine 6in. by 12in. by 8in. stroke, using steam at 100lb. working pressure, the engine running uncoupled, not driving anything, steam cut off in the h.p. at ½ stroke and l.p. at ½ stroke. I trust some one will be able to give me a little information. C. E. L.

[97382.]—**Rats.**—If the querist cannot get rid of the rats by the methods previously mentioned, I would suggest the employment of a professional ratcatcher. Rats are useful (when dead), for the pelts are always of value to make felt, or the skins for "kid" gloves. I saw it mentioned recently that in the Strand, where the old houses are about to be pulled down, there are thousands of rats, and it is certain that they abound in all the basements of London where there is any food to be obtained. To drive them away there is nothing better than catching a few and tarring them. The whole colony will leave. F. D.

[97429.]—**Tin Scale.**—Tin is easily soluble in strong hydrochloric acid, and is converted into white, nearly insoluble, powder by nitric acid. Messrs. E. and C. Kuhn, chemists, of Sechshaus, near Vienna, patented an invention for producing pure tin, good weldable iron, ammoniac, Prussian blue, &c., from clippings of white iron. Mr. Higgin, of Manchester, utilises tin therefrom for making stannate of sodium. The Panton patent (New York) tin-scrap is placed in a revolving inclined box, provided with hollow journals, through which is passed dry chlorine gas, to form and carry over to condenser bichloride of tin, which is precipitated as oxide and reduced. Mr. F. G. Martin, Bermondsey, S.E., has also worked on this subject. Also, Manhattan Metal Co., of New York, and Adolphe Ott, of the States, also; process used in Germany and Belgium. P. S. Simmonds on "Waste Products," 1873. Regent's Park.

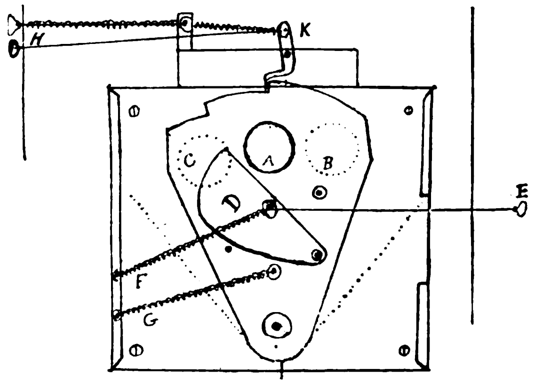
[97436.]—**Stamping Notepaper.**—The reply on p. 560 by Mr. Theodore Brown may suit the querist, but it appears very crude. Wonder whether Mr. Brown has ever seen how they impress stamps at Somerset House for cheques, &c. The ink is simply rather stiff printer's ink, and it is forced into the die either by a roller or by a dabber (not a stencil brush). The surface of the die is then wiped with a cloth, which may or may not have a little whiting on it, and the impression is taken in the usual way. A little hand apparatus can be bought at any stationer's, but most people now use a rubber stamp for common work. Dies of the kind are not in a hurry to go rusty, but when put away they are not covered with "white beeswax," but with a mixture of pure fat and plumbago—sometimes the latter only. S. H.

[97442.]—**Eyepiece.**—In this instance "Polaris" has already received replies to all his queries in "F.R.A.S.'s" usual courteous and accurate form, so that the peculiarity of certain other replies alone induces me to beg leave to draw further attention to this much and often queried subject. First, as to the three possible meanings of (1) "the theoretical limit of power," which may be either (*a*) magnification per linear inch of aperture, (*b*) minimum separation of double-stars observable, or (*c*) minimum magnitude of stars observable. Answers to (*a*) and also to (*b*) for one set of conditions have already been given with much clearness at page 535 by "F.R.A.S." while (*c*) has been taken up by Mr. Banks at page 544. Personally, I think (*a*) alone was meant by the querist, to judge from his own words, and if I also may give my experience, I should say that 30 or 40 per linear inch of aperture is about the maximum magnification possible with critical precision, for objects which present surfaces upon which details are expected to be seen—if atmospheric conditions permit.

But on the other hand, I should not limit the magnification even to 100 per linear inch of aperture, where, at times, certain stellar objects are to be scrutinised. Secondly, respecting the formula for the equivalent focus of "compound eyepieces," I find still more need for adding a little. Mr. Banks gives at p. 544, first of all, the well-known general formula which serves for all forms of compound eyepieces which have two lenses only, although, curiously enough (and peculiarly so in being presumably from the pen of a practical optician), he limits its applicability to eyepieces of the Ramsden or "positive" type, failing to notice that what he thinks necessary to add as a second "rule," suited specially to negative or Huyghenian eyepieces, is simply a roundabout way of expressing in words the shortened form of the first given formula. Line 9 of middle column at p. 537 shows how the formula he first quotes becomes simplified into what he gives as a second one adapted specially to negative eyepieces as he thinks, while, as I there have shown, the first given formula is equally applicable.

$$\frac{F_1 \times F_2}{(F_1 + F_2) - d} = \frac{2\,F_1 \times F_2}{F_1 + F_2} = eq.f.$$

are just two ways of writing the same thing in the usual familiar short language of symbols; but as already explained at p. 537, we are only justified in utilising this formula in its second form when (*d*) or the lens distance apart equals half the sum of the foci. The second form given above is Mr. Banks's expressed shortly. But should perfect accuracy in (*d*) be aimed at, we can no longer use the "half sum" originally proposed by Huyghens in order to equalise the refractions, but must use as supplementary the formula given at p. 537, first col., in which case we are forced to take the formula in its complete form as first given. Huyghens knew nothing about the wonderful coincidence connecting (*d*) with the conditions for achromatism, and which require, except for the very longest telescopes (*d*), to be made greater than the "half sum" (see 43250 quoted above). In microscopes particularly has this to be attended to, as the measurement of micro. eyepieces by the best makers will show. For my demonstration of the simple matter of diaphragm aperture in the letter just quoted, (*d*) equalling the "half-sum" was good enough for the purpose; still I there founded my deductions for the Huyghenian eyepiece on what Mr. Banks thinks only applies to the positive eyepiece. Thirdly, as to decrease of field of view by increase of magnification, I do not think the reply of "F.R.A.S." could be in any way improved upon. It was, "As the power increases, angular subtense of the stop decreases." Now, as *the stop* evidently meant by the querist and as understood by "F.R.A.S." is the diaphragm in the eyepiece, and not a stop near the object-glass—such as "O.G." speaks of in query 97457—it is very easily seen by all, that Mr. Banks has given a reply about diametrically opposed to the correct one when he wrote the following: "The field of view—is not influenced any way by a stop"; although he allows it to be "governed by magnifying power chiefly." Why chiefly? Is it not possible, as we all know, to contract the field of view very much more by a small "stop," than would be practically possible by any increase of power with which vision would be else than a dim apology for it? Indeed, for certain solar observations this is frequently done, and the spectroscope slit itself is but another form of diminished field when the instrument is used in its "analysing" form. [In my letter 43257, p. 545, first column, line 15, for "reflector" read "refractor."] H.

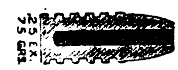


[97364.] — **Hand-Camera Shutter.** — This sketch shows the shutter open when taking a view. Before taking a view, A in fan-piece is at B, and C is at A; of course, C and B are solid metal—no holes—which covers A before exposure and after exposure; D is pulled in front of A by E when renewing shutter ready for a fresh exposure. The dotted line showing the position of fan-piece before and after exposure, F and G causing D and the fan-piece to act properly, which are very fine brass wire springs. E is very fine catgut. H is strong brass wire, with a knob that is pushed with the thumb, and is outside the camera, and when pushed causes K to release the fan-piece for either instantaneous or time exposure. The sketch is the exact size, and the holes in fan-piece and fixed front-plate are exactly opposite, and ½in. diameter, and opposite centre of lens. PHOTO.

[97456.]—**Launch.**—Yes; it is quite practical to bring the propeller tube out to one side of stern-post in a small boat where it would dangerously weaken the boat to cut the stern-post. The tendency will be to drive the boat a little out of the straight, which is easily remedied with the rudder. I fixed up the propeller in this way in a small launch I fitted. Fill up inside with pitch run in hot, and see that wood is quite dry; outside a piece of copper can be riveted on to hold things together. The job wants doing nicely, or you will have trouble. The propeller will, of course, go outside rudder, and will have a movable stay to hold it in position. When wanted out of the way, it is merely folded up. If the description of jointed shaft is not sufficiently clear to "Navigator," I will make a sketch if I can find the time. With regard to prices for the same H.P. varying so much—well, some makers are liars, and some are not, when speaking of the power of their engines. W. J. SHAW.

[97457.]—**Stopping-down Object-Glass.**—I must apologise to "O. G." for having been so long in replying to his query. My superb 4in. Cooke refractor, like his, has several stops down the tube. These are for the purpose of cutting off stray light and surface reflections, and as long as they are placed at their proper intervals according to their diameters, they in no way reduce the aperture of the object-glass. The shortest way to discover whether the stops are cutting off any useful light is to adjust the telescope to solar focus, and, turning the eye end of the instrument to the light, examine it from the object end. The full aperture of the object-glass should then appear to be illuminated from all positions in which the eye may be placed. Should this, however, not be the case, remove the stops, and, having ascertained the focal length of the o.g., find, by the following simple method, the proper distances at which the stops should be placed. Assuming your object-glass to be 4in., and its focal length 72in., drive two tacks into a plank (or one of the floorboards of a room) the former distance apart, and a third tack the latter distance away at right angles to a point midway between the two tacks; then tightly stretch a thread completely round the three tacks, and you will have a triangle representing a full-sized section of the cone of rays formed by your object-glass. Now locate the spot where the threads are apart exactly the diameter of your largest stop, and measure its distance from the two tacks. This will be the place where that particular stop should be fixed in your tube. Apply the same process to the remaining stops, and if the object-glass is a good one, it will now perform its best. I may here remark that it is not uncommon for unscrupulous makers to conceal the faults of a lens imperfect near the edge by cutting off the defective margin in this secret way, so that what pretends to be a 4in. is in reality only equal to a 3in.—or less. If, however, your instrument is by a maker of repute, and yet will not pass the test I have given, it is probable some of the stops may have become accidentally misplaced, and only need correct adjustment. NORMAN LATTEY.

[97467.]—**Rook Rifle.** — The short rim-fire cartridges will shoot very accurately up to about 35 yards, while the long and the long-rifle cartridges will kill up to about 60 and 130 yards respectively; and with a little practice you should hit a penny every time at a distance of 30 yards. The penetration of the short cartridge bullet is about 3in. of deal, and the long rifle 5in., both at a distance of six yards. I have used a Marlin and a Colt 22 cal. repeater for the last five or six years, and find that they are of very little use for rabbit shooting unless they hit in the brain. The hollow-fronted bullets are somewhat better, but many rabbits get to ground after being hit. During the late frost, I had a rabbit dug out; the spinal column was completely smashed just behind the head, yet it managed to crawl nearly a yard down the burrow. For shooting sitting rabbits and rooks I use a Marlin 25 cal. repeater, shooting a bullet like the sketch, with 10 grains of black powder and a telescopic sight. "W. S." will have to load these



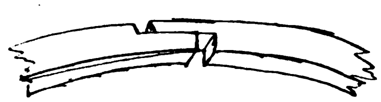
cartridges himself; but this is very simple, and the cost of a complete rig-out, including gun, telescope, and loading tackle, will be about five guineas, and if "W. S." does not bag two out of every three rabbits up to 45 yards, it will not be the fault of the gun. CLYTIE.

[97469.]—**Tender Feet.**—Take regularly a short footbath, putting a handful of bran into the water, and apply a little slice of raw beef upon the tender part. Hold your legs in a horizontal position whenever you can. T. N.

[97471.] — **Piano-Organ.** — The querist must satisfy himself by adopting the motor which suits him. Apparently the usual spring-work, as used in musical-boxes, is most suitable. A little electric motor could be employed, but that would involve a battery, unless the current could be obtained from the "leads" of one of the companies. It is not stated whether the organ is to be movable. If so, the battery would be necessary, and then I should think "clockwork" would be the best arrangement. R. S.

[97472.]—**Oil Engine.**—Much better buy a set of castings; they should only cost about 35s.—less than you can make the patterns for, and they will be correctly designed. Do not make an engine with a smaller cylinder than about 4in. by 2½in., which should give about ½B.H.P. at 400 revolutions. CLYTIE.

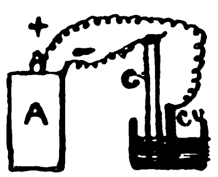
[97474.]—**Knocking in Gas - Engine.**—I would strongly advise "Country Parson" to test the tightness of the key securing his flywheel, as he may there find the cause of the knocking in his engine at every explosion. It is no use to merely try with a light hammer, which may fail to locate the trouble, as I have found on two occasions that on one of my gas-engines I have had to drive in the key with a sledge to stop a similar trouble. I may say the engine is of 14H.P., so required a good heavy hammer, a 4lb. one failing to put it right. It is not at all likely the leakage past rings is the cause of trouble. As to rings in gas-engines, it is surprising how indifferently these most important adjuncts are generally fitted, as either they have a gap in which, when in position, is a fixed stop, or they are cut across with a mere diagonal cut. Neither of these can be really made gas-tight. Quite recently I fitted a new set (four) of rings to my electric-light gas-engine, diameter of cylinder 7in., and made the joint as per sketch. I milled



out the joint—a vastly superior plan to filing—and got a perfectly gas-tight joint. Having cut the joints, as shown, I sprung the rings into size of cylinder, and took a light cut over to get a true circle, and a very few hours of working showed that the result was well worth all the trouble as against the old butt joints with a fixed stop.

Plymouth. E. H. MICKLEWOOD.

[97476.]—**Tinning Carbon.**—The first thing to do is to clean the end of the carbon you wish to tin; then place the end into a saturated solution of sulphate of copper. The arrangement is shown in the accompanying sketch. C the carbon plate



connected to the negative pole of a cell A. Cu copper plate placed with its face parallel to the face of the carbon, is connected to the + pole of the cell (you must be careful not to have the plates touching each other). When there is a fairly thick coating of copper on the surface of the carbon you wish to tin, take it quickly from the solution and rinse it in hot water, having ready a clean, hot, well-tinned soldering-iron. When rinsed run the iron quickly over the coppered surface. I say

quickly, because if the copper surface is exposed to the air it quickly oxidises; if this happens you will not get a nicely tinned surface on your carbon.

A. STAMMWITZ.

[97477.]—**Brasswork.**—The brass can be cleaned with rouge, with oxalic acid, or with ordinary "dipping acid," but it will soon tarnish unless protected by a coat of lacquer. I guess "Seeker" wants something that no one has yet found. If brass or copper is to be protected against the action of the air, it must be coated with something—a lacquer or collodion. The best way is to lacquer the work after it is thoroughly cleaned. Brass or copper will begin to tarnish directly it is exposed to the air, so the only remedy is a cover—otherwise lacquer.

R. S.

[97480.]—**Chlorine and Fluorine.**—Fluorine was first definitely isolated by Moissan in 1886 by the electrolysis of hydrogen fluoride, containing the acid potassium fluoride in solution. It had previously been found by Gore that perfectly pure anhydrous hydrogen fluoride would not conduct.

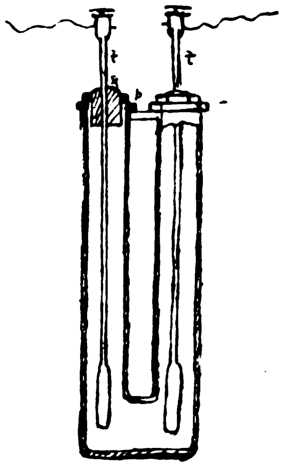


Fig. 1 shows apparatus used. The anhydrous hydrogen fluoride is poured into the U-shaped platinum-iridium vessel, with one-fifth of its weight of hydrogen potassium fluoride. The open ends are closed by fluorspar stoppers (*f*); these are ground so as to nearly fit the tube, and are then wrapped round by thin platinum foil. The electrodes (*t*, *t*,) are of platinum-iridium, held in position by leaden washers (*p*), the whole being covered with melted shellac. The U-tube is placed in a double-walled glass vessel containing liquid methyl chloride, which cools the tube to $-23°C$. On passing current from 25 Bunsen cells arranged in series, hydrogen is given off at the negative electrode, and fluorine at the positive pole. The fluorine is passed through a platinum spiral tube surrounded by methyl chloride, in order to condense any vapour of hydrogen fluoride; the last traces being absorbed by fragments of sodium fluoride contained in a platinum tube. In this manner from three to four litres of fluorine may be prepared in an hour. The reaction goes on as follows:—

(1) $2KF,HF = 2K + H_2 + 2F_2$

(2) $2K + 2HF = 2KF + H_2$.

Fluorine is a light greenish-coloured gas, with a pungent, irritating smell resembling that of hypochlorous acid. It is characterised by an extraordinary chemical activity. Sulphur is at once melted in it and inflamed; phosphorus takes fire; arsenic, antimony, and boron become incandescent; iodine inflames, and crystalline silicon burns with great brilliancy; fluorine combines with hydrogen with explosion even in the dark; organic compounds are violently attacked; cork is carbonised and inflamed; alcohol, ether, benzine, and turpentine take fire; glass is at once corroded. With liquid O as refrigerant, and in making a vacuum, it was found by Dewar and Moissan that the liquefaction of F takes place by evaporation of liquid O at a pressure of 325mm. of mercury. Boiling-point of F is $-187°C$. Density of liquid fluorine is 1·14; it still inflames turpentine at this temperature. It is a clear, yellow, highly-mobile liquid. Chlorine is interesting as being the first gas which was liquefied, viz., by Northmore in 1805—1806, who obtained it by heating chlorine hydrate in a sealed tube. Used in colour-making works and for treatment of gold ores. It was easily solidified by Faraday, about 1845, using a mixture of CO_2, snow, and ether as a cooling agent. Solid chlorine is a greenish-yellow mass melting at $-75°C$.

R. W. M.

[97480.]—**Chlorine and Fluorine.**—(1) Fluorine, the first of the halogen series, was the most recent to be discovered, it having baffled all attempts to isolate it until the year 1886, when Moissan succeeded in solving the problem. Its isolation depends upon the discovery that a solution of the acid potassium fluoride, HF,KF, in anhydrous hydrofluoric acid is an electrolyte, and that by the passage of an electric current through this solution fluorine is disengaged at the anode, or positive electrode, and hydrogen is evolved at the cathode. The primary decomposition taking place is the breaking up of the acid potassium fluoride:—

$$HF,KF = F_2 + H + K.$$

The atom of potassium, in contact with the free hydrofluoric acid present, is then converted into potassium fluoride with the elimination of an equivalent of hydrogen—

$$K + HF = KF + H.$$

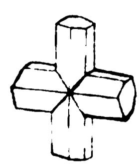
And the normal potassium fluoride then unites with a molecule of the acid to regenerate the acid salt—

$$KF + HF = HF,KF.$$

The reaction is performed in a U-tube made of an alloy of platinum and iridium, a material which is less acted upon by the liberated fluorine than platinum alone. The anhydrous hydrofluoric acid is introduced into the apparatus, and about 25 per cent. of its weight of the acid potassium fluoride is added, which really dissolves in the liquid. The tube is immersed in a bath of methyl chloride, which boils at $-23°$ C. On passing a current from 20 to 25 Grove's cells through the apparatus, fluorine is evolved at the positive electrode, and hydrogen at the negative. A more recent method (Brauner, June, 1894) is by heating potassium fluor-plumbate, $3KF,HFPbF_4$. At 200° C. this salt gives off hydrofluoric acid, and when heated to $230°-250°$ C. fluorine is evolved. With regard to its properties, it is the most chemically active of all the known elements. Fluorine appears to be colourless, judged by the small volume of it that can be viewed at once. Smell, like a mixture of chlorine and chlorine monoxide evolved from potassium chlorate and hydrochloric acid. When cooled to a temperature about $-185°$ C., it condenses to the liquid state (Moissan, May, 1897). Even gold and platinum are attacked by fluorine. (2) When chlorine is cooled to a temperature of $-102°$ C., it freezes to a yellow crystalline mass.

Bonnyrigg. GEO. W. STRATON.

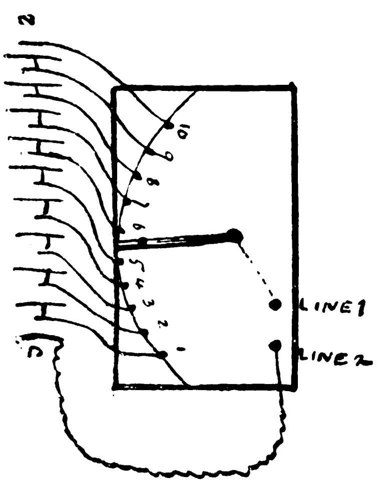
[97496.]—**Silicates of Alumina.**—Alumina has chemical formula Al_2O_3; silica or flint SiO_2. A large number of aluminium silicates occur native and constitute important minerals. Kaolin or porcelain clay $Al_2O_3,2SiO_2,2H_2O$ is produced by the decomposition of orthoclase $K_2O.Al_2O_3.6SiO_2$. Staurolite, which occurs in remarkable cruciform crystals (see figure) has the compositiom $4Al_2O_3$,



$3SiO_2$, a portion of the alumina being frequently replaced by ferric oxide; andalusite and kyanite have the formula $Al_2O_3SiO_2$; Allophane has the composition $Al_2O_3,SiO_2 6H_2O$. Specimens can be obtained from any chemical dealer.

R. W. M.

[97504.]—**Electrical.**—I trust that the accompanying sketch will answer your purpose.



S. ELLIMAN.

[97511.]—**Radiometers.**—The term "ultra-gaseous state" is used when a gas is so highly rarefied that the mean free path of its molecules becomes of appreciable magnitude—can be easily obtained by a Sprengel pump. A fair state of ultra-gaseity would give M.F.P. of 5cm. (2in.), the pressure would then be about $\frac{2}{1000000}$ atmos., and the number of molecules per c.c. about 2×10^{13}. The properties of the ultra-gaseous state, as far as they are purely thermal or mechanical, are best studied by means of Sir W. Crookes's radiometer (see Fig. 1).

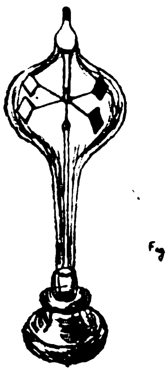


Fig 1

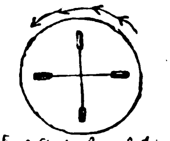


Fig. 2 Direction of revolution of radiometer.

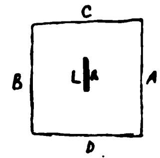


Fig. 3.

It consists of a glass vessel, at the bottom of which is a glass support carrying a fine steel pivot. On this revolves a light glass cup carrying four aluminium vanes, fixed vertically to the extremities of a pair of light horizontal arms at right angles. One side of each vane is coated with lampblack and the other left bright, and arranged so that all the black faces look the same way round a horizontal circle. The interior of the vessel contains air in the ultra-gaseous state. (See Fig. 2 for direction of rotation.) If the gas in the vessel falls short of the ultra-gaseous state, the vanes rotate very slowly in a direction opposite to the arrow. As the ultra-gaseous state is approached they become stationary, and when it is well maintained they behave as shown in figure. If exhaustion is carried too far they again become stationary. All these actions have been mathematically investigated by Clerk-Maxwell; we shall confine our explanation to general terms. (See Fig. 3.) Let A B C D be a vessel containing gas wherein is suspended a disc whose right face, R, is black, and its face L bright, and let the vessel be exposed to radiation equally all round. Then, since R is a better absorber than L, it becomes hotter. Now, temperature of gas close to either face is practically equal to temperature of face, and since the higher their temperature the greater the molecular velocity μ of mean square, the velocity is greater over R than over L. From the fundamental equation $p = \frac{1}{3} \rho \mu^2$ it is therefore clear that if the difference of temperature between R and L does not establish any appreciable difference of density, the augmentation of μ must render the pressure on R greater than on L, and so drive the disc (if free to move) from right to left. But if the difference of temperature sufficiently diminishes the density over R as compared with that over L, this diminution may, in accordance with equation (ρ = density of gas), just compensate for augmentation of μ, the pressures on the two faces remaining equal, and no movement occurring; or it may be over-compensated, in which case the disc moves from left to right. Consider three cases:—Case 1. When gas falls considerably short of ultra-gaseous state. Here the hotter molecules, after rebounding from R, encounter numerous others which obstruct their progress towards A; this diminishes the density over R, and increases it over L, and so over-compensation above referred to is produced; the disc therefore moves to the right. This corresponds to rotation of the radiometer opposite to arrows (Fig. 2) when insufficiently exhausted. Case 2. When the ultra-gaseous state is nearly attained. Here the rebounding particles still encounter others, but not so many; the obstruction and consequent flow from R to L is less, and the diminution of pressure just compensates for the augmented velocity; the disc accordingly does not move. This corresponds to the non-rotation of the radiometer vanes when the exhaustion has reached a certain pitch. Case 3. When the ultra-gaseous state is well maintained. Here the rebounding particles encounter practically no others; the flow and density diminution are practically nil, and there is nothing to compensate for the augmented velocity; the disc therefore moves to the left. This corresponds to the ordinary action of a properly made radiometer. The reason the radiometer does not revolve when the exhaustion is

carried too far is because the actual pressures on each side of the vanes are so minute that their difference is insufficient to overcome the friction between the cup and the pivot. It should be noted that we have supposed vessel A B C D to be exposed to radiation equally all round. This is quite unnecessary with the radiometer, since if, in a certain position, the bright face of one vane is towards the source of radiation, and dark face away from it, the effect of the bright face getting hotter is more than compensated by the vane at the other extremity of the same arm. Case 3 is probably reached when mean free path = R A (Fig. 3), borne out by fact that the larger the bulb the more complete must be the exhaustion. If a gas between two surfaces be such that mean free path of molecules is not much less than distance between the surfaces, it is called a Crookes's layer. Therefore a radiometer only works when there is a Crookes's layer between the vanes and the bulb. R. W. M.

[97517.] — **Propellers.**—Herewith I give particulars of two large fast twin-screw ships at a moderate and top speed. One is a recently-built cruiser, the other a mail steamer.

	H.M S. *Diadem.*		S.S. *Normannia.*	
Length	435ft. 0in.		498ft. 9in.	
Breadth	69ft. 0in.		57ft. 5in.	
Draught	26ft. 0in.		22ft. 3in.	
Block coefficient	0·495		0 582	
Displ. (tons)	11,000		10,590	
Diam. of screws	16ft. 9in.		18ft. 1½in.	
Pitch of screws	22ft. 11in.		26ft. 9in.	
Developed surface	116sq.ft.		175sq ft.	
Speed of vessel (knots per hour)	20·72	16·01	20 75	14·53
I.H.P.	17,104	6,277	16.244	4,310
Revs. per minute	118·6	86 9	92·5	60
Slip of screws	23°/。	17 9°/。	15°/。	8·2°/。

The above examples are the nearest I could get to the speeds required; the developed surface given is for both screws. I suppose your correspondent need not be warned that the slip per cent. as usually stated (and given above) is only the "apparent" slip. To find the true slip we require to know the speed of "wake" or shell of water which accompanies every ship in motion. This wake is a function of block coefficient, length, and speed. Hitherto practical men have only been able to get approximate values of this important quantity.

Glasgow. CLUTHA.

[97522.] — **Solution Wanted.** — The indeterminate equation of "E. H. R."—viz.,

$$16v + 13w + 9x + 21y + 5z = 17(v + w + x + y + z)$$

becomes by transposition—

$$4y = v + 4w + 8x + 12z$$
$$\therefore\ y = \tfrac{1}{4}v + w + 2x + 3z.$$

Therefore if v be any multiple of 4, we may give to w, x, z any integral values we please.

West Norwood. HENRY T. BURGESS.

[97523.]—**Curious Geometrical Figure.**—If "E. H. R." will get a piece of the gummed margin of postage stamps and fold it with a half-twist, as he has done, and then cut it through longitudinally, he will find something more curious than the fact of its having only one edge and one side. He will get one ring double the diameter and half the width of the original ring. If this is cut through again the result will be two rings linked together like a chain, and, of course, one quarter of original width. Take another piece and fold it with a complete twist—this is, two half-twists—then cut through lengthwise, and the result will be *two* rings of same diameter as the original. If a ring is folded with three half-twists, the result, after cutting lengthwise, will be one ring double the diameter, but with one side twisted round the other like a knot. By repeated cuttings of these rings the convolutions become so complicated as almost to defy tracing them. The more twists given on first folding, the more complicated and curious the result. I saw this given many years ago as a kind of illustration suggestive of a "fourth dimension of space." A ring with one half-twist has only one edge and one side, because the twist has brought the outside edge into line and continuous with the inside edge, and the top side has been turned over and brought surface to surface with the under side. All odd twists, no matter how many, produce, when cut lengthwise, a ring double the diameter with the number of twists also doubled. All even twists produce two rings of same diameter, each one of which, if cut through again, produces two rings, and so on indefinitely; the odd twists, after the first cutting, doing the same. Try one with four half-twists, and one with five; the result is not only in the highest degree unexpected—it is simply bewildering. JAMES PARIS.

[97525.]—**Threshing.**—The first process, the threshing, is performed by a rapidly-revolving drum, having about six or eight beaters bolted to its circumference. This is surrounded for about a third of its circumference by a concave or breast-work capable of adjustment nearer or farther from the drum; the sheaves, after the bonds have been cut, are opened out and dropped on the drum in as even a stream as possible, being carried between the drum and concave, some of the grain being knocked out by the beaters, and some rubbed out between the beaters and concave. After the straw, &c., escapes from between drum and concave at the bottom, it falls on the shakers; these, generally four or five in number, are wooden frames with cross-bars, something like ladders with the staves very close together, and are mounted on cranks in such a manner as to carry the straw forward, at the same time giving it a severe tossing, and so shaking out any loose corn which may not have separated from it. When first leaving the drum the straw is delivered over the end of shakers, whence it falls to the ground ready to be taken away. Under the shakers is a reciprocating kind of wooden tray (the riddle) which catches the grain and short straws, &c., which work along till they come to a place where the tray is perforated with holes about ¾in. or 1in. in diameter; the grain and chaff fall through these, and the short straws pass on over the end, where they fall to the ground and are called cavings. The grain and chaff, after falling through the riddle, are met by a blast from a fan, which blows out the chaff, the grain going on to sieves which remove anything larger than the grain, such as small pieces of stick or stones, &c. It then goes on to an elevator, and if the machine is a double-blast finishing machine, and wheat is being threshed, it may be turned through a kind of secondary drum to knock off any chaff which may adhere to some of the grains. It then goes before another blast, and through a second set of sieves, and finally into a revolving screen, which takes out cracked or shrivelled corn, the best passing right through the screen into the sack. The screens usually make three divisions of the grain, and are adjustable. When barley is being threshed it is caused to pass through a cylinder, through which runs a spindle studded with knives, which cut off the awns or beard of the barley; the knives act as a screw conveyor. In the makers' catalogue they generally give diagrams showing the different parts of machine. LOYAL ENGLISHMAN.

[97528.]—**Power for Motor.**—Theoretically, the power required to drive a dynamo having an output of 40a. at 100v., is 5·36H.P. Practically, it will not be less than 6H.P. In like manner, the theoretical output in H.P. of a motor excited by a current of 40a. at 100v. would be 5·36; but, allowing for conversion losses, it will probably not exceed 4H.P., or less, if the distance to which the current has to be conveyed is considerable. S. BOTTONE.

[97528.]—**Power for Motor.**—If these motors are of moderately good design, an efficiency of 85 per cent. may be assumed. Consequently, with an electrical H.P. of 4,000 watts (100v. × 40a.) as a dynamo either of the machines will require $\frac{4000}{746} \times \frac{100}{85} = 6{\cdot}28$B.H.P. In the same way the motor when supplied with 100v. 40a. will give out $\frac{4000}{746} \times \frac{85}{100} = 4{\cdot}55$B.H.P.

A. H. AVERY, A.Inst.C.E.
Fulmen Works, Tunbridge Wells.

[97528.]—**Power for Motor.**—You would require 5B.H.P. to drive the dynamo, and you might reasonably expect to get 4B.H.P. to 4½B.H.P. on the shaft of the motors, if both machines are of modern design and efficient.

Dudley. WEBSTER, MICHELSON, AND CO.

[97531.]—**To Mr. Avery.**—If the Lahmeyer dynamo is to be built exactly same size as the reduced copy in the December *Model Engineer*, it will be necessary to substitute a cogged drum armature, or the magnetic reluctance of the circuit will be too great. I should advise the following:—Cogged drum armature, six teeth, wound with 360 conductors No. 24 S.W.G.; field coils, 440 turns of No. 22 S.W.G., connected in shunt; output 10 volts 3 amps. at 2,800 revs. as a dynamo, or $\frac{1}{15}$B.H.P. as a motor at the same speed.

A. H. AVERY, A.Inst.E.E.
Fulmen Works, Tunbridge Wells.

[97532.]—**Electro-Motor.**—To MR. BOTTONE.—Altogether too small and too skimpy to make a good dynamo. Put in a tripolar laminated armature; wind this with about 2oz. No. 24 silk-covered wire. If now you can manage to get 8oz. No. 26 on each limb of the F.M.'s, and connect these up in shunt, you will get the best attainable results—viz., about 6v. 1a. at 3,000 revs. Current required to drive as a motor, 1a. at 6v. pressure. S. BOTTONE.

[97534.]—**Turning Vulcanite.** — Vulcanite is worked and turned like the hard woods, scraped and filed smooth, and receives a delicately fine, even surface, rather than a polish, first with emery-paper or the powder on rubbers with oil, and is finished with rottenstone powder and oil applied in same manner, and then the dry powder, which many apply in palm of hand. REGENT'S PARK.

[97534.]—**Turning Vulcanite.**—Ebonite is very easily turned by hand in an ordinary lathe, using a sharp chisel as for wood. Try French polish.

Salisbury. E. R. DALE.

[97534.]—**Turning Vulcanite.**—The best way to turn this material is undoubtedly with the slide-rest, using sharp-pointed dead hard tools. Flat and round edges are smoothed after first two or three cuts, and can only be used for round and hollow parts with a grindstone handy. Ebonite takes a beautiful polish by fetching out scratches with emery cloth, then finally using 00 blue-back, afterwards oil and chamois leather. Vulcanite may be treated same way. ELECTRO.

[97536.]—**Lacquering Bedstead.**—"W. A. H." may proceed in following manner:—Procure from chemist or colour merchant a sufficient quantity of lacquer of (I should recommend) a light shade, it being easier to manipulate; also some methylated spirits. With the spirits wash off the old lacquer, then heat the rail with Bunsen burner till you can just bear your hand on it; then apply the lacquer with a broad camel-hair brush in very light thin coats, waiting till one coat is dry before putting on another, which only takes a second or so, keeping up the necessary heat by the Bunsen. Rail may be polished before lacquering, but must be free from grease. ELECTRO.

[97537.]—**Induction Coil.**—To MR. BOTTONE.—You will find that discs of paraffined paper, built up to $\frac{1}{16}$in., will be quite equal in efficiency to vulcanised fibre, or rather superior, if anything. But the paraffin must be good, and should have been previously melted over some dried powdered chalk, to neutralise any acidity. Of course, the clear melted paraffin must be decanted off the chalk sediment before use. The paper circlets must be ironed together, so as to form a compact mass of the desired thickness, and should fit the tube tightly. S. BOTTONE.

[97538.]—**Wood Connecting-Rods.**—Wooden connecting-rods have greatly taken the place of iron ones on threshing machines, as they bend and require no oil or grease. E. R. DALE.

[97539.] — **Wood Connecting-Rods.** — First cost, to enable machine to be sold for less than if fitted with metal. £ s. d. is the governing factor in all productions. MONTY.

[97540.]— **Quick - Drying Black Paint.** — "Constant Reader" does not say if he wants his paint dead or glossy; but, if either, I think he will have a job to make it cover on white ground. In fact, he will find it, I'm afraid, impossible. The quickest drying will be the dead or dull, which you can varnish afterwards if required glossy. The following may suit you:—Get a tin of drop black ground in turps, and mix with turpentine till thin enough, and add sufficient gold size to bind it or to keep it from rubbing off. Very little is sufficient. I may say it will not weather without being varnished, but would last all right inside providing there is no handling. HOUSE PAINTER.

[97540.]—**Quick-Drying Black Paint.**—Black enamel will be suitable, or he can rub up drop of ivory black in a little French polish, and thin to suit with methylated spirits. FRED DAVIS.

[97540.]—**Quick-Drying Paint.** — Lampblack ¼lb. Make this red-hot, leave to cool, then crush to powder; then add spirits turpentine half-pint. May be worth a trial on small scale; lay on quickly. REGENT'S PARK.

[97541.]—**Planing Machine.**—I think 3in. is thick enough for the size you name. In reference to the rack and wheels, double-skew teeth are better than plain spur-gears if the teeth are made correctly as parts of true spiral. But there the difficulty comes in. The helical teeth would be cast, while spur-teeth can be cut, and have no backlash. Probably you know that the Sellers planers are rack-driven by a worm, and run remarkably smooth. An alternative would be a screw with differential bevel-wheels to operate it; or a crank drive, which is more precise, like a shaper. J. H.

[97541.]—**Planing Machine.**—To "J. H."—ERRATA.—I notice thickness of table is given as 3½in., it should be 2½in., and for the word "beams" read *bearers*.

Bromley, Kent. A. F. SHAKESPEAR.

[97544.]—**Welding Compound.** — Borax 10, salammoniac 1; grind together; fuse until spume has gone. When clear, pour out to cool and concrete. Grind to powder, raise steel to bright yellow heat, dip into powder, heat as before, and hammer. Or, pulverised white marble; heat pieces, roll in marble, and hammer. (A. A. Hopkins.) REGENT'S PARK.

[97544.]—**Welding Compound.**—The following seems much used:—1 part salammoniac, 10 parts borax. These are pounded together and fused until clear. It is then poured out, and allowed to cool, when it is then pounded to *powder*. To temper a chisel: first heat the chisel in the fire to a dull red heat, cool the point of it in

water, and rub with sandstone. When the colour of brown yellow comes to the point plunge it into water. The temperature is 500° Fahr. STUDENT.

[97543.]—**Indicated Horse-Power and Probable Brake Horse-Power of Compound Engines.**—Assuming Boyle's law, we get that the final pressure is 30lb.; then, for low-pressure cylinder—

$$p_m = \frac{60}{2}(1 + \log_\epsilon 2) - pb\ (= 3\text{lb.})$$
$$= (30 \times 1{\cdot}69) - 3 = 49{\cdot}2\text{lb.}$$

Then, for high-pressure cylinder—

$$p_m = \frac{120}{2}(1 \times \log_\epsilon 2) - 49{\cdot}2$$
$$= (60 \times 1{\cdot}69) - 49{\cdot}2 = 52{\cdot}7\text{lb.}$$

$$\text{I.H.P.} = \frac{2\ P\ L\ A\ N}{33{,}000}$$

For H.P.C.—

$$\text{I.H.P.} = \frac{2 \times 52{\cdot}7 \times 114 \times 180}{33{,}000} = 96\text{H.P.}$$

For L.P.C.—

$$\text{I.H.P.} = \frac{2 \times 49{\cdot}2 \times 285 \times 180}{33{,}000} = 152\text{H.P.}$$

Total I.H.P. = (96 + 152) = 248I.H.P. Brake horse-power = 75 per cent.

$$\frac{75}{100} \times 248 = 186\text{B.H.P.}$$

These values are too high, as sufficient data are not given for accurate calculation. STUDENT.

[97546.]—**Transformer.**—To MR. BOTTONE OR MR. AVERY.—Premising that in order to make such a transformer of small size you must use in conjunction with it a suitable resistance or self-induction coil to pull down the current to 8 amps., you will find that the following proportions will give you good results:—Iron core, 7in. long 1¼in. diam., built up of No. 22 soft-iron wire; heads of bobbins should be soft-iron plates fitting tightly on the core. The whole should be dressed with india-rubber tape, then wound with ½lb. No. 18 d.c.c. for the primary, and ¼lb. No. 14 d.c.c. for the secondary. If the whole coil is inclosed in a roll of soft sheet-iron, screwed to the bobbin-heads, it will work all the better; but, of course, holes must be put through this covering to admit of the passage of the ends of the primary and secondary wires—which holes should be bushed with ebonite. Could not well be used with direct current. S. BOTTONE.

[97547.]—**Induction Coil for Motor.**—To MR. BOTTONE.—For your particular purpose, and especially using such small current batteries as those you name, the wire of the primary presents far too high a resistance. I make no doubt that if you remove the 24, and substitute for it an equivalent weight of No. 18 d.c.c., you will do all you desire. (2) It is possible that I used wire of somewhat finer gauge than yours. B.W.G. is not a standard size, and varies a good bit. It may also be that I made some mistake as to the precise weight. Anyhow, four layers is the amount I used; but not for a motor-car coil. S. BOTTONE.

[97549.]—**Hardening Soft Steel.**—For thin steel use:—Beef suet 3lb., train oil 1½gal., wax 6¾oz.; add rosin 1½lb. REGENT'S PARK.

[97549.]—**Hardening Soft Steel.**—Heat the articles to be hardened in a muffle to a bright red; then plunge them into common linseed-oil. They can then be polished, and let down to the required shade of colour by any of the usual methods. As I have had no experience with whale oil, I cannot say if it will harden steel. You might as well add brickbats to it as to put resin or potash in it so far as the effect on the steel would be, so that "Polished Pincer" will do well to keep to pure oil. I presume "P. P." is using a good-quality cast steel. E. W. FRASER.

[97550.]—**Electrical.**—Very little is to be gained by coupling-up a voltmeter when charging as you state. Couple your three bichromate cells in series, and take a reading with the voltmeter to see whether they are giving six volts. Now couple the cells direct to the accumulator. After a fair time of charging uncouple the accumulator, and test it alone with the voltmeter. When it is fully charged it should indicate 4·4 volts on the meter. The amount of oil of vitriol in a one-quart cell will be about 6oz., thus:—Water, 1 pint; bichromate of potash, 3oz.; oil of vitriol, 3oz. S. BOTTONE.

[97551.]—**Leather to Glass.**—Bicycle-puncture solution or Prout's or marine glue, or shoemaker's paste or glue-paste will do this if no wet comes near. FRED DAVIS.

[97551.]—**Leather to Glass.**—Secotine. E. R. D.

[97553.]—**Magnetic Induction.**—Purely a matter of convenience. When a mass of iron (an armature, is placed between the poles of a magnet, it completes, more or less perfectly, according to its proximity, the magnetic circuit, and at every alteration in the strength of the magnetic field current can be taken off from conductor surrounding the entire circuit at any point, so that if independent coils are wound round any portion of the field-magnets, current can be taken from these, as well as from the armature. So in the coil, the magnetic circuit may be completed, or nearly completed, by making the core-wires twice as long as the bobbin, and binding them over to nearly meet at the centre. Then, of course, a separate contact-breaker is required. This is, in fact, the form given to the "Hedgehog" transformer. S. BOTTONE.

[97556.]—**Glass.**—"Cristal" corresponds to our English words "flint glass," which is a heavy lead glass. "Cristal de roche," like our rock crystal, is sometimes used to indicate quartz or pebble, same as used in the best spectacles; but no large windows are made of this, for the simple reason that no very large masses of transparent quartz are found. S. BOTTONE.

[97557.]—**Leather to Glass.**—The following cement will stick pretty well anything: 1 part indiarubber, 12 of coal-tar. Heat gently, and mix; then add about 18 parts shellac. It should be used hot. E. W. FRASER.

[97558.]—**Motor Crankshaft.**—Malleable iron is not suitable for crankshafts, being too soft and liable to blow-holes. It is more suitable for any thin flat or hollow work. The so-called cast steel is more frequently mall. iron. There is Mitis iron, which might suit, made from Swedish wrot. iron to which a small quantity of aluminium has been added. Why not make two small cranks, with a coupling between? This is the usual method adopted. MONTY.

[97560.]—**Cellulose Packing.**—Bloxam gives cellulose when pure is white, opaque; is infusible and insoluble in all ordinary solvents. Dissolved by Schweitzer's reagent, and presumably has long life. REGENT'S PARK.

[97561.]—**Paint and Oil for Models.**—Has "Cymro" tried vaseline on the bright parts? I could not say if it would do, but it may. I do not think you will do better than use Brunswick or, what is better, Japan black; both quick-drying, and will stand steam heat. HOUSE PAINTER.

[97561.]—**Paint and Oil for Models.**—"Cymro" should use one or the other of the muchly advertised sewing-machine or cycle oils for his models. Blacklead and tallow mixed is grand for cylinder grease. When putting models away, coat them with common vaseline. It never dries, and does not affect steel or iron. I once had a £20 model nearly ruined through putting it away coated with machine oil; so do not use it, except for bearings. Paint to stand hot water can be got of any colour at any colourman's. Personally, I prefer Maurice's bath enamel. By the way, "Cymro" should not paint his cylinders; they should be lagged. E. W. FRASER.

[97562.]—**Water Bath.**—Because water will never boil unless it can circulate freely, and the metal holding it prevents this. FRED DAVIS.

[97563.]—**Wireless Telegraphy.**—There are two ways open to you. (1) Arrange the relay with the armature horizontal, and nearly balance it by a short wire and counterpoise; or (2) control the armature by means of a very fine helix of very fine wire and controlling screw. S. BOTTONE.

[97564.]—**Cleaning Enamelled Slate.**—I wash mine carefully with soap and warm water, and, if not smooth, French-polish it with a little black stain dissolved in it—like black polishing is usually done. FRED DAVIS.

[97569.]—**Automatic Duplex Diaphragm.**—This consists of two ordinary cells joined together with a tube, to allow of a second outlet at right angles, like the letter T; the usual floating weight and limiting screw are fixed to one cell, and the glass diaphragm is placed in the other, and the two connected with a long needle. I am greatly disappointed with mine, as it gives far less sound than the ordinary (single) one. FRED DAVIS.

[97570.]—**Specification for 3in. Spark Coil.**—To MR. BOTTONE.—Your general plan is good. The only point of weakness is the ebonite tube: it should not be *less* than ¼in. in the shell. However, you can probably use your existing tube with perfect safety if you bind it round with well-paraffined demy paper until you have increased the outside diameter to 1½in. Put 12oz. of wire in each division. Ebonite is polished by rubbing with soft flannel, dusted with putty powder, and moistened with paraffin oil. S. BOTTONE.

[97573.]—**Bare Patches on Animals.**—Generally caused by a skin disease, a kind of eczema, due to too much fat food. Let doggie have more biscuits, more grass, and less meat. Pussy will benefit by being kept to bread and milk. To effect a rapid cure give 5 minims a day to each animal of Fowler's arsenical solution to the cat in the milk, to the dog on bones. This solution is flavoured with *lavender*, and some dogs object so strongly to this smell that they will not touch food containing it. In this case ask your chemist to give you the *acid* arsenical solution; this has no smell or taste. Of course you must not give more than five drops; otherwise you may kill your pets, instead of curing them. S. BOTTONE.

[97573.]—**Bare Patches on Animals.**—These are due to weak health. Strumous or scrofulous children and aged people lose their hair, both from same cause—weak health, causing degeneration of the hair-supplying glands. The only remedy is raising the "tone" of the animals—plenty of fresh air, cleanliness, wholesome food, tonics, &c., just like human animals. FRED DAVIS.

[97573.]—**Bare Patches on Animals**—are probably mange. Try this as a simple one of some nine in Beasley's "Book of Recipes." Ointment: Charcoal powder 2oz., sulphur 4oz., salt tartar 1dr., Venice turpentine ½oz., lard 6oz. REGENT'S PARK.

[97573.]—**Bare Patches on Animals.**—These are due to a parasite. Persons coming in contact with the animals may be affected in the same way. The cure is dilute acetic acid; use each day till the hair can be distinguished on the patches, when the cure is complete. ROY.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered, are repeated four weeks afterwards. We trust our readers will look over the list, and send what information they can for the benefit of their fellow contributors.

Since our last "Optical L." has replied to 97301.

97133. Kelvin's Rule for Size of Feeders, p. 366.
97139. Rearing and Keeping Goats, 366.
97144. Acetylene Cycle Lamp, 366.
97146. Stanley Telephones, 366.
97147. Britain v. United States, 366.
97148. Isle of Man Steamers, 366.
97153. Building an Alternator, 366.
97163. Aluminium Gas-Engine, 367.
97167. Backstay for Use with Traversing Mandrel, 367.
97168. Flare Spots, 367.
97169. Oil-Engine for Launch, 367.
97171. Stone, 367.
97182. Extra-hardened Grammaphone Needles, 367.
97184. Portrait Painting in Water-Colours, 367.
97186. Speculum, 367.

97321. Oxyhydrogen Blowpipe, p. 457.
97329. Electrical Contact for Regulator, 457.
97337. New Form of Microscope, 457.

QUERIES.

[97575.]—**Crowdus Battery.**—Full particulars of same will oblige.—BATTERY.

[97576.]—**Edison Phonograph Grand.**—A rough sketch and description of speaker and records of this instrument will oblige.—PHONO.

[97577.]—**Electric Organ Action.**—Can any reader tell me what size wire to use for electro-magnets for organ action? How much wire per magnet, and what size core? The armature-valve is a free ferrotype disc, ⅝in. diam. What size wire for cables? Flexibility is no object, as console is fixed. Will cotton-covered wire do for magnets and cables? I am using three or four Leclanché cells. Should they be connected in series or parallel? Robertson's excellent book gives no practical information on this branch of the organ trade. Any hints would be very acceptable.—ZADDEUS.

[97578.]—**Lathe Matters.**—Would some of our lathe experts kindly advise as to the adaptability of the "Barnes" or "Star" 4½in. lathes for the fitting of milling attachments? Possibly some of our readers may have such attachments fitted to lathes of the above or other American makes. I feel sure that a description of same would be of interest to many of our friends interested in lathe matters. Personally, I fear the "Barnes" 4½in. lathe would not be sufficiently rigid for milling purposes, except very light work. I feel sure the 4½in. "Star" lathe would be more satisfactory in this respect, and it also has the advantage of automatic cross-feed. The former weighs 270lb. and the latter 333lb., I believe. I know the workmanship in the "Barnes," also that the metal is intelligently distributed, although the tool is light. I am wishful to obtain information in this respect with regard to the "Star."—HENRI.

[97579.]—**Affection of Moustache.**—Can any of "ours" give a remedy for the above? I have consulted my club doctor, and he says he has read of the affection somewhere, and that it is "hair jointed like bamboo," but gives no remedy, merely saying that it will go off again, and that it is not due to parasites, or anything of that kind, and that it is not likely to spread to any other part of the body or head. There are as many as half a dozen joints on some of the hairs, and they look as though they had been singed. They are easily broken off at the joints, and are then liable to split. I hope some of "ours" will be able to assist me in getting rid of this affection.—J. E. W.

[97580.]—**Sea-Water and Bacteria.**—I shall be much obliged if some of your correspondents can give me any information on the following points:—(1) What effect has sea-water on anaërobic and aërobic bacteria? (2) If a system of sewers is flushed by salt water, the sewage being carried to a septic tank and bacterial contact beds, would the bacteria do their work as efficiently as they do it in fresh water? (3) If 25 per cent. only of the water is salt (sea-water), the remainder being fresh, what effect would this have on the bacteria? (4) Have any experiments been made in this direction?—S. C. B.

[97581.]—**The Sun.**—Can prominences be seen with a

spectroscope on a 5in. achromatic? How many prisms? Direct vision or radial?—CORONA.

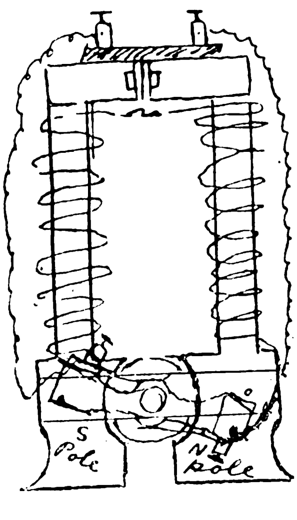
[97582.]—**Model Traction.**—Will some mechanical friend explain the method of the fast and slow speeds. and the way they are arranged on a traction engine? Also, how is the compensating gear arranged on the road wheels? A sketch would oblige.—N.

[97583.]—**Mercurial Column.**—Could any reader give instructions how to construct mercurial column for the testing of pressure gauges?—USAGE.

[97584.]—**Bone Bearings.**—Can "Jack of All Trades" say whether these would work well, with salt water only as a lubricant, in such bearings as those for the gunmetal journals of centrifugal circulating pumps for marine work? These are usually of lignum vitæ.—W.

[97585.]—**Electric Cables in Coal Mine.**—Will any kind reader let me know how electric cables are run in a coal mine? Are they put on insulator or not? Do they use solder iron or ladle for branch wire in a fiery mine (for electric motors)?—JOHN HOLDEN.

[97586.]—**Plating Dynamo.**—To MR. BOTTONE.—You replied to my query, "Plating Dynamo" (97242). Having come into possession of some 22d.c.c., I put that on the field-magnets, eleven layers on each, which just took up all the available space, and seven layers on armature 18d.c.c., but I cannot get it to work. I have magnetised the field-magnets with a No. 3 Leclanché cell. I send sketch showing connection, which perhaps I have



wrong. It does leak in winding, for I have tested it. The commutator has an oblique cut 1/16in. wide in it. If you rectify the cause of failure, I should be obliged.—SECULARIST.

[97587.]—**Motor Car.**—I should be obliged if the writer of the articles would give me a little information on the construction of core boxes for the cylinder, and especially the end for water jacket. I have a foundry of my own, and can manage any ordinary castings, but have had a difficulty with water-jacketed ones. I have made several gas-engines, and to get over the difficulty have brazed the water jacket on separately.—J. M.

[97588.]—**Acetylene Burners.**—I cannot get a burner for optical lantern work that is satisfactory. Will someone kindly assist me?—LANTERNIST.

[97589.]—**To Mr. Bottone.**—I wish to construct a small dynamo continuous current capable of giving a pressure of 40 volts, and sufficient current to light eight 10c.p. lamps. I also wish to charge accumulators with it. What kind of armature do you recommend? Also, what length and gauge of wire shall I use for armature and field-magnets, and what should be their dimensions?—J. O. T.

[97590.]—**Sound.**—At Butha Bathe, and at Ahlotsi, in Basutoland, they can hear the big guns at Ladysmith —130 miles away. They want to know—1. Does rain, not fog, help, retard, or affect sound as to its travelling distance? 2. Does very rare atmosphere help, retard, or affect sound—Ahlotsi plateau is over 6,000ft.? Would that atmosphere help or retard, as compared with the atmosphere of the sea level? 3. Would the fact that the sound has to cross a range of mountains help or retard?—S. BOXWELL.

[97591.]—**Differential Gear.**—Will any reader kindly explain the action of the common form of differential gear, as applied to traction engines, &c.? A sketch or two would be very much appreciated.—COMPENSATE.

[97592.]—**Silicate of Alumina.**—I am much obliged to Mr. Bottone and Mr. Forman for replies on this subject. I want a silicate of alumina which would fuse and become very hard when subjected to a powerful heat, giving as a product something like glass. Which, amongst the various things named, would be best?—S. W.

[97593.]—**Wireless Telegraphy.**—I should be much obliged if Mr. Bottone would kindly tell me what size, and how to make a Leyden jar to use with a ½in. spark coil for wireless telegraphy, and also whether it is best to use one or two jars?—CARLIOL.

[97594.]—**Motor-Car.**—To THE "WRITER OF THE ARTICLES."—Will you kindly say if I can use common paraffin oil instead of petrol in the motor you are describing? If not, what alterations would be required? I see motors for paraffin are advertised in this paper. Ten miles per hour will be the fastest speed I shall want to travel. Will you also tell me if there is a tax or license on motor-cars? I have been told that all motor-cars must be fitted with gear for backward motion. Is that so? I cannot find anything relating to the Locomotives on Highways Act in the "E. M."—W. H. W.

[97595.]—**Motor-Car.**—Could the "Writer of the Articles" please give me some idea of the lowest cost of making the present motor-car? I should make it of wood as described, and with solid rubber tires on the wheels. The woodwork to be stained and varnished, as I should use loose cushions on the seats. I should also like to know the length and breadth of the car, and the height of the wheels?—CARLIOL.

[97596.]—**Kitchen Range.**—Would some competent subscriber give instructions, with working drawings and scantlings of materials, for making a small wrought-iron kitchen range to burn solid fuel, with oven and hot-water vessels, adapted to a family of three or four persons?—M. G. MATTILICH.

[97597.]—**To Mr. Bottone.**—Thanks for your reply in Jan. 5 concerning reversing arrangement of armature. Will you kindly inform me if the method described in Fig. 2—viz., series wound motor—is applicable to motors of considerable power, say two-horse?—J. H. C.

[97598.]—**Elleviegen Light.**—What quantity of oxygen gas does a saturator require per hour? Could a saturator be used with an injector jet?—G. P.

[97599.]—**Permanganate of Potash Battery.**—Could Mr. Bottone, or any other electrician, inform me the best way to make the above battery, as I am told it is stronger than the bichromate?—J. W.

[97600.]—**Nickel or Silver-Plating Small Articles.**—The best method of doing same, whether by dynamo or batteries? I have plenty of power and tools, &c., but I have practically no knowledge of it. Will some kind reader oblige and name a book on the subject?—PLATER.

[97601.]—**Power of Boiler.**—Will a boiler, 30in. by 12in., with internal firebox and a single flue, and a working pressure of 50lb. per square inch, drive an engine 3in. bore, 1in. stroke, at 100 revs. per minute? If not, what sized engine will the boiler steam if the stroke and speed are to be kept the same? The engine will be of the vertical inclosed and balanced type, and run in oil. With steam cut-off at ¾in. stroke, about what power should I get? I should add that the cylinder is double-acting.—E. W. FRASER.

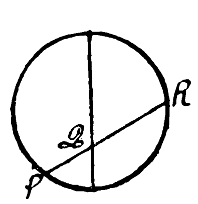
[97602.]—**Motor-Car Engine.**—Would the writer of the articles on "Motor-Cars," or any correspondent, kindly tell me what alterations would have to be made to drawings in "E. M." to increase power to 4 B.H.P.?—POWER.

[97603.]—**Dilution of Creasote.**—Will some of "ours" oblige by giving information as to the best method of diluting creasote to the extent of from 1 part of creasote to 3 or 4 of the diluent? The diluent must not exert a deleterious influence on wood, and must be cheaper than creasote.—TIMBER.

[97604.]—**Mixed Jet.**—How do the oxy-hydrogen and oxy-coal-gas lights compare as regards brilliance? Is the manipulation as regards working of jet the same in each case?—LYMNOS.

[97605.]—**Grating.**—How may Thorpe's glass-plate diffraction grating be applied to camera, ordinary table spectroscope, and lantern? And how may wave-lengths be calculated by its means? Any other useful information will oblige.—LYMNOS.

[97606.]—**A Geometric Difficulty.**—Through a given point, P, in the circumference of a circle, to draw a



chord, PR, cutting a given diameter in Q, so that the segment QR of the chord may be equal to a given straight line. A solution of this, or any comment that may suggest a solution by plane geometry, would greatly favour.—A. J. D.

[97607.]—**Telescope.**—I have long desired to make a telescope of large aperture, and have at last, after reading of Mr. Glass's achievements, decided to make an 8½in. Newtonian of 84in. focus. Would some reader kindly clear up the following points for me?—(1) What should be the dimensions of the plain elliptical mirror, and what distance should its minor axis be from the face of the speculum? (2) Using the telescope terrestrially, what would be its maximum power, with good light, under average atmospherical conditions? I am making a machine to grind the speculum, like that made by Mr. Glass. (3) In this machine what should be the stroke of the grinder and polisher for an 8½in. mirror? (4) What should be the (a) size of and (b) space between the leaden facets and the pitch facets of the grinder and polisher? (5) What pressure should the grinding and polishing tools exert on the speculum? (6) Where can I get a good book on grinding and silvering telescope mirrors?—R. E. WATTS.

[97608.]—**Water Power for Electric Lighting.**—I am desirous of putting an electric light installation of some 150 lights into a country house, using water power. Will Messrs. Webster Michelson or someone else kindly inform me if I can get sufficient power from a breast wheel, 14ft. in diameter and 3ft. 5in. wide, with an available fall of 9ft., to charge a set of accumulators, sufficient to run 80 16c.p. lights for eight hours? The supply of water is practically unlimited, or only limited by the size of the stream which conveys it from the dam on the river. The distance of the house to be lighted, and accumulators from the water-wheel and dynamo, is 1,200yds. I should prefer not to have to work the dynamo for more than six hours per day, as the same power with another [illegible] works a sawmill when required.—ROYAL NAVY.

[97609.]—**Polyphone Attachment for Phonograph.**—Have any of our readers any experience as to the construction of this fitting, which is described in the "E. M.," No. 1797, Sept. 1, 1899? It seems to me to be a superb idea, and one simple of putting into effect. The phonograph is hardly clear enough for a fellow to copy from. Is the spectacle-frame hinged? and does the split boss or clip in sketch No. 2 grasp the sliding tube? I don't see how the fitting can be put on an ordinary phonograph, unless the whole of the spectacle-frame is removed. Can someone say who knows? Does our friend R. A. R. Bennett know anything of its merits? As I have nearly finished making a phonograph (which I shall shortly describe, with the Editor's permission), I should like to have the latest addition. What is a Bettini reproducer? Does it make much improvement in the speech of phonograph? What is about the pitch of teeth and the diameters of the train of three wheels which works the screw of 50 threads to the inch, carrying the spectacle-frame. I had three wheels cut (and they were beautifully done) for mine; on the ¾in. wheel there were 24 teeth, and on the 1½in. wheel 48. Of course, this was all right as regards the proportion of numbers, but the row those three wheels kicked up completely drowned all reproduction by the stylus. Have I had them cut too coarse a pitch?—SLIDE-RULE.

[97610.]—**Grammaphone.**—Will any of "ours" kindly help me if they can? Having built a grammaphone, I should like to make my own records, as I find it rather expensive to give 2s. 6d. for every record I want, and then only have songs and music of people I do not know. 1. What is the record to be made of? If a composition, I should like description of same. 2. Will an ordinary needle scratch the lines? 3. Shall I want a fine-thread screw to carry the sound-box to the centre of record-plate? And, if so, how many threads to the inch, and at what relative speed should record and screw travel at? Should I want a different diaphragm? If so, please give description.—CHUFFY.

[97611.]—**A Problem.**—Will any reader of the ENGLISH MECHANIC solve the following, which I give in its original form? "I have a spherical cheese 1ft. in diam. A sphere taken from the centre, 1in. in diam., weighs exactly ½lb., and is worth 1s. 6d. per pound. The surface of the cheese is worth 1s. 2d. per pound. The difference of weight of cheese from the centre to the surface is in the same ratio as the price. It is required to find the size and weight of a central sphere of this cheese, the value of which is to be exactly 5s." The working will oblige.—A. H. W.

[97612.]—**Constant Voltage.**—I have an apparatus which works well with 12 volts of electricity. The current is made and broken about thirty times per minute, and is only on a fraction of a second each time, and will at the most be used eight hours per day at above rate. Now, what I want is a constant supply of 12 volts when each contact is made. I have tried E.C.C. and National batteries, but these have soon grown weak. I know very little about the construction of batteries. Would some kind of accumulator do? Would someone kindly tell me what kind of battery, &c., I should require, or other information that would help? I want the battery clean and easily portable.—VOLT.

[97613.]—**Percussion Powder.**—Would any reader of the "E. M." give me a recipe for a percussion powder for putting into small rim-fire cartridges? I have tried chlorate of potash and sulphur mixed, but it does not seem sensitive enough. It should be capable of being made into a paste, so that on being poured into the cartridge it would solidify and fill the little rim. I believe the substance that is put into the small paper caps for toy pistols would suit my purpose very well if only I could find out what it is composed of.—AN OLD SUBSCRIBER.

[97614.]—**Nautical Telescope.**—Could any one of "ours" kindly tell me the cause of extremely bad definition of old nautical telescope? At a distance of twelve yards objects are clearly defined; but beyond that they become hazy in proportion to distance of removal. Its length from object-glass to eyepiece is 3ft. (36in.), outer tube of mahogany 19in. long, and sliding tube 17in. The object-glass is of 1⁹⁄₁₆in. aperture, and formed of two lenses—one convex crown glass in front, and one concave flint glass behind. The sliding tube has two lenses in small tube about 12in. from eyepiece, which has also two lenses. These lenses are all perfectly sound and clear. I would like to know whether the fault can be remedied, and also whether such a telescope would be of any use astronomically, and what alterations it would require. The lenses are all removable, and do not appear to be other than those put in when new. The sliding tube bears the inscription, "Hughes, London, Day or Night."—SPHINX.

[97615.]—**Electrical.**—Will any electrician kindly tell me the probable output in volts and ampères from an undertype dynamo? The armature is laminated, 3in. long, 2in. diameter (tripolar), wound with 27 yards No. 22 s.c. wire; fields, 2in. section (square), 4in. in height, wound with 2lb. No. 22 c.c. wire in shunt. What speed ought it to be driven at? Could I charge a 12-volt accumulator with this machine?—FRONTAL ATTACK.

[97616.]—**Jesse's Acetylene Generator.**—Will the correspondent (letter 43265) on Jesse's Acetylene Generator answer the following questions? (1) Will compo. gas-pipe do for the tubes mentioned, the large one in holder being of a larger size to slide as holder rises? Is this so? (2) Will ordinary gas-burner do? (3) How large will holder and generator be for, say, one burner to be kept on for three or four hours? (4) I presume the generator is lined by a water jacket to keep it cool. Does it fill from the vessel in which the holder is? (5) Is it not a lot of trouble to refill with carbide, and to get the mud out? I suppose the feed-hole is large enough to get one's hand in. Is this so? (6) If any gas is left in holder when the generator is refilled, what is to stop it coming back to same? Is there a tap? (7) Will the receptacle for purifying ever want refilling? (8) Will the seams of all parts do soldered?—S. R., Bromsgrove.

[97617.]—**To Mr. Bottone.**—Seeing your reply (96963) on dry cells, I have made the cell. I have half filled it with sawdust, with which I put half-pint of

water, 1oz. of chloride of zinc, 2oz. of salammoniac, and ½oz. of glycerine. This I soaked in a jar for four days, and then I made another paste of 1oz. of powdered carbon, ¼oz. granular black oxide of manganese, 60 grains of rouge, with sufficient golden syrup to make the paste, which I pasted on the carbon plate. I next placed a piece of cork in the bottom of the cell, and then filled in with the soaked sawdust, and then filled in with pitch. I had to use golden syrup, as I cannot get treacle. I do not know if that will make the difference. The cell will not ring my bell.—Constant Reader.

[97618.]—**Air Silencer.**—Will some reader kindly describe the construction, with a sketch, of silencer for air-inlet to small gas-engine, 3½in. bore, 5in. stroke, 250 to 300 revolutions per minute? It is very noisy when drawing in air on suction stroke. There is 8in. length of ¾in. pipe to air tap.—Tudor.

[97619.]—**Repairing Stone Steps.**—There is a powerful cement for repairing steps or making-up stone steps. Can anyone inform me what it is composed of? It makes a smooth surface, and is as hard as rock.—F. H.

[97620.]—**Concrete Floor.**—I have a concrete floor, the surface of which powders, covering everything with fine dust. I wish to be informed how to cheaply make it have a hard, smooth surface that will not powder and stand a fair amount of wear.—J. H. H.

[97621.]—**Vinegar.**—How can I make vinegar from old ale? I have a few gallons turning sour, and I know it can be done; but how to do it remains a query. How is malt vinegar made, and why is it there is so much difference in the flavour of vinegars?—Jimmy.

[97622.]—**Charging Accumulators.**—My charging switch is also the discharging. By having a six-way charging and discharging switch put on, could I charge cell 30 ampères while discharging 30 ampères, cells taking 60 ampère charge? And would it not be very economical, as our discharge is generally from 30 to 40 ampères?—A. Archer.

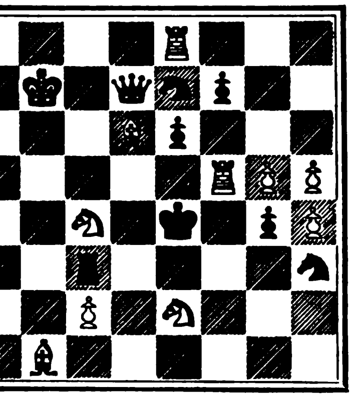
[97623.]—**Sizes of Telescopes.**—Will any reader kindly give a few particulars of the principal large telescopes—the "Lick," and that now being prepared for the Paris Exhibition, &c.—diameter of the o.g., focal length, magnifying power, diameter of mirror (when a reflector is used), &c.?—T. R. D.

CHESS.

All communications for this column to be addressed to The Chess Editor, at the Office, 332, Strand.

PROBLEM No. 1712.—By W. A. Clark.

Black. [7 pieces.



White. [12 pieces.

White to play and mate in two moves.

(*Solutions should reach us not later than Feb. 19.*)

Solution of Problem No. 1710.—By T. Taverner.

Key-move, Q-Kt 5.

NOTICES TO CORRESPONDENTS.

Problem No. 1710.—Correct solution has been received from Richard Inwards, F. B. (Oldham). H. B. F., G. W. U. ("The Q neatly outsteps the Kt in various directions"), J. E. Gore, Whin Hurst (May we wish "God speed and a safe return!"), A. Tupman, E. Hunt, Rev. Dr. Quilter ("A very instructive and excellent problem, and merits a first prize, although the key-move is not difficult to find"), N. M. Munro.

A. H. W., T. Chipperfield, B. E. D. (Genoa).—Only solution as above.

Metal, it is said, never rusts in the waters of Lake Titicaca. A chain or an anchor can be left it in two weeks, and will be as clean and bright as when it came from the foundry.

The production of aluminium in the United States last year did not greatly exceed that of 1898, when the output was 5,200,000lb. The prices of this metal remained practically unchanged through the greater part of the year, a slight reduction in quotations having been made towards its close. The selling prices in the United States for No. 1 ingots, 99 per cent. pure, range from 33c. to 37c. per pound, and No. 2, 90 per cent., from 31c. to 34c., while rolled sheets held at 42c. and upwards per pound, according to quantity purchased. The production continues in the hands of one company.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 332, *Strand, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries, put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded, and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Feb. 7, and unacknowledged elsewhere:—

Interested.—G. E. Bonney.—Electric Sign.—R. W. B.—Young Electrician.—Jack of All Trades.—J. E. L.—Robbie Burns.—Silver Plume.—Theodore Brown.—Ajax.—Acetylene.—Bird.—Dragoon.—Grove.

G. J. Cocks.—We know nothing of them. If you want to make inquiries, you should write the Superintendent of Police, Derby.

Slide Rest.—When suggestions of the sort referred to are offered, readers should try them for themselves—if they think it worth while. We really cannot spare space for replies to questions asking whether such "are successes" or not.

F. C. Lambert.—Linen or cotton will do, or the special material to be seen on mounted maps. Stretch it over a board and damp it, then paste the map and lay it on, letting the centre touch first. Work out towards the sides. Press down with another board until dry.

A. M. B.—The original "graph composition"—a patent—was 1 part of glue, 2 parts of water; when melted, add 4 parts of common glycerine, a few drops of carbolic acid, and sufficient whiting or white-lead to make the whole milky. Sulphate of baryta is preferable to white-lead. There are other recipes, but they are much the same. 2. For blackboards, see p. 323, No. 1704, Nov. 19, 1897.

C. O. D.—"Gas, Oil, and Air Engines," by Bryan Donkin, jun. (London: Charles Griffin and Co., Ltd.) But why not look up the subject in our back numbers and recently? Any of the large booksellers in Leeds could probably show you the works on the subject, or some of them.

Geo. F. Scott.—You would find all about Tidal Power inventions by searching at the Patent Office Library. There is much information in back volumes.

A. Paull.—We have no advice to offer, and cannot adopt your other suggestion. The box awaits your messenger.

E. R. D.—One like the Perkins or the Serpollet, in which the plates are so hot that the water injected flashes into steam immediately. 2. Would it be possible to get the burning-glasses sufficiently close to the camps? 3. Do not know. Where did the description of the gun appear? 4. Liquid air is still on view at the Royal Institution, and is being used every day nearly for experiments and investigations. If you refer to the liquid air schemes in America, we are unable to give any further information. Probably the companies were not so successful as was anticipated. See answer to "Thrasna" below.

Jimmy.—Anything that will encourage the acetous fermentation will do; but the query is inserted, as most of the flavour depends on the way the fermentation is carried on.

W. H. Turner.—It would be advisable to see a medical man, and ascertain if there is any organic disease. For a good, safe hair dye see the Mutual Aid Column of the *Weekly Times and Echo* last week.

A. Archer.—The nature of the battery cell is not stated, but probably there was a mixture of hydrogen and air, and so the explosion when a light was brought near.

Tin.—See many recipes in back volumes. Guttapercha mixed with pitch is a good common one; but we know of nothing better than the solution of indiarubber properly applied.

York.—You will require air-compressing plant, or else ammonia plant. The half-horse engine will be of little, if any, use for such a purpose. See articles in back numbers.

Thos. Greene.—Only by inquiry of the engineering firms, or by recommendation of someone known to the firm. Some firms do not care to take apprentices at all; but from the terms used the boy is to be a "gentleman apprentice," and for that a rather heavy premium must be paid.

F. J. Caldar.—We cannot tell you whether the lenses are easily procurable, nor what would be the probable cost. You must apply to those firms who manufacture lenses. Any of those who advertise in our pages would tell you at once whether they manufacture such lenses, and the price.

Thrasna.—A full illustrated description of "The Latest Liquid Air Plant" will be found in No. 1793, Aug. 4, 1899. Do not know where you can purchase liquid air in this country; but it is made at the Royal Institution, and is rather expensive.

F. H. Ewer.—Too long. We have given all the space we can spare to the subject, which has quite got out of the range of *practical* interest, and we are very short of space just now.

W. W. Rickmers.—1. The curious visual deception referred to has been more than once pointed out and examples given; thanks all the same. 2. We have tried the experiment, and we certainly cannot find any "clinging" of the pencil shavings to the desk. There is now and then the most momentary pause, due probably to impact, but that is all.